EVERYMAN'S SCIENCE

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EDITORIAL

ON QUANTIFICATION

No branch of human knowledge is completely devoid of quantification today—to meet a genuine need for as much of precision as possible and, in some cases, to fall in line with workers in the same field who consciously allow their knowledge of quantitative methods to play a meaningful role in their scientific pursuits. Starting with the so-called 'exact sciences' where different entities under investigation needed quantifiers to express their magnitudes and involved measurements for the purpose, quantification has now been vigorously taken up to study even unobservable (but possibly perceivable) traits like interest, attitude, aptitude, feeling and emotion. We also find that quantification has been an age-old practice that was in vogue even before commonly agreed scales of measurements were available and simple or sophisticated measuring instruments were developed.

'Quantification' is derived from the Latin root 'quantus' meaning 'how much'. Quantification literally implies 'to limit by a quantifier, to bind by prefixing a quantifier, to determine, express or measure'. Incidentally, quantization is a completely different exercise—though not incongruous with quantification. 'Quantization' mean 'sub-division (as energy) into small but measurable increments or to calculate or express in terms of quantum mechanics.' In fact, first quantize and then quantify is what is commonly—though not explicitly—done in a variety of investigations, like those dealing with images, motifs, etc.

Quantification generally involves measurements, though categorization or ranking are also recognized tools for quantification. And the motivation for measurements arises from considerations of precision and accuracy. However, measurements present an amazing panorama with a wide diversity in precision and accuracy and, more so, in uniqueness. Let us look a bit closely at measurements—their diversity and quality—to help us in answering a vexing question as to whether the use of some measurements adds to the credibility of inferences in all situations.

While orthogonal classifications of measurements based on different considerations may not be easy, such a classification is really not necessary to realize the wide diversity of measurements. Thus, for example, we have very large measurements like those on inter-stellar distances in billion light-years, to microscopic measurements of intermolecular separations in solids. On the one hand we talk of a macro-level measurement like the concentration of a suspended particulate matter in the atmosphere over, say, a paddy field while inter-regional disputes arise over total stocks of such matters in whole regions. Quite often, macro-level measurements like the latter are obtained by multiplying small micro-level measurements taken on much smaller units. It is not difficult to realise that even a minute error in the micro-level measurement gets largely magnified in the macro-measurement. Sometimes, the reverse procedure is followed to derive the micro-level measurement as the quotient of a large macro-measurement divided by a usually large number of units. This is the case with, say, per capita national income or per capita annual consumption of active substance extracted from nature in USA.

There are many other distinguishing features of measurements. Thus, we have exact measurements as are yielded by some measuring devices against approximations or estimates. The latter not only correspond to rounding off of measurements to a desired order of accuracy, but also relate to situations where exact measurements are ruled out and estimates have to be made on the basis of limited measurements on related entities and/or some assumptions. For example, we can speak of the exact quantity of coal raised from a pit, and can offer only an estimate of the total exploitable reserve of coal in a coal-field. As a second illustration, we may consider the exact measurement of the response (assumed quantitative) of a single living organism to a given dose of a biological preparation, as against the estimate of the lethal dose 50 or the median effective dose of that preparation. Further, we can easily distinguish between direct measurements involving some measuring equipments directly in contact with the entities/objects/artefacts to be measured and indirect measurements which may involve measuring equipments not in contact with the real objects and also some calculations(s). Thus the height of a building is a direct measurement, while the height of a mountain is only an indirect measurement.

We sometimes make distinction between primary and derived measurements, noting further that some derived measures are based on theoretical considerations or on some models while other are based on aggregation or relational considerations. For example, we have the primary measurement of performance of an individual child in a school examination and we then derive a measure of wastage or stagnation or drop-out in primary education. Again, the latter may be based on cohort data, following up a cohort of children admitted at the same time to class I and the concept of a tree diagram, or we can and are sometimes compelled to make use of current data on admission to various classes along with class examination results.

Since measurements provide bases for making scientific inferences, we should and we do worry about the quality of measurements used in a particular investigation. Quality of a measurement is not amenable to a unique definition or measurement, and has been generally comprehended in terms of three parameters, viz., adequacy, accuracy and currency or contemporaneity. Accuracy is the key parameter and has attracted a lot of attention. In Metrology or Measurement Science, the terms accuracy and precision have different connotations and more recently investigators focus attention on the inherent uncertainty in a measurement. While precision is concerned with consistency among repeat measurements, accuracy is defined as closeness with true value. Now the problem is to define and obtain the true value of a measurand (quantity to be measured).

Estimating the uncertainty in a measurement (obtained through a measuring instrument along with a reference standard in a certain environment) from results of repeat measurements and statements or prior information about the input quantities (of which the measurand is a function) has of late been a problem of great interest in Measurement Science or Metrology.

The basic statistical problem here is to construct the theoretical distribution of true values for a given observed value on the basis of observed distributions of realized values against each of several true values. The length of an interval that covers a large part of this distribution is taken as a measure of uncertainty. It may be easier to consider this length as a corresponds to the level of confidence we can have in a statement that the (unknown) true value of the measurand (property of parameter to be measured) lies within this interval.

Measurements carry the charisma of objectivity and there has been a growing tendency among investigators to use measurements as bases for arguments—for and against. It should be remembered that subtle, subjective (individualistic) behaviours, attitudes, aspirations, aptitudes, and similar traits studied in social sciences do not strictly admit of unique measurements. Though uniqueness and objectivity are not synonymous attributes of measurements, they are quite akin to each other. Hence the use of measurements in unfolding the vectors of the human mind or in related matters should not be downright denounced, but should be taken with due caution.

Prof. S.P. Mukherjee

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

PRESIDENTIAL ADDRESS

RATIONALISATION OF MEDICINE IN INDIA

COLONEL SIR RAM NATH CHOPRA*

INTRODUCTION

The highest honour which a scientist in this country can aspire to is to be elected the President of the Indian Science Congress, and I wish to express my deep sense of gratitude to you for this distinction. On looking back at the brilliant array of my predecessors—great scientists, distinguished industrialists and eminent statemen, I am also made conscious of the great responsibility which the election to this office entails. On receiving the news of my election, I wondered whether I would be able to do justice to the task assigned to me. I accepted with great humility and with doubts of my ability to succeed worthily that great statesman and foremost national leader, Prime Minister Pandit Jawaharlal Nehru. I was, however, encouraged by the thought that in carrying out my duties, I shall have the full support and collaboration of the body of eminent scientists and others associated with this great organization.

The venue of the Congress in Patna is of personal interest to me. It was during 1929-30 that the Patna University invited me to deliver a course of lectures in connection with the recently founded Sukhraj Ray Readership in Natural Science. As at that time, I was engaged in the study of the rationalization of the use of the material medica of Indigenous Medicine. I selected it as the subject of my lectures. Today, in my address on the *Rationalisation of Medicine in India* I propose briefly to review the work done since and to indicate how this study is likely to help in replacing the empiricism current in medical practice by a system based on scientific research and verification, i.e., a rational system.

INDIGENOUS MEDICINE

Zenith of Development

The development of Medical Science in India is a fascinating study. The ancient Hindu system of medicine has not only provided relief for the past many centuries, but is still doing so to large sections of our people over vast areas of this great country. Ayurveda, which is stated to have been written about 2,000 years B. C., formed the foundation stone of medicine in India. Later on such works as Charaka medicine, and sub-castes, who on one side believed that as the Ayurveda was an inspired Science, it was not possible to improve on it further by the wisdom of man. On the other hand the touching of dead body was regarded as polluting and therefore sinful and the dissection of bodies was given up, the result was that studies of such basic subjects as Anatomy and Physiology were altogether neglected. The effect of ignoring these basic studies particularly on Surgery can well be imagined. A large number of drugs were, however introduced during the late Buddhist period and properly equipped hospitals and well-organised system of State medical relief was instituted. But with the decline of Buddhism deterioration set in all round in knowledge, teaching and practice of

* General President, Thirty-fifth Indian Science Congress held during January, 1948 at Patna.

medicine. Not only was information regarding many drugs lost, but recognition and identification of a large number became impossible. This was a great loss to Ayurvedic medicine, and whilst there undoubtedly, is reason to be proud of its glorious past, it is not possible to view its present condition without a sense of apprehension.

It has been my good fortune to come into contact with eminent scholars and practitioners of Indigenous Medicine some of whom have also studied the Western Medicine. They are equally concerned with the decline and sterility of the system but consider that as there is much in common between the old and new ideas concerning the etiology, pathogenesis and treatment of disease, the restoration and development of the Indigenous system would not be difficult. The old theories of causation of disease according to them can be justified in the light of recent advances in scientific medicine. Some even claim that there are indications that the old Hindu medicine had knowledge of the bacterial origin of disease, and that even the role of viruses was not unknown. They point out that in their system more attention has rightly been given to the state of the soil, that is the body, than to the seed of disease, that is, the micro-organisms which become engrafted on it. In recognizing the importance of this soil factor, which has now been appreciated by Modern Medicine, Indian Medicine was undoubtedly centuries in advance of the Western. The eminent scholars and practitioners of Indigenous Medicine, however realize fully the need for investigation and research, if their system of medicine is to be brought into line with the present day requirements. For with the lapse of time and changes in environments some diseases have become modified and perhaps their etiology and pathology altered. While some of the old diseases have disappeared new ones have come in. The great advance recently made in treatment too cannot be neglected. Unless fresh knowledge is acquired, their practice would be at a grave disadvantage. Unfortunately, very little has been done so far in this direction. Many among the orthodox Vaidas still believe in the divine origin of Ayurveda and resent the introduction of any innovations. They have resisted all attempts at the inclusion of new ideas and even of considering the possibility of any improvements in the practice of their ancient system.

The position with regard to Tibbi medicine, both as regards its theory and practice, is no better than that of the Ayurvedic medicine. What has been said about the present day status of Ayurvedic medicine applies with equal force to the literature and practice of Tibbi medicine.

That there is much in the Indigenous Medicine, especially in its material medica, which can contribute to the well-being of the people of the country, is beyond any doubt. Eminent Western scholars and the medical men have borne testimony to their efficacy and usefulness. But with such a background as has been described above, Indigenous Medicine, it is believed, cannot play as effective a part nor take its proper place in the present day medical relief in this country, as its exponents would claim, and the people would rightly expect them to do. They will first have to put their house in order and become cognisant of the present-day environments and their requirements. The practitioners will have to be properly trained, and unauthorised practice will have to be rigidly eliminated. The true spirit of research and discovery will have to be inculcated and irrationalism excluded from diagnosis and treatment of disease. The discoveries which have proved effective beyond doubt in the treatment of disease must be accepted and incorporated and all inherent prejudices discarded to achieve the one sublime object of the alleviation of human suffering.

MEDICAL RELIEF TO THE MASSES

Mode of Relief

At the present time in this vast country, medical relief to the masses is carried out by two agencies

1. Indigenous and
2. Western

1. Indigenous Medicine is being practiced by a vast number of practitioners. Unfortunately only a small portion of these have received any proper systematic training in educational institutions set up for the purpose. Of the rest a few may have acquired some knowledge through connection with families which have either practiced this art for generations or through having sold medicines. By far the largest number, however, have medicines and sell these to the ignorant and credulous masses. Many of them are wandering pedlars who carry their stock-in-trade of medicines with them from place to place. Their nostrums have the virtue of cheapness no doubt, but they cost the people very dear indeed. There is evidence to prove that they are responsible for producing much misery and suffering. But it is this very class which at the present time attends to the needs of the major portion of the population, particularly in the rural areas which are so inadequately supplied by properly trained practitioners of any system. There are however some important considerations in favour of the Indigenous medicine if properly practiced. The first is that the materia medica used is derived entirely from indigenous sources, and therefore is inexpensive and suits the people whose economic condition is low. The second is that these systems are ingrained among the people who have faith in the treatments prescribed and the drugs used. Some even consider that it suits their constitution better.

2. The second agency of medical relief is through practitioners of Western Medicine. This system of medicine has been in vogue in India for nearly a century and a half, and is the form of relief recognized by the State. Though it has a scientific basis and is, therefore, much more amenable to rational practice, it unfortunately does not reach much more than 20 per cent of the population of this vast country in spite of all efforts that have been and are being made to extend it.

The reason for this tardiness is not far to seek. The economic condition of masses of the people is very low and there are millions who cannot afford any kind of treatment whatsoever, cheap or expensive. Consequently they have to depend on charitable medical relief institutions which, considering the extent of the population, are not only too few in number but are so situated as to be available only for limited areas of the country roundabout. The cost of medicament is so high that most of these institutions with limited annual budgets are not able to cope with the demand for common essential drugs to say nothing of the expensive medicines which are sometimes necesary and are even indispensible. For these reasons, but chiefly on account of its costliness, the practical utility of Western Medicine for medical relief on a very large scale has been limited.

In any scheme of rationalization and extension of medical relief to the masses, all these factors will have to be carefully considered without prejudice for or against any particular system—medical relief on rational lines and on as extensive a scale as possible being the prime and only consideration.

IRRATIONAL PRACTICE OF MODERN MEDICINE

Quite in contrast to the Indigenous Medicine, Western Medicine has made enormous strides, both in connection with the causation of disease and its treatment. This is not the place for me to go into details of the progress which has been made during recent years, but its effect in relieving human suffering has been remarkable. So far as the application of these discoveries in actual diagnosis and treatment of disease among the teeming millions of this country is concerned it must be admitted that the general practitioner has lagged far behind the times in his knowledge and equipment. This position is unsatisfactory and regrettable. It has been my painful duty to point out from time to time the tendency of practitioners of Western Medicine towards mere empiricism. The remarkable progress in the aetiology, physiology and pathogenesis appears to lose its significance, and makes little appeal to them in the actual practice of the healing art. Diagnosis is still made on empirical basis in the majority of cases. Non-critical and irriational use of therapeutic agents is rather the rule than the exception. In part this is due to the fact that medicine is mostly taught through European and American textbooks and is practiced without making due allowances for climatic and other environmental factors. The ideas regarding diet in disease run counter to the beliefs held by people and are often repugnant to their social and religious susceptibilities. In fact if the state of medical practice in India is examined without prejudice, one is forced to the conclusion that with the exception perhaps of a small number of institutions, such as large hospitals and colleges and of a comparatively small number of practitioners, the practice of Western Medicine is not even a shade better than that of Indigenous Medicine. And one dare not estimate the harm that has been done through indiscriminate use of powerful remedies which Science has placed in the hands of the practitioners.

In addition the outlook of the average Western medical practitioner of the present day is sadly restricted. While he is always crying down indigenous medicine, he takes no steps to improve the low standard of his own practice. The charge of irrationalism applies as much to him as to the practitioner of indigenous medicine. Pandit Jawaharlal Nehru, while inaugurating the meeting of the Conference of physicians last year, criticized the spirit of narrow trade unionism which dominated the medical profession in India. He exhorted the practitioners to keep in view the interest of the community as a whole and to help in building up a healthier and more prosperous India. This call was truly needed for public health is perhaps the most important item in the programme of a nation and yet its promotion is badly neglected by the medical profession in this country. It is a sad commentary on things that though Western medical science has been well-established in the whole country for at least half a century, if not more, it has not yet succeeded in making the average educated men more health conscious to say nothing of the uneducated and ignorant masses. Again there is very little understanding between the medical man and the patient. The doctor often looks down upon the poor class of patients and does not accord them the sympathy and consideration which is their right. This is particularly the case in government and semi-government institutions. The resentment often expressed in the press and elsewhere, bears simple testimony to this fact, and most of us are aware of it from personal observation also.

These are some of the potent reasons why "an average" Indian shuns the Western medical practitioner and prefers the more sympathetic and considerate Vaid or Hakim. How can rationalization be achieved under such conditions ? I say without the least hesitation, from my personal experience during the last forty years that I have discerned little progress in the rationalization of practice of Western medicine generally in this country. But while I say this, I must also admit that the blame does not lie wholly at the door of the general practitioner.

WHY RATIONAL MEDICINE NOT PRACTISED

Financial Starvation

One of the chief reasons why rational medicine has not been practiced, is that those responsible for the Government of this country in the past have neglected the growth of the nation-building health services. The per capita expenditure has, in the past, been absurdly low as compared with that what should have been spent. The Bhore Committee on Health Survey and Development has pointed out that even after making due allowance for the much higher national incomes in countries like Great Britain and the United States "India should have spent annually Rs. 3.3/- per head of the population if her expenditure on health services were to bear the same relation to the national income as the amount spent in Great Britain 1934-35 on health measures bore to her own national income. On the basis of a similar comparison with the United State, India's per capita expenditure on health, should have been Rs. 2.5/-" In comparison with these figures the combined expenditure on medical relief and public health activities in the provinces during 1944-45, ranged between 2.8 annas *per capita* in the Central Provinces to 10.9 annas in Bombay. Is it, therfore surprising that medical education and medical research which form the foundation of rational medicine have suffered seriously ? The teaching institutions are too few and many of those that exist are poorly equipped and inadequately staffed. The teaching of such important subjects as physiology and pharmacology the science of action of drugs, on which mainly depends the progress of medical treatment, is highly defective. Others such as pathology and bacteriology are no better. Practical instruction in most subjects leaves much to be desired. Hospitals and dispensaries are few and far between, and lack modern facilities and appliances, and the number of practitioners is far below that required for adequate relief.

MEDICAL EDUCATION

Medical education should therefore be carried out on much broader and sounder lines than heretofore if the present low standard of medicine in India is to be raised. This can only be done by improving the educational institutions, both as regards their teaching staff and equipment. No doubt, this will mean enormous expenditure, but it is expenditure that will repay itself many times.

The system of letting all the clinical teachers indulage in private practice has led to much abuse and neglect of their teaching duties. Such practice in State-supported hospitals has given rise to most reprehensible differential treatment of patients. While it is desirable that a few of the senior teachers may take up private practice and bring the experience from that particular type of practice to the student, its indiscriminate indulgence by all teachers has done incalculable harms to medical education.

Then, large sums of money are being spent at present on students going to foreign countries for obtaining qualifying medical degrees. If our own educational institutions were improved this drain would stop. Facilities for postgraduate studies should be very considerably increased and medical graduates encouraged to take these courses frequently. This can best be done by sending selected teachers to progressive countries to receive advanced knowledge and after their return to disseminate it among the medical profession. Provision should also be made for sending abroad qualified individuals for training in specialized subjects so that this knowledge is brought to the postgraduate students. Exchange of lecturers and professors should be arranged with well-known institutions all over the world. With the object of training our own men in special lines experts in highly sepcialized subjects should be imported, for limited periods, into Universities and Colleges, irrespective of the cost.

GROUP PRACTICE

It is obvious that modern medicine cannot be practiced scientifically and rationally unless the necessary expert personnel and facilities for diagnosis and treatment are available. Both these are sadly lacking at present even in large towns.

During recent years the development of "group practice", that is collaboration of specialists in different branches, with all their resources in the diagnosis and treatment of disease, has become a very noticeable feature in America and in Great Britain. In the latter country, the proposed National Health Service will bring into being the helth-centre, an institution which it is intended should provide the general practitioner with all modern methods of diagnosis and treatment. If the medical practice in this country is to be rationalized, adequate provision will have to be made on similar lines. A beginning on these lines was successfully made in the School of Tropical Medicine, Calcutta some years ago.

Medical Research

There is no doubt that rational medicine cannot be practiced unless there is extensive medical research. Here again one is struck with amazement at the callousness and apathy of the Government of this country in the past, at the manner in which medical research was relegated to the background. The annual grant for medical research by the Government of India, till recent years, was only a paltry few lacs of rupees and even this was cut down through the disgraceful recommendations of the Inchcape Commission. The research worker is poorly paid and all the best talent goes to practice because it is more remunerative. You have only to see what importance countries like the U. S. A. and Great Britain are attaching to medical research and the amounts they are spending for this purpose, to realise the importance of medical research in rationalization of medicine. With all these disabilities it is not surprising that the standard of medical practice in India is low, and scientific or rational medicine has not been practiced.

The immediate implementing of a progressive plan like the one put forward by the Bhore Committee will enable us to draw abreast of recent knowledge and to introduce in our country up-to-date teaching and research and what is best in the health administration of advanced countries. Medical education, postgraduate studies and medical research will thus be brought to the level in the progressive countries. This will mean that the expenditure on health measures which has hitherto been in the neighbourhood of the absurdly low figure of about 6 annas *per capita* per annum, will be increased to 2-5 rupees a year. Even when this has been done India would be spending on public health only 15 per cent of her national income (Central and Provincial) as compared to the 25 percent spent by Great Britain. But increased expenditure is the only method which will eventually give the country an up-to-date health organization and medical relief on scientific basis.

TRAINED PERSONNEL AND THEIR RETIRING AGE

Trained personnel is the first most important single factor for provision of adequate medical relief on rational lines. India possesses not more than 40,000 trained medical men and this works out about one doctor for 10,000 of population. Even this proportion does not give a correct idea because most of this personnel is concentrated in large towns. Look at it any way you like, the present number available is entirely inadequate. For adequate relief necessary for rationlisation there should be at least one medical man per 1,000 of the population. In fact in advanced countries there are two or three per 1,000. Thus we need at least "ten times" the number we have and it will take at least 30 to 40 years to train sufficient men for our need. It is imperative, therefore, that we do make the most of what we have. The present retiring age in regular services and elsewhere is considered to be 55 years when most of the incumbents are yet fit to carry on efficiently for many years. They should be made to work as long as possible and, if necessary, their sphere of work should be changed to suit their physical capacity.

When we come to highly specialized workers, such as Research Workers, of whom we have a still less adequate number, it would be foolish to retire them as is the usual practice at the age when they are most valuable for training other workers, organising new institutions and directing the activities of younger workers.

The retiring age of 55, which is now treated in the country as an unalterable law, was fixed by a foreign Government for Imperial Services staffed largely by foreign workers. They wanted them to go back Home, live in comfort or carry on efficient work for many years at our expense. What I am saying about medical workers applies with equal force to other scientific and technical personnel. There is no other country in the world where other than manual workers are retired earlier than 65 years.

THE ROLE OF INDIGENOUS MEDICINE

Bhore Committee

The Bhore Committee considered in detail various aspects of public health, and medical relief, but left the part played by indigenous medicine severely alone. It was stated that the Committee was not in a position to assess the real value of Indigenous Medicine as practiced today. They stressed, however, that certain aspects of health problems could be secured wholly or at any rate largely, only through up-to-date scientific medicine and that indigenous medicine could not give much help here, as preventive medicine or public health was its weakest feature at the present time. The Indigenous Medicine does not also, at present, deal with such vital aspects of medicine as obstetrics, gynaecology, advanced surgery and other highly specialized subjects. Further, no system of medicine which is static in conception and practice and does not keep pace with the discoveries and researches of scientific workers the world over, can ever hope to give the best ministration to those who need its aid. The Committee, therefore, recommended that "it should be left to the Provincial Governments to decide what part, if any, should be played by the Indigenous Systems in the organization of public health and medical relief. It is for them to consider after such investigations as may be found necessary, under what conditions the practice of these systems should be permitted and whether it is neceessary either during some interim period or as a permanent measure, to utilize them in their schemes of medical reflief. The criticism offered is very cogent and awaits an answer by the exponents of Indigenous Medicine.

The scheme envisaged by the Bhore Committee, admirable as it is, is bound by its very nature to take a considerable time to mature. the question, therefore, is whether things should be allowed to drift as they are drifting while a perfect system is being evolved or should anything be done in the interim period to improve the existing inadequacy of medical relief by using the Indigenous System ? And if something is to be attempted what line should it take ?

POPULAR VIEW

There are many thinking people who consider that while a comprehensive and rational system of public health is being evolved, use should be made of Indigenous Medicine. Indigenous System—good bad or indifferent as it may be—still caters for the needs of the major portion of the population particularly in rural areas. They, therefore, consider that it cannot be excluded altogether from the field, and urge that it should be used to the best advantage while the process of evolution of a perfect system of rationalization of medicine is being worked out. During this transition period, they also hope that Indigenous Medicine will overhaul itself and became an integral part of the permanent system evolved.

If the existing state of affairs is considered without prejudice, there would appear to be a good deal of justification in favour of this course.

Indigenous Medicine should be given a fair opportunity to overhaul itself, to discard what is useless, and to bring up-to-date in the light of modern discoveries, what is intrinsically efficient and useful in it. It is also to be remembered that the people who still use Indigenous Medicine do not all belong to the ignorant and uneducated class. A portion of the high intelligentsia in the country, who can think for themselves, believe in its efficacy, and it is reasonable to suppose that they must be getting some benefit out of it to think in this way. One is, therefore, forced to conclude that Western Medicine has not attempted to understand the Indigenous systems, and has been carried away by the inherent prejudices of the foreigners who have hiterto controlled the destinies of medical relief in this country. But while one can understand the European medical practitioner not understanding the value of Indigenous Medicine, it is not possible to endorse the views of the Indian practitioners of standing, when they assert that no notice should be taken of it, as it is archaic and obsolete, and therefore more or less useless. This attitude shows a lack of appreciation of the fundamentals and practice of their own system, and makes it essential to reorient their ideas with regard to the extension of medical relief.

SYNTHESIS OF MODERN AND INDIGENOUS MEDICINE

I have always held that some of the distinctions drawn between the various systems of medicine practiced in this country and which have given rise to the prejudices in the minds of the advocates of one system against even the good points of another, are unreasonable and unscientific. The universal and cosmoplitan nature of Medicine does, of course, vary according to environment and with the advance of knowledge necessary adjustments have to be made. But the only solution for rationalization of Medicine is the evolution of a country-wide extension of a system, which can be regarded in the words of the Bhore Committee, "neither as Eastern nor Western but in a corpus of scientific knowledge and practice belonging to the whole world to which every country has made its contribution."

Regarding this question I feel that a thoroughgoing synthesis may, at present result in the almost complete submergence of the Indigenous into the Western System. For, the Western System is based on the surer foundations of Biological and Physical Sciences, and has all the recent facilities for diagnostics, cure and prevention at its command. Moreover, any real synthesis will take years to work out.

The Indigenous System on the other hand is cheap and suits the pockets of the poor, and being widespread, serves a very large number. Under modern democratic conditions the State too cannot be indifferent to what is popular with its people. Such a cheap and popular system cannot be ignored and we must consider whether the building up of efficient health services in the country cannot be extended and accelerated through its addition to the State-sponsored Western System.

Western Medicine, which at present dominates the country and is the system recognized by the State, should discard its narrow outlook of contempt for anything which is not its own. The Indigenous Medicine, on the other hand, should discard its inherent prejudices and bring itself up-to-date by incorporating from other systems all that is of value. The practitioners of indigenous medicine should understand that in these days no claims of esoteric knowledge can be entertained, nor origin, antiquity and fancied utility urged as justifications.

IS A SYNTHESIS POSSIBLE ?

In connection with the rationalization of medical practice in India two important questions suggest themselves. Firstly, can the practice of medicine be so regulated by the exponents of Modern and of the Indigenous Systems that the fullest possible use is made of the facilities available for diagnosis, treatment and prevention of disease ? I have already alluded to this. The second question is, can a synthesis of Indigenous and Modern Systems of Medicine be attempted so as to promote the utilization of the knowledge from all available sources for the interpretation of health and disease and for diagnostic, curative and preventive purposes.

A PARTIAL SYNTHESIS

I believe that both extension and acceleration are possible through what may be called a partial synthesis of the two systems, in the elementary stages of our teaching. The present course of study in the Indigenous Medicine should be suitably curtailed on one side and enlarged on the other. On the side of curtailment, I suggest the teaching of subjects like Anatomy, Physiology and Pathology should be reduced to some extent. Their inclusion, on the present scale in the curriculum of the Indigenous Medicine leads to considerable confusion in the minds of the students. In passing it may be mentioned that the reduction in studies will go parallel to the reduction in the studies of students of Western Medicine, as proposed by the Bhore Committee. On the side of enlargement, I suggest that in addition to the basic principle of Ayurveda and Unani the students should be taught the basic principles of Western Medicine. They should also be given training in preventive health measures.

The next effect of this suggestion will be two-fold. It will shorten considerably the period of study and thus lead to the training of a much larger number of qualified practitioners. And, secondly while giving the students a sufficient background of scientific knowledge with regard to the diagnosis, treatment and prevention of disease, it at the same time will make them conscious of their own limitations and of the necessity to appeal to higher practice in difficult cases. There are about a hundred thousand practitioners of Indigenous Medicine in India, many of whom could be quickly fitted for this purpose after suitable training.

Those who are likely to object to this curtailment and partial synthesis, should bear in mind that nearly 80 per cent of ailments are of a minor nature and can be dealt with by simple medical and surgical measures and require no advanced knowledge of the theory of diagnosis and treatment. More over, the suggested training will enable the practitioner to become an integral part of the health services, and thus the administrative difficulties now being experienced in some provinces through a dual system of medical relief will be avoided.

The services of such practitioners will be of particular value in the rural areas, which are now almost beyond the reach of Modern Medicine. Rural medical relief will be considerably facilitated if some further steps are taken to standardize medical practice by prescribing uniform scales of drugs and medical appliances for institutions, their production in bulk and distribution under the auspices of the State. If all practitioners are properly registered and practice by non-registered practitioners prohibited, a reasonable standard of competence could be secured by prescribing and enforcing the necessary rules regarding an expeditious system of training and examination in respect of their qualifying diplomas.

RESEARCH IN INDIGENOUS MEDICINE

Importance of Research

Nothing can remain static in this dynamic universe, and the ever-changing world needs ever-changing methods to deal with its ever-changing problems. Indigenous Medicine can be no exception to this rule. While this partial and workable synthesis is taken in hand, I would earnestly suggest that careful research be made by the exponents of the Indigenous Medicine so as to link their system with the Modern Medicine. There is nothing derogatory in this. But the work can only be taken up by the learned Vaids and Hakims and is bound to take time ; and yet, if this is not done their systems are bound to become entirely obsolete. The process of rationalization of their material medica should be comparatively easy and has already been taken up by a number of workers outside these systems.

A reference has, however, to be made here to the unreasonable attitude adopted by some of the indigenous practitioners towards the workers outside their own fold. They consider that investigation of their drugs by methods of chemical analysis and biological testing developed by Science, serves little purpose. It is opined that there is something mysterious in the action of "whole drugs" which cannot be investigated or elucidated by such tests. It is possible that there may be some such factors. The discovery of antibiotics and hormones in plants to which no importance was previously attached may lend support to these views. But these should be explained and the mystery cleared by efforts of the exponents in the light of present knowledge. If they do this a complete synthesis will not be a remote possibility. If they fail, the world outside cannot be blamed if it refuses to believe their theories. The present-day world cannot accept any fantastic views whatever be their origin and however strong their following. The result will be their complete extinction in the course of time.

The outside workers should not be depressed by the hostile attitude and should go ahead. Every little contribution adds to our knowledge and may help materially towards the alleviation of human suffering.

I now give some concrete suggestions for Research in Drugs, in Indigenous Materia Medica, for Drug Standardisation, Manufacture and Control which are essential for rationalization.

DRUGS AND MEDICAL REQUISITES

Central Institute for Drug Research

My first suggestion is that a Central Institute for Drug Research should be established at the earliest possible opportunity. The lines on which the Institute should work have already been endorsed by the Council of Scientific and Industrial Research. The institute will ensure the fullest collaboration between all the Allied Sciences concerned in drug research, between the scientists themselves, and between them and the industry. By rationalising the materia medica the Institute will help considerably the rationalization and extension of Medical Relief all over the country and particularly in the rural areas.

It is worth recording that the beginnings of this work were laid down by me more than a quarter of a century back at the School of Tropical Medicine, Calcutta. As a result of the activities at that School, botanical identification, chemical analysis, pharmacological studies and clinical trials of a large number of commonly used drugs have been completed. Rational explanation with regard to the efficacy of some of these drugs has thus been forthcoming, and a number of these drugs are now largely used by medical practitioners in the country. But only the fringe of this vast subject has yet been touched. It would be for the proposed Institute to take up this work on an extensive scale in all its details.

All sections of the Institute should be liberally staffed and generously equipped. It should perform the dual function of investigating the indigenous material medica on scientific lines so that it can be brought into more extensive use and of synthesizing and evaluating, with special reference to the requirements of this country, the new remedies which are being daily introduced by scientific organizations and firms of repute. In so far as these remedies are essential for the welfare of the people, economic commercial processes for their manufacture should be worked out immediately. Had such an institute been established after world war I, the acute shortage of drugs which was experienced during the world war II would not have occurred. The country woruld have been self-supporting with regard to medicinal agents of every description. Further the price of drugs would have been brought down to the economic level of the people. Such a scheme does not preclude the existence of individual foci of research in universities and other research organisation ; on the other hand these should be encouraged more than ever. This Institute should also be independent of the work envisaged in the Drug Control Laboratory, and in the Divisions of Biochemistry and Biological Evaluation of the National Chemical Laboratory.

The Central Institute should have a fully equipped special section in which the exponents of the Indigenous Medicine can work in their own way, rationalize their material medica and demonstrate its efficacy to the world.

The reason why a Central Institute has not been brought into existence is that the vested foreign interests wanted this country to remain the largest dumping market in the world of all kinds of drugs good or bad.

PANEL ON DRUGS AND FINE CHEMICALS

The Bhore Committee, to which I have already referred, gave serious consideration to requirements of the country as regards essential drugs and other medical requisites. They considered that for the better medical relief organization of the country, the therapeutic substance and medical appliances came second in importance only to the adequate number of personnel needed by the country and they stressed the extreme importance of making the country self-supporting as regards drugs and medical requisites of every description. They pointedly drew attention to the disruption of the medical relief organization of the country brought about by the shortage of drugs and medical appliances caused by the war. They strongly felt that India must never suffer that fate again. They brushed aside the usual arguments advanced against the manufacture of drugs and medical appliances in the country, such as that the cost of production in the country would be greater or that the raw materials for the manufacture of drugs were not available in the country or that certain drugs and appliances were of such a highly specialized character that they would take long to produce in India and then the difficulty of patents. They considered these arguments and came to the conclusion that these objections made it all the more important to plan on a wider basis. India has enough talent and more than enough, and if it is properly exploited, it could match production anywhere. They definitely stated that the lack of raw materials for making synthetic drugs in India was an additional reason why in addition to the drugs the raw materials should also be produced in the country and they saw no difficulty in such a manufacture being made a success. However they recommended that an *ad hoc* committee should be appointed by the Government of India to go into the question.

Such a Committee was instituted by the Planning and Development Department of the Government of India in 1945 under my chairmanship. On this Panel for Fine Chemicals, Drugs and Pharmaceuticals were represented the leading scientists and the representatives of the important drug manufacturers in the country and the services of an eminent consulting chemical engineer from the U. S. A., were made available in an advisory capacity. This committee thoroughly went into the question and produced a valuable Report in 1946. I particularly want to draw your attention to some of the salient recommendations made by the Panel. The country must produce all essential drugs and make them available for use of the masses at economic prices. It was specifically recommended that the manufacture of two types of drugs should be undertaken immediately, namely.

1. those which are essential for guarding the health of the public and warding off infectious diseases and
2. those for which India already has or can easily develop raw material in abundance.

Under the first category come sulpha drugs, antimalarials, antibiotics like Penicillin, Stereptomycin etc. The arsenicals and D.D.T. can also be included in this list. The panel recommended that the manufacture of these drugs should be taken up immediately and recommended that Government should take up the initiative and put up the first plants which should serve as models. I wish to draw special attention to this recommendation, and its full significance will be understood when you realize that the representatives of commercial firms, who were present, fully endorsed the view that the first plants should be put by Government. These would serve as models for the industry and provide a training ground for personnel. Further, these drugs are needed by the poorest of the poor and they must be made available to the health authorities at the lowest possible cost.

In the second group come drugs of vegetable origin. The production of the drugs from vegetable sources, such as quinine, emetine, morphine, caffeine, ephedrine, santonin, essential oils etc., should be developed to the fullest possible extent, both for the needs of the country and also for export. These drugs are literally to be treated as the wealth of the country and should be exported to good purpose.

DEPUTATION TO ENGLAND AND THE U.S.A

In consonance with the recommendation of this Panel, the Government of India deputed two distinguished scientists from the Haffkine Institute to go to England and America to explore the possibility of the manufacture of antibiotics, sulpha and antimalarial drugs. They returned to India by the end of November last year and submitted their Report to the Government of India, Department of Industries and Supplies. I have seen this Report and can say without hesitation, that the Report is of great national importance for more reasons than one. In the first place, it gives complete data which are necessary for undertaking the manufacture of drugs and these data show clearly that all these drugs can be made much cheaper in India, at about 1/5th of the cost, than they can be imported from abroad and when the question of the treatment of millions of the poorest of the poor is involved, this is a matter of very important consideration. But the making of these drugs is not to be recommended solely on the grounds of saving money.

A VALUABLE TRAINING CENTRE

The making of drugs in the country in a State Institute would mean greatly increased production. If the drugs are manufactured in the country, we would have an excellent training center, such as we do not possess at present. The Government of India, is incurring heavy expenditure for sending men abroad for training. It should be realized that no country abroad gives training in industrial production readily. Dr. B. C. Roy recently stated that though he could get promises of great deal of facilities for academic training of our men, he was not so successful as regards industrial training in manufacturing concerns. Here lies the importance of the scheme. We have workers who have gained the experience of production and have the necessary ability and are actually producing these drugs in a semi-commercial scale, in laboratories like the Haffkine Institute. We should now put up a large plant under public auspices, which will provide those facilities for training which the country has so far lacked and without which the country will get nowhere. This will provide a first-class modern chemical plant and research laboratory for training for drugs and fine chemical manufcture. If such a scheme materializes, I feel confident that within a few years, we would train hundreds of new chemists and within a reasonable period, say 10-15 years, the country would become fully self-sufficient and would not have to depend on foreign import.

VEGETABLE WEALTH OF THE COUNTRY

The question of the manufacture of the second type of drugs I have mentioned above its equally important. Here we have literally ready-made wealth in our hands and in these days of lack of dollar credits, we can use this great wealth of the country to very good purpose for foreign markets. A start has already been made in this direction, only now the Government must take a hand and put the production on a proper basis.

I would, therefore urge the Government of India to immediately consider these propositions and take steps to implement them. I have said before that even the Panel on which representative of commercial firms were represented, had no hesitation in saying that the first plants for the manufacture of synthetic drugs like sulpha drugs and antibiotics must be put up by the State and now that we have the necessary knowledge and trained personnel, there is no reason why the interests of the country be damaged by delaying the implementation of the proposed scheme which is essential for the rationalization of medicine.

RESEARCH IN INDIGENOUS MATERIA MEDICA

This work must be carried out in a systematic manner under the following sections.

Identification of Plants

The materia medica of Indigenous Medicine consists predominantly of substances derived from the vegetable kingdom and practically all the plants used, grow in India. In the investigation of these plants the greatest difficulty I encountered in the beginning was that many plants mentioned in the literature baffled and defied recognition and identification. The descriptions in the old texts were in such vague and general terms that it was often impossible to be certain whether the specimens obtained were of the drug described. The identification of drugs is naturally not possible until prominent characteristics of each plant are establised. But the verbal descriptions, are of economic plants. Detailed surveys of grass-lands and other localities would be the function of this Bureau so that measures for protecting live-stock against the menace of poisoning could be adopted.

FOREIGN AGRICULTURAL RELATIONS

The Section on Foreign Agricultural Relations should be an important part of this Bureau if a seperate Bureau for this purpose is not established. This will help "in addition to other activities, medicinal plant culture by publishing statistical information showing the principal market outlets for such botanicals nearest to their point of production and by establishing liaison with countries through diplomatic and other channels, for procurement of seeds and other agricultural information necessary for the acclimatization of a new crop of economic and industrial significance."

HERBARIUM OF MEDICINAL PLANTS

The section of Bureau of Plant Industry should have along with it a special section of Herbaria of Medicinal and Economic Plants. Herbaria are urgently needed for food and fodder plants, grasses and for plants poisonous to men and animals, edible and poisonous fungi, algae, mosses, etc. Knowledge regarding these plants is lacking at present.

There is no doubt, a large herbarium in the Botanical Gardens at Sibpur, Calcutta, but the specimens are so mixed up that to look up for a specimen is like hunting for a needle in a haystack.

In order, therefore to facilitate the work, on indigenous drugs, some years back, I decided to build up a reference herbarium containing authenticated specimens of all medicinal plants growing in the country. The collection of such a herbarium was slow at first, but was speeded up when grants for the purpose were sanctioned by the Indian Research Fund Association and the Imperial Council of Agricultural Research. A well-equipped botanical unit was established for making collections of plants from all parts of India and for their proper preservation and identification. By extensive investigations and collections in the field and by laborious studies in all the existing local herbaria in different parts of the country, about 10,000 specimens of nearly two thousand of the common species of medicinal plants were collected. Several sheets of each species were prepared, and to ensure perpetuity and enhance and extend their utility to scientific workers, three more or less, complete sets of speciments were housed at the Forest Research Institute, Dehra Dun, the School of Tropical Medicine, Calcutta and at the Drug Research Laboratory in Kashmir State. A few hundreds of the uncommon species have still to be collected and this is being gradually done; this work could be expeditiously done by the Bureau of Plant Industry. This Herbarium is already becoming known and it is being used by scientific workers.

SURVEY OF MEDICINAL AND POISONOUS PLANTS

Side by side with the survey of the distribution of medicinal plants, there should be a section on Survey of Poisonous Plants and Food and Fodder Plants. A preliminary given in the old literature, could not enable the botanist to identify the plants and parts of plants which even in themselves do not invariably present the same characteristics and even the learned exponents of Indigenous Medicine cannot with certainty indicate which is the authentic specimen mentioned in the old texts. As a result considerable confusion has arisen in the literature of Indigenous Medicine. Again, many drugs are frequently sold under different names, and entirely different drugs often under the same name. Very careful and detailed enquiries had, therefore, to be made before a plant could be taken up for investigation. In the work of identification help was at first obtained from the works of Western writers of the 19th century such as Jones, Ainslie, Roxburg, Wallich, Dymock, Watt and others who had carried out laborious studies to classify these plants. This also did not solve all the practical difficulties that arose.

BUREAU OF PLANT INDUSTRY

The great handicap was that there has not been in this country a proper organisation corresponding to the Bureaus of Plant Industry in advanced countries which collect and keep the information concerning plants up-to-date and encourage investigation and research. The Botanical Survey of India (Economic Products Section) and Forest Research Institute (Minor Products Section) do some scattered work in this connection but the whole work must be unified and concentrated so that full collaboration with allied organizations can be established.

For collecting and supplying all information regarding plants, a Bureau of Plant Industry on the lines of that existing in the United States of America and in the U. S. S. R., should be established under the Ministry of Agriculture. The Bureau in America can serve as a model. It carries on its activities under the Department of Agriculture in collaboration with agencies such as Bureau of Entomology and Plant Quarantine, Federal Crop Insurance Corporation, Federal Surplus Commodities Corporation, Forest Services, Office of Foreign Agricultural Relations, Agricultural Marketing Service, Food and Drug Administration etc., Any organization planning to stimulate the cultivation and development of medicinal plants in this country must collaborate with scientific workers in allied branches for the solution of inter-related problems. The functions which such a Bureau could usefully perform, are multifarious and should be worked out according to the requirements of the country. For example, it could collect and maintain up-to-date information with regard to all plants of economic importance by carrying out surveys and collecting statistical data regarding their export and import. It could have information with regard to new species which can be successfully introduced and commercially developed and about markets in India and abroad. It should have knowledge regarding the quality and quantity of drugs growing in a state of nature and which are and can be successfully cultivated. Substitutes of pharmacopoeial drugs which might serve the same therapeutic purposes could be investigated under this auspices and brought into use. The Indian drug trade has seriously suffered because the quality of drugs has not been maintained and adulteration has been rife. The Bureau could exercise quality control and regulate drug trade by establishing drug emporia which could act as a central clearing house for authentic drugs. It should establish herbaria for the various types survey was made by me, years back. The exact habitats of plants growing in a state of nature or otherwise were verified during extensive tours and a lot of existing confusion was cleared up. Many of the medicinal plants are poisonous to man and animals, and in the course of the survey, notice was taken of those which have toxic properties but are not used in medicine. It was very soon realized that while much work had been done on this group in Europe, America, South Africa and other countries, no systematic work had so far been attempted in India.

But much remains to be done. The distribution of many plants as described in the literature of Indigenous Medicine in the latter half of the 19th century is often vague and inaccuracies which have crept in have passed from one book to another. Again plants may change their habitats and exotics may come in. Such a survey is, therefore, important not only from the point of view of distribution of medicinal plants but in other respects also.

Further, for the extension of medical relief on rational lines it is not only necessary to make a scientific study of these plants but to cultivate them for therapeutic use if need be. The only way in which it is possible to determine the areas of optimum production, with any degree of accuracy, is first to find out whether a particular plant grows well and in abundance or is scarce in any particular area. These studies alone can provide the basic information regarding the suitability of localities for the cultivation of different plants. The gradual development of such work has led to the cultivation of a number of plants of great utility with as good active principle contents, as are found anywhere else.

The medical and toxicological aspects of the Cryptogamic flora of India constitute an almost unexplored field. We have very little information about the deleterious effects produced by Indian algae. Many of the fungi such as rusts, smuts, etc., attack food and fodder, while poisonous mushrooms grow in many parts. Many more poisonous species exist than have been studied and about these also little or no information is available. The same applies to liverworts and mosses of India.

POISONOUS PLANTS AND INSECTICIDES

So far as the Phanerograms (flowering plants) are concerned, two main groups exists ;

1. The group of plants poisonous to man and livestock. This is a large one, and while considerable information is available about plants poisonous to man, knowledge regarding poisoning of the livestock is meagre. India possesses roughly a third of the bovine population of the world and the question of its fodder supply is of utmost importance. Even in countries like America, where much is known about these plants, the figures of

losses suffered through poisoning are high. Similar figures of losses are not available in India, but they are sure to be very high. Unless detailed information about these plants is available, preventive measure cannot be adopted. Grasses form an important part of the food of animals and some of these develop dangerously large quantities of hydrocyanic acid, flourides etc., under certain climatic and soil conditions, especially in time of drought when plants have become wilted and stunted.

2. The group of plants poisonous to insects and fish is also important in the economy of the nation. Insects do incalculable harm and are responsible for a considerable loss of life and destruction of property. On a moderate computation the annual loss caused to India through insect pests has been put at 2,000 millions of rupees and over a million and a half in human lives. An effective control of these enemies of social and economic progress will reduce this enormous loss and will facilitate national development. One means of fighting them is by insecticides which could be supplied by this group of plants. In spite of the development of cheap, synthetic and potent insecticides such as D. D. T., vegetable insecticides still hold a prominent place, as they are less deleterious to warm blooded animals and plant life and possess immediate knock-out effects.

CULTIVATION OF MEDICINAL PLANTS

The acute shortage of drugs during the world war II drew attention to this important subject and a good deal of interest is now being taken to give it a practical shape. Most of the drugs required for therapeutic purposes are grown in this country. Those which do not grow can be grown in selected places. Among the exotics of great practical utility which have been successfully cultivated may be mentioned cinchona, ipecacuanha, digitalis, pyrethrum and others. It should be realized, however, that this is no novice's work but needs specialised knowledge and guidance of a scientific organization. The soil, the season of planting, the gathering time, hybridization, plant diseases etc., are some of the important factors which call for expert attention in connection with the active principle of plants. The collaborative efforts of plant and culturists, pharmacognosists, pharmacists, pharmacologists, entomologists and chemists are essential and these could be made available only by such organizations as the Central Institute for Drug Research, Bureau of plant Industry, Foreign Agricultural Relations Bureau, etc.

DRUG STANDARDISATION AND DRUG CONTROL

Rationalisation of medicine is not possible till the drugs in use are standardized and controlled. This applies with equal force to the drugs used in Indigenous Medicine.

Adulteration

It has been shown that a large number of drugs and pharmaceutical preparations marketed in this country, vary a good deal in regard to the potency claimed for them. While a certain amount of determination in active principles takes place through climatic factors and effects of storage, it has also to be admitted that often open and wilful adulteration of many remedies is being practiced. To rectify this state of affairs, the Government of India appointed the Drugs Enquiry Committee of 1930-31 under any direction. Investigation on an extensive scale showed that the position was even worse than had been believed. The Committee submitted its report early in 1931 but unfortunately legislation could not be enacted till 1940, and owing to the exigencies of war, it was not possible to establish the machinery for implementing it till April last year (1947). This legislation, while it is far from perfect, should help materially towards stabilizing the quality of drugs in this country.

The Committee unfortunately could not suggest any action with regard to the drugs used extensively in the Indigenous Medicine, although there was abundant evidence that these were extensively adulterated and were often of inferior quality. The main reason was that the active principles of many of these drugs had not been identified and, therefore, no standards could be laid down for their control.

The protagonists of Indigenous Medicine should realize that unless standards are established for drugs they use, either by their own methods or by the generally accepted chemical and biological assay the efficacy of their drugs cannot be guaranteed. Establishment of standards for all drugs and their inclusion in the Indian Pharmacopeia of the future is absolutely essential before such drugs can play an effective role in a rational system of treatment.

Indian Pharmacopoeia

A National Pharmacopoeia is primarily meant to meet the claims and to satisfy the needs of a particular group of physicians at a particular time. The object of a pharmacopoeia is, in the words of founders of the United States Pharmacopoeia, "to select from among substances which have medicinal power, those the utility of which is most fully established and best understood, and to form from these, preparations and compositions in which their powers may be exerted to the greatest advantage." The modern pharmacopoeia is a book of standards, its fundamental objects are "to provide standards for drugs and medicines of therapeutic usefulness or pharmaceutic necessity, sufficiently used in medical practice ; to lay down tests for the identity, quality and purity, to ensure as far as possible, uniformity in physical properties and active constituents." In other words, usage—rational usage and scientific usage are bases of judgement. Such criteria are no less applicable to Indigenous Medicine as to Western or any other system of medicine wherever practiced.

The Drugs Enquiry Committee considered the question of compilation of an Indian Pharmacopoeia and came to the conclusion that there were cogent scientific reasons in favour of it. The methods of therapy vary in different countries. The raw materials from which medicinal preparations are made do not possess the same qualities, and may not be available so readily in one part of the country as in another. The effect of climatic conditions on the pharmaceutical processes has to be studied. Racial variations in dosage also have to be considered. For these reasons the pharmacopoeia of one country is not always applicable to another country. It is essential, therefore, that each country should evolve a pharmacopoeia best suited to its own peculiar climatic and racial factors. It should include the therapeutically active substances of known composition, of definite action, of well established therapeutic use of known toxicity, and with necessary standards for determing safe maximum dosages. In the case of the drugs in use, it is essential that requisite standards should be established for strength and purity of the materials which are to be used in treatment.

A Permanent Pharmacopoeia Committee

Such standards are being gradually worked out and have actually been evolved in case of a number of drugs used in the practice of medicine both indigenous and modern. It is gratifying to note that at last the foundation of such an essential work has been laid by the publication of an Indian Pharmacopoeial List compiled by a Committee appointed by the Central Health Ministry (formerly Health Department) of which I was the chairman. This work should be considerably extended by the proposed Central Institute for Drug Research and other research organizations. A permanent Committee should be set up on the lines of British Pharmacopoeia Commission or the organization in the U. S. A. to build up an Indian Pharmacopoeia including all drugs of value in the practice of Medicine in this country. This can be accomplished in the very near future if all facilities are made available. Such a Pharmacopoeia is essential for rationalization of Medicine in this country and will act as a bulwark against the present tendency towards irrational practice.

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COMPREHENDING THE EARTHQUAKE RISK ESTIMATION : A NEW APPROACH

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The statistical characteristics of natural drainage systems and earthquakes have been mapped in the northeast India region using the satellite imagery and International Seismological Catalogue data. The maps reveal the seismogenic structures and the crustal heterogeneities, which are useful for earthquake hazard estimation.

INTRODUCTION

The indian subcontinent in general and the northeast India in particular is the region the maximum number of earthquake disasters. A disaster is defined as "a calamitous event bringing great damage, loss or destruction." Earthquakes (also called seismicity) are natural disasters caused by earth's internal energy. The area of study discussed has suffered the consequences of intense tectonism in the past. Two great earthquakes; the June 12, 1897 Great Shillong Earthquake (25º42' N, 91º00' E) of magnitude 8.6 and the 1950 Great Assam Earthquake (28º30' N, 96º30' E) of magnitude 8.6 were accompanied by catastrophic loss of property and lives in adjacent areas. The present write up covers from latitudes 26º to 27º N and longitudes 91º to 95º E of the northeast India. However to discuss the seismicity patterns, the surrounding regions have also been incorporated.

To get an idea of the seismic status of a place, or region, a variety of geological and seismological information is required such as : (i) detailed information on past earthquakes including isoseismal maps of important events, (ii) catalogue of earthquakes giving details of epicentres, origin time, depth of focus and magnitude, (iii) tectonic maps delineating the various fault systems along which earthquakes had occurred as well as those which are currently active. (iv) history of formation of geological structures in regions of earthquake activity, and (v) detailed knowledge of the geological foundations on which the structures are to be built. Tectonic eqrthquakes occur as a consequence of the accumulation of strain due to relative motion of the plates which behave as rigid bodies while the plate boundaries behave as brittle mass. The strain release takes place along the plate boundaries giving rise to distribution of earthquakes. However, not all the earthquakes are restricted to plate boundaries. On a regional scale it is observed that some rigid blocks that are largely aseismic are bordered by relatively softer regions having appreciable seismic activity. The parameters of an eqrthquake are hypocenter (focus), epicenter, origin time and magnitude. Magnitude is the measure of energy released by an earthquake and it is instrumentally determined numerical quantity independent of the location of the instrument. Seismic hazard means the probability of occurrence of potentially damaging seismic soil motions at certain site within a certain time interval.

STATISTICAL CORRELATIONS

The process of determining seismic hazard in a region is called 'seismic zoning'. The main outcome

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of a seismic zoning procedure are zoning maps displaying a quantity related to the assessed frequency and severity of shaking due to expected future earthquakes. Various statistical correlations have been used to relate the frequency of occurrence of earthquakes to their magnitude, but the most generally accepted is the Gutenberg and Richter relation and it is applicable globally as well as locally. In this relation there are two constants, namely; 'a' is a measure of seismic activity dependent on the area and time period involved and 'b' is a measure of relative abundance of large and small earthquake events. Furthermore, the 'b–value' varies preceding a major earthquake[2]. Many objects in nature, e.g. mountain landscapes, coastline, ocean floor topography, fracture networks, etc. have a self-similar structure. This implies that system parameters are correlated over large distances, and are called fractals. The earthquakes are represented by self-similar mathematical construct, the 'fractal', and the scaling parameter is known as the fractal dimension[3], 'D'. The fractal dimension characterizes the degree to which the fractal fills up the surrounding space. Obviously, the fracture characteristics can be predicted by knowing the fractal dimension value. Furthermore, the natural drainage systems analysis provides clues to the distribution and attitude of the underlying rock formations and geological structures ; such as fractures, faults, folds, etc[4]. The spatial distribution of the natural drainage systems can be characterized as fractals[5]. An extrapolation of the fractal relation for drainage systems and regional seismicity appears to make a reasonable prediction of great earthquakes over a given section.

EARTHQUAKE PREDICTION

Multidisciplinary approach towards earthquake prediction programme is now increasingly popular. Satellite based geomorphological mapping in the north-east India has immense applicability for earthquake prone zone analysis, because the existing database, regarding this purpose in this region, is extermely unreliable, outdated and also not easily accessible. The new approaches in the present years for comprehending seismicity of northeast India are the satellite imagery based natural drainage systems mapping and the fractal theory of natural drainage systems ; also the earthquakes have been taken into consideration in this communication.

Geologically, the study area comprises oldest to youngest rock types : Precambrian gneissic complex, the Shillong group, older and younger alluvium. The earthquakes in the Himalayan arc are referred to collision tectonics and are associated with the known regional thrusts, the Main Boundary Thrust (MBT) and the Main Central Thrust (MCT)[6]. There are several major faults and lineaments in the study region.

Satellite remote sensing has been used for natural drainage systems mapping in the study region based on visible interpretation of IRS LISS–III imagery of 5th March, 2003 on 1:250,000 scale. The drainage frequency (D_f) is defined as the total number of stream segments per unit area (Number/Km^2). The drainage density (D_d) is defined as the

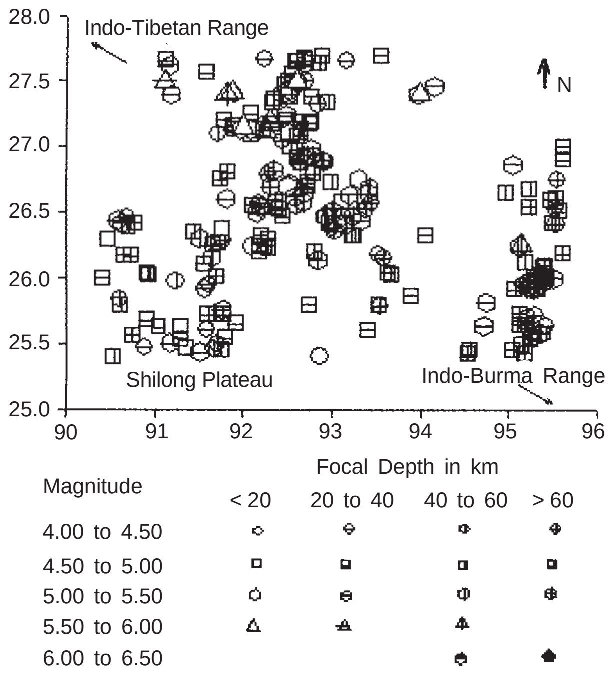

Fig. 1. Location of earthquakes epicentre in the study region

total length of stream segments per unit area (Km/Km^2). The drainage systems can be represented as a growing tree. The number of branches at each node (including the root) is constant as the tree grows. The growth of a tree is symbolized by the addition of fresh branches at each node. The earthquake data have been adopted for the period 1964 to 1993 from the International Seismological Catalogue (ISC) of magnitude (m_b) $\geq$ 4.0. The distribution of earthquakes in the study region has been shown in Fig. 1.

Contour maps were prepared separately of the fractal dimensions for the earthquakes, drainage frequency and drainage density of the study region as shown in Figures 2, 4 and 5 respectively. The

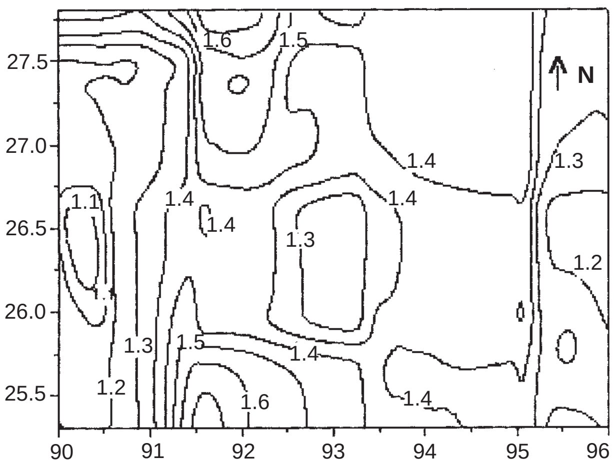

Fig. 2. The contours of earthquakes fractal dimension in the study region.

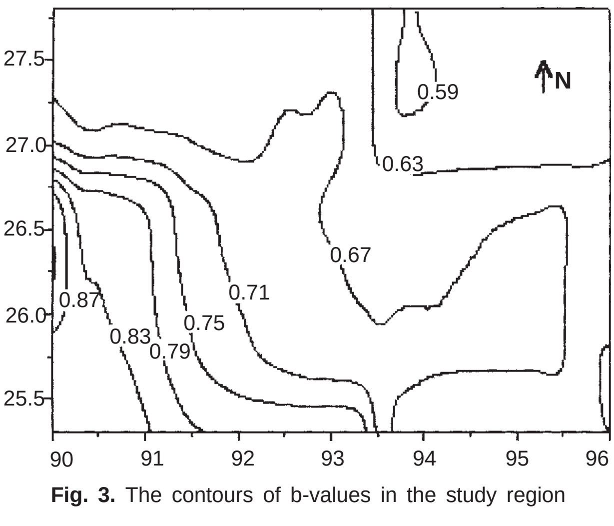

Fig. 3. The contours of b-values in the study region

b – value estimate in the study region has been shown in Fig. 3. Figure 3 shows higher b – value contours towards Indo-Burma ranges as well as towards Shillong Plateau and lower contours towards Assam valley area. The variations in the fractal dimension (Figures 2, 4 and 5) values are

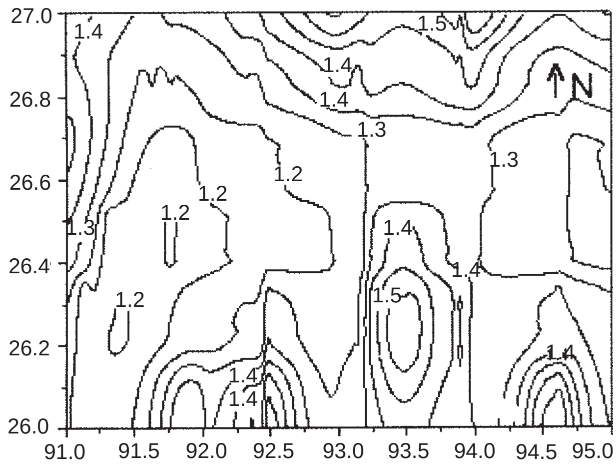

Fig. 4. The contours of the fractal dimension of drainage density in the study region.

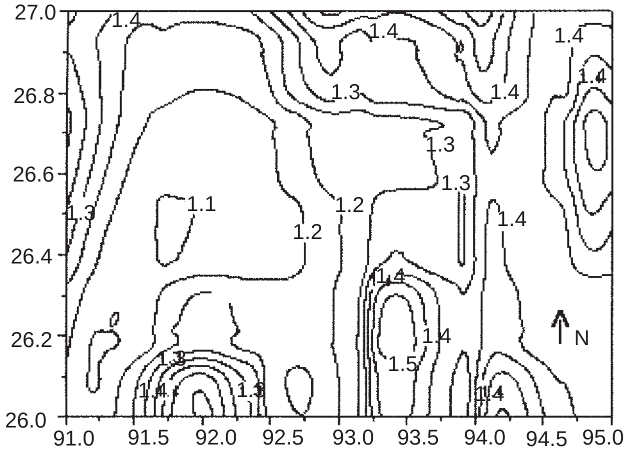

Fig. 5. The contours of the fractal dimension of drainage frequency in the study region.

comparable. The estimated fractal dimensions in this study suggest that the faults are spatially distributed in the whole region, and the whole region is seismically active. Furthermore, the fractal dimension contours show a higher trend in the NW–SE direction along the Kopili lineament and along the Indo-Burma ranges, which are comparable with the b-value trends (Fig. 3). It may be seen that while the North-East India region as a whole is highly seismic, there are pockets of very high seismicity with other small areas of comparatively less activity. Hence, the fractal dimension mapping of drainage parameters may be identified as the seismogenic structures in this study region; an inhabitant structural and lithological controlling agent of landform evolution of the mother earth. Obviously, with the help of these estimated parameters, the seismic zoning of the study has been done as shown in Fig. 6

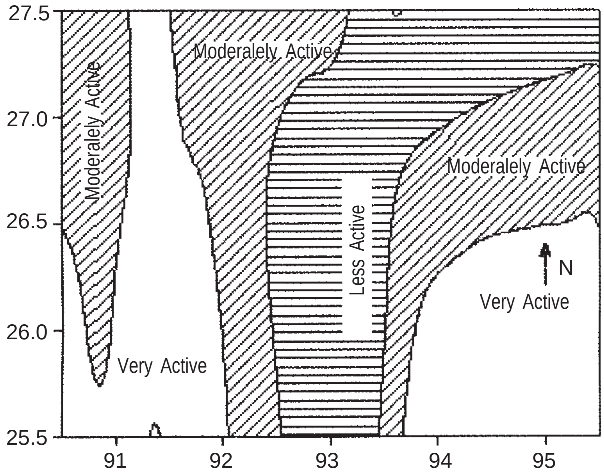

Fig. 6. Earthquake potential zones in the Study Region.

Hence, this entirely new technique utilized for earthquake risk evaluation from the natural drainage parameters may communicate a broadly new idea regarding the earthquake hazard estimation.

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DO YOU KNOW ?

Q1. What is a Femts second ?

Q2. How big or how small is the landmass of Antartica as compared to India ?

ENVIRONMENTAL AUDITING AND ITS COUNTENANCE

Shreerup Goswami and Prabhasini Pati*

Environmental auditing is a management tool, which simply inspects the environmental management activities performed by the industries or organizations and makes them aware of new cleaner technologies. Objectives of environmental auditing and its benefit are discussed in this article. Moreover, environmental audit scheme and its components, principal areas of environmental auditing and its processes, environmental audit practice and its status in India are also enumerated. For popularization of environmental auditing in India and to serve as an important environmental management tool for the improvement of companies and industries, some suggestions are also recommended.

INTRODUCTION

The growing problems of increasing human population and rapid growth of industrialization has created a lot of overburden on the earth. There is now a clarion call from every nook and corner of the society that "Save the nation from—this menace the pollution". Now-a-days people from every walk of life have become aware of the adverse impacts of air, water, noise and soil pollution. Governments, all over the world, have formulated laws and regulations to correct and cure the past violations of good environmental practices.

We are familiar with the term "auditing" wherein financial accounts and records are examined. Environmental audit, similarly, refers to verification and assessment of environmental measures adopted by an organization. It is examination of accounts of revenues and costs of environmental and natural resources, their estimation, depreciations and values recorded in the books of accounts[1]. Environmental auditing is a management tool comprising a systematically documented, periodic and objective evaluation of the performance of the organization to protect the environment with the aim of

- facilitating management control of environmental practices ;
- assessing compliance with company policies, including observance of the existing regulatory requirements and
- facilitating professional competence[2].

The concept 'environmental auditing' was first used by British Petroleum (BP) international group in 1972, when a perfumery and petrochemical complex was subjected to a stringent study. In Europe, Ciba-Geigy was the first corporation to adopt environmental audit in 1981. The United States Environmental Protection Agency published their environmental policy in 1986 followed by International Chamber of Commerce booklet on environmental auditing in the year 1988[3].

ISO-14000 is a methodology for environmental management. It provides necessary requirements and recommendations for any organization to develop and implement a cost effective system of management by introducing environmental auditing. ISO-14000 series covers environmental audit, audit

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procedure, audit criteria, audit management, site assessment, labeling, performance evaluations and life cycle assessment[2].

OBJECTIVES OF ENVIRONMENTAL AUDITING

The important objectives of environmental auditing are as follows :

1. Monitoring, measuring and evaluating the performance of a company, assessing the probable risk/hazards associated with the malfunctioning of the pollution control equipments.
2. Assessing the scale of optimum utilization of the resources and evaluating the relative position and orientation of the company at national and international level.
3. To improve energy consumption and to suggest for using alternative energy for conservation of energy resource.
4. To determine the mass balance of various materials used and the efficiency of machineries and processes.
5. To identify the areas of water usage, utilization of waste water and also determine the characteristics of waste water and their effects on the living system.
6. To determine the polluted air emission, their sources, quantities and characteristics.
7. To identify the categories of solid wastes and hazardous wastes and their sources, quantities and characteristics.
8. To help in minimizing the wastes through modern cleaner technologies.
9. To identify and document the environmental compliances status.
10. It helps in producing environmentally educated and technically sound personnel by regular environmental auditing once in a year.
11. To protect the corporation from the probable liabilities[3, 4].

Before auditing a particular industry or organization the third party or the auditors design a set of plans and programme. It is otherwise known as auditing protocol. It gives step-by-step guide to the auditor on how evidence is to be collected. It includes outlines of total audit work, and its time period. The audit work can be done systematically and efficiently by the help of environmental auditing programme[5]. It helps in the proper utilization of natural resources and as a whole it improves environmental quality.

The auditing programme is, therefore, the key step in conducting audit so far as it informs managers and others about the scope of the audit and provides the opportunity to request to make some additional changes for better environmental management[1].

ENVIRONMENTAL AUDIT SCHEME AND ITS COMPONENTS

Environmental auditing scheme is a management tool involving a systematic, objective, documental and periodic evaluation of Environmental management system with a broad aim for a green environment.

- It helps in minimizing wastes.
- It helps in assessing compliance with regulatory requirements.
- It helps in prevention and control of effect of pollutants.
- Lastly, it establishes relationship between qualified technical professionals, individual industries, state pollution control board, other public authorities and industrial associations etc[6].

There are the following three components of Environmental Audit Scheme (EAS).

(a) State Pollution Control Board.

(b) Internal Auditor Board.

(c) External Auditor.

(a) State Pollution Control Board :

The State Pollution Control Board should have an active participation in environmental audit for effective implementation of the audit scheme. The roles of State Pollution Control Board are given below :

- To prepare format of audit report incorporating information on all the aspects of environmental protection.
- To select internal auditors who can be engaged by the industries to prepare audit report.
- To accept/receive the audit reports prepared by internal auditors from the industries.
- Forwarding the audit reports to appropriate agency for evaluation and verification.
- Initiating the action if any, based on external auditor's comments.

(b) Internal Auditor

As environment has no limit, it includes subjects from every aspect. For this reason there must be a team of auditors consisting of experts from various backgrounds with at least one to two years experience having :

- A degree in chemical/civil/environmental enginering and
- a degree in microbiology/biochemistry/ environmental science/allied disciplines.

The team must be recognized by the State Pollution Control Board and provided with the well-equipped laboratory facility for analysis of water and air samples. Internal audit report is to be prepared as per the format prescribed by State Pollution Control Board.

(c) External Auditor

The external auditor team should be constituted with component institutions/agencies as approved by State Pollution Control Board. The team of external auditors examines the audit reports submitted and verifies the facts given therein. After verification, external auditors have to send their comments to State Pollution Control Board for further action at cost.

Environmental audit scheme may have some limitations. However, its ultimate goal would be achieved and become fruitful only when the audit scheme is willingly accepted by the industries.

PRINCIPAL AREAS OF ENVIRONMENTAL AUDITING

The concept of Environmental Audit has wide scope covering the following principal areas[2, 3, 4, 7].

(a) Material audit.

(b) Energy audit.

(c) Water audit.

(d) Health and safety audit.

(e) Environmental quality audit.

(f) Waste audit.

(g) Engineering audit.

(h) Compliance audit.

(i) Management audit.

(j) Liability definition audit.

(k) Property transfer audit.

(a) Material Audit : Material audit examines the use of different raw materials or natural resources for production, quantity use for unit, cost per unit, process wise consumption, process wise wastage etc. and available information pertaining to material usage. Data for last few years (at least 3 years) should be collected and analysed. Other environmental factors like conservation of raw material, scientific storage and reuse of wastage material are taken into consideration in material audit. A comparison of data with similar industry should be made preferable to know the more information pertaining to material usage.

(b) Energy Audit : Energy audit examines consumption of various forms of energy in different processes in any industry or organization. Energy audit aims at minimization, elimination of avoidable losses of valuable energy and their conservation. Without input of energy we cannot get any type of processed product from any industry. Thus, conservation of energy is very vital for us. It saves money, minimizes operation cost and gives more profit. It also partly reduces environmental problems as a whole.

(c) Water Audit : Water audit conducts consumption of water at different sources. It aims at evaluation of raw water intake, performance in different waste-water treatment plant, cost involved in water treatment and reutilization of waste-water. Data analysis of last few years should be reviewed.

(d) Health and Safety Audit : As the trained workers and employees are the wealth of the industrialists, they should take care for the health and safety of the employees. Health and safety audit aims at examining existing health and safety measures in the industry or organization. The risk and incidence of occupational health hazards and accident statistics of the organization should be examined carefully and an on-site audit must be carried out. Physical management of hazardous wastes, toxic pollutants and fire prevention measures etc. should also be evaluated .

(e) Environmental Quality Audit : A thorough examination of the status of existing air quality within the industrial complex, noise level at different sites, functioning of effluent treatment plant, contamination of soil and review of the greening programme undertaken etc. should be done sincerely.

(f) Waste Audit : Waste audit covers a number of steps like examining the waste generation sites and identification of the type of waste etc. It is also analysed that whether waste can be minimized or eliminated or recycled or ceased ; whether it can be a raw material for another organization ; Whether the particular industry has the recycling facility or not and whether it disposes wastes without segregating different types of wastes. Accordingly, suitable strategies should be recommended for waste minimization.

(g) Engineering Audit : Engineering aspects like efficiency of plants and machineries, engineering methods and techinques may be examined. Accordingly, preferable and suitable processes are recommended.

(h) Compliance Audit : The different aspects of audit that are required to be carried out as per regulations, procedure and according to the policies of that particular industry are known as compliance audit. Each activity of an industry has certain limit. Some sort of rules and regulations in every aspect must be obeyed for running an industry smoothly. There are different types of regulations like hazardous Waste Management and Handling Rule 1989, Water act 1974, Water Cess act 1977, Air Act 1981, and Municipal Solid Waste Management and Handling Rule, 2000 etc., which contain important procedures for environmental management.

(i) Management Audit : A management audit determines whether an adequate compliance management system is established, implemented and used correctly to integrate environmental compliance into every day operating procedure. Such an audit examines socio-cultural management and operational elements which include internal policies, human resources training programme, budgeting and planning, monitoring, reporting system and information management system. Some of the broad activities are done through management audit like – responsibility of the owners or other technical persons, adequate system of authority, division of duties, training of personnel, documentation and internal verification etc.

(j) Liabilities Definition Audit : Another type of environmental audit is a liabilities definition audit. Such an audit identifies the environmental problems that could reduce the value of a property or expose the buyer to liability.

(k) Property Transfer Audit : A pre-audit is required prior to the transfer of industrial property.

PROCESSES OF ENVIRONMENTAL AUDIT

The environmental audit approach has three different process as given below[7, 8].

(i) pre-audit activities/Planning and preparations,

(ii) On-site activities and

(iii) Post-audit activities

Pre-Audit Activities : Pre-audit activities include various preparatory works.

(a) Collection of preliminary information which includes
   - (i) location of the industry with surrounding land use,
   - (ii) climatic conditions,
   - (iii) products manufactured,
   - (iv) raw materials used,
   - (v) organizational set up and policies of the company for environmental management.

(b) Formation of the audit team and their composition from different fields

(c) Imparting education of environmental audit to each and every person of the industry is the primary task.

(d) Time frame for the audit must be carefully formulated so that the whole activities are accomplished within a stipulated time period.

(e) Necessary questionnaire must be prepared to collect and analyse relevant information before the commencement of the audit.

On-site Activities : The main purpose of on-site activities is to review documents maintained at the facility, to interview the employee at site and to inspect thoroughly all relevance operations conducted at the facility.

The activities at the site include the following :

(i) Deriving material balance

(ii) Identifying waste flow line

(iii) Monitoring of waste characteristics

(iv) Evaluation of the performance of process and pollution control equipment/system

(v) Assessing environmental quality

(vi) Reviewing safety measures

(vii) Reviewing operating and administrative records and documents etc.

(viii) Holding discussions with the manager and finally preparing the draft report.

Post-Auditing Activities : Post-auditing activities include discussion among the auditors about the present status of a particular industry after site visit, preparation of an audit report based on the information obtained with suitable suggestions for environmental management.

A typical environmental audit report contains general information about the industry i.e. name, size, code, etc. and about the environmental management performance of that industry.

Steps in Post-Audit :

(a) Issue of draft report

(b) Issue of final report
   - (i) Correction of draft report
   - (ii) Distribution of final report
   - (iii) Highlighting the requirements for action plan.

(c) Implementation of action plan based on audit findings in final report.

(d) Conducting follow-up to the corrective action[2, 3, 5].

BENEFITS OF ENVIRONMENTAL AUDIT

A properly implemented environmental audit plan provides a wide range of benefits[3, 4, 7, 8] for an organization as well as to the environment. These are :

- It provides a framework for measuring and therefore managing environmental performance.
- It identifies potential ways of cost savings, which can be achieved through reduction in raw material consumption by way of waste minimization, recycle and reuse and reduction of pollution load to the earth.
- It increases awareness of environmental policies and responsibilities.
- It helps in understanding the technical capabilties and the environmental status of the company.
- It helps in timely warning, management of potential future problems and plan for emergencies.
- It helps in interchange of information between units of the same industry and even on a wide scale between similar industries.
- It enhances production as well as reputation of the company.
- Confidence and co-operation among the labours are boosted.
- It produces trained personnel. Thus production capability increases.
- It reduces the social resistances and brings awareness of envirnmental policies between staffs and generates an information base for disaster management.
- As a whole environmental audit plays an important role in minimizing the environmental problems locally, regionally, nationally and internationally.

ENVIROMENTAL AUDIT PRACTICE : STATUS IN INDIA

The development of industrial audit facilities in India appeared in the beginning of the nineties. Many efforts are being made to make the programme successful before it could be mandatory. Oil spill of the British South Coast (England), Bhopal gas leak (India), Chernobyl disaster (USSR), and pollution of various rivers, etc. have led to increased concern in industrial environmental management. The United States Environmental Protection Agency published their environmental audit policy in 1986 followed by International Chamber of Commerce booklet on Environmental Auditing. UNEP also published their technical report on environmental audit and many other environmental protection agencies in other countries started to think about their environmental management systems. India is one of them.

In India, recognizing the importance of environmental audit (EA), procedure for EA was first notified under the Environmental Protection Act, 1986 by the Ministry of Environment and Forest by issuing of a gazette notification (No. GSR 329 (E)) on 13th March 1992, through which submission of the environmental audit reports has been made mandatory. The industries are now required to submit their audit reports to the concerned State Pollution Control Boards on or before 15th day of May every year beginning 1993. A large number of polluting industries were identified to submit their EA reports[5]. The EA report has been renamed as Environmental Statement (ES) in 1993. The detailed format prepared by the State Pollution Control Board is known as Form V.

DETAILS OF PROFORMA FOR FORM V

FORM V

Environmental Audit Report for the Finacial year ending the 31st march.

PART A

I. Name and address of the owner/occupier of the industry operation or process.

II. Date of the environmental audit report submitted.

PART B

Water and Raw material consumption

(i) Water consumption m^3/d

Process

Colling

Domestic

Name of product	Water consumption per unit of products	
	During the previous financial year (1)	During the current financial year (2)
(1)		
(2)		
(3)		

(ii) Raw material consumption

Name of the raw material	Consumption of raw material per unit output	
	During the previous financial year	During the current financial year

PART C

Pollution generated

(Parameter as specified in the consent issued)

(i) Pollution	Quantity of pollution generated	Percentage of variation from prescribed standards with reasons
(a) Water		
(b) Air		

PART D

Hazardous Wastes

(As specificed under hazardous wastes/management and handling Rules, 1989)

Hazardous wastes	Total quantity (kg)	
	During the previous financial year	During the current financial year
(a) From process		
(b) From pollution control facilities		

PART E

Solid wastes

	Total quantity	
	During the previous financial year	Druing the current financial year
(a) From process		
(b) From pollution control facilities		
(c) Quantity recycled or re-utilized		

PART F

Please specify the characteristics (in terms of concentration and quantum) of Hazardous as well as Solid wastes and indicate disposal practice adopted for both these categories of wastes.

PART G

Impact of the pollution control measures on conservation of natural resources and consequently on the cost of production.

PART H

Additional investment proposal for environmental protection including abatement of pollution

PART I

Miscellaneous

Any other particular in respect of environment protection and abatement of pollution.

SUGGESTIONS

For popularization of environmental auditing in India and to serve as an important environmental management tool for the improvement of companies and industries, some suggestions are prescribed hereunder[2, 9].

1. In order to obey the environmental legislations, important steps must be taken for adoption of cleaner technologies for prevention and abatement of different types of pollution by the Indian corporate sector and organizations.

2. An environmental report must be published annually by the companies as a part of annual report and it should be made mandatory for all Indian companies.

3. As environment has so many complexities, environmental audit needs expertise from different fields with special knowledge. The team should comprise eminent professionals selected from different national institutes and universities. Indian Association for Environment Management (IAEM) and National Environmental Engineering Research Institue (NEERI) can play major role in this regard.

4. The environmental report must reach the public, so that it would succeed in minimizing the communication gap between the public and the industries. Based on this report, the company can challenge the public claims about the wrong notion that the industries are the major polluting agencies. Subsequently, it would help create awareness among other similar industries to abate their polluting activities.

5. Efficiency or inefficiency of the various departments of a company can also be judged by environmental audit. Accordingly, the efficient departments should be encouraged and likewise the inefficient ones must be penalized.

6. Environmental auditing and the report preparation should be done separately in each department, *viz* production management, industrial management, environmental engineering and in commerce. Such compilation would serve better for the industry.

7. Regular environmental audit reduces the risk of technological hazards. It saves money which could be utilized for better environmental management.

8. In major polluting industries, environmental audit, at least once in three years, if not yearly, should be made mandatory. Subsequently, this should be referred to other industries.

9. The Form V of the environmental statement notification also needs some modification.

CONCLUSION

The Environmental Audit (EA) is carried out to provide an indication to company management about how the environmental organisation system and equipments are performing. As a result, the best practicable means can be applied to preserve air, water, soil, plant an animal life from the adverse effects.

The EA should not be undertaken simply to facilitate compliance with law. It should be seen as means to accomplish long-term strategic goals.

Industries can benefit from a critical self-examination of the purposes and procedures using technology. It must see problem areas particularly with regard to human health.

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DO YOU KNOW ?

Q3. Can the sum of angles of a triangle be greater than 180 ?

Q4. What are Pangaea and Pantholassa ?

EARLY ACHIEVEMENTS OF INDIAN SCIENCE AND TECHNOLOGY

B. B. Singh* and Sandip A. Wagh*

This article pin-points some important contributions of Indian Scientists and Technolgists to various disciplines of Science and Technology during ancient times.

INTRODUCTION

India's place in science and technology had its peak early especially due to its pivotal position in mathematics and astronomy long before the era of Aristotle and Plato. Its textile had the global distinction. The age-old Indian philosophy, mythology and way of life have had ingredients of deep-rooted systematization of knowledge that are now being rediscovered, re-invented by most powerful tools capable of probing the secrets of nature. Many famous authors of science fictions, like Sir Arthur Clark, do not hesitate to appreciate the great marvels of the ancient Indian scriptures. However, during the last 5-6 centuries, it has received a set-back. As if to add to our handicap, the industrial revolution of the Western World took place when India had been shackled under colonial rule. During the later part of 20th century, extra-ordinary rapid growth in scientific knowledge coupled with technological innovation and expansion took place.

Although Modern Western Technology has produced amazing achievements, we must analyze the wider implications of such technological progress. These technologies often bring huge negative consequences that seem negligible in the short-term.

When such extraordinary rapid developments were in motion in the Western World, India achieved her independence. At that time, in the name of technology, India had only a few obsolete textile and sugar factories and produced almost nothing of what the country needed. This was further worsened with stagnating agriculture. With the entrenchment of colonialism, the contributions made by Indian Science and Technology were ignored. No serious efforts were made by the British regime to bring renaissance in the Indian Science. The British colonizers could never accept that Indians were highly civilized as far back as the third millennium BCE when the europeans were still in a barbarian stage. Under their industrial policy the Indian manufacturers were forced out of business, often through draconian laws. This was, in many instances, justified as civilizing them. Meanwhile, a new history of India was fabricated to ensure that the generations to come would believe in the inherent inferiority of their own traditional knowledge. This was done at the instance of Macaulay, a civil servant, who became the most prominent champion of such British cultural imperialism strategy. The policy had created a climate in which entrenched prejudice against the non-western knowledge still persists. Even after independence, a step-motherly treatment towards

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our traditional science and technologies continued. Many Indian intellectuals still continue to use the pre-colonial, feudalistic frame-work of Indian society.

Yet the fact is that amongst all the conquered and colonized civilizations of the old world, India is unique in her science and technology. In case of native Americans, the plunder by the colonizers was of natural assets. In case of Africans, the plunder was of natural assets and of slave labour. But in India's case, the colonizers took extraordinary profit margins from the control of India's exports, the taxation of the economic production and usage of science and technology to increase the production at colonizer's home. This comprised an immense transfer of wealth out of India to Europe. Because of this reason only, India was reduced to an importer of goods despite being the world's major exporting economy and despite being the source of much of the economic capital that funded Britain's Industrial Revolution once upon a time. From its envied status as one of the wealthiest nations, it became a land synonymous with poverty. A country whose educational institutions attracted the cream of foreign students from Asia, became the land of highest number of illiterates.

The justification for this gross exploitation and denigration of colonial victims was known as the civilizing mission. The colonial powers argued that in exchange for the wealth they plundered, both material and intellectual, they were providing the colonized people an opportunity to modernize. But, first, they had to create the perception that the West held all the keys to progress and that it was benevolently willing to share its gifts with the world. This perception was manufactured by Eurocentric historiographies and manipulation, distortion, and concealing of historical data. In the Indian context, colonial Indologists were required to create a portrayal of India as a region that was backward and in need of colonial stewardship.

In the case of China, Joseph Needham, a leading scholar at Cambridge, made it his life's work to document China's history of science and technology in over 30 volumes. But the time he died at the age of 90, his works had transformed the study of China forever. The Needham Foundation has continued this monumental work, and has been expanding the series with new volumes. Today, every research library on China, and every major library on science and history, has the Needham collection as important reference. Every serious China scholar respects this work, and its impact on the perception of China has been phenomenal. This impact has also trickled down to depiction in schools and the general media.

Unfortunately, India is yet to achieve this kind of intellectual repositioning. She continues to be depicted through "caste, cows and curry" images all too often. Indian culture is frequently portrayed as being mystical in the sense of being irrational, and in lacking a sense of advancement in the material plane of society. Often many Westernized Indians internalize these colonial stereotypes.

A similar history of Indian's science and technology has not yet been attempted, though many of the elements have been well discussed in particular studies. The absence of a general study, like Needham's, is influenced by an attitudinal dichotomy. On the one hand, those, who take a rather spiritual, even perhaps a religious view of Indian's history, do not have a great interest in the analytical and scientific parts of India's past except to use as a piece of propaganda about India's greatness. On the other hand, many who oppose religious and communal politics are particularly suspicious of what may even look like a glorification of India's past. The need for a work like Needham's has remained unmet.

INDIAN CONTRIBUTIONS TO EARLY SCIENCE AND TECHNOLOGY

Al-Beruni and other visitors recorded centuries ago that Indians were among the leading medical practioners, researchers and educators in the Middle-East. Records in China support these claims. Indians pioneered in various fields of mathematics, metallurgy, agriculture, medicine, shipping and trade language, etc. India was the mother of pan-asian civilizations in certain ways just as Greece was the mother of European civilization. This Indian influence on East and Southeast Asia is acknowledged by those scientists today and is well-documented in their own writings, but not in the writings by European authors where Indian sources are often marginalized.

The depth and breadth of Indian science and technology is staggering, and this section gives just a glimpse into the genius of India's scientists and engineers.

Civil Engineering

For complex Harappan towns to Delhi's Qutub Minar, India's indigenous technologies were very sophisticated. They included the design and planning of water supply, traffic flows, natural air conditioning, complex stone work, and construction engineering. The Harappan or Indus-Saraswati Valley Civilization in India is the world's oldest and most advanced civilization. This Civilization was the world's first to build planned towns with underground drainage, civil sanitation, hydraulic enginering, and air-cooling structure. While the other ancient civilizations of the world were small towns with one central complex, this Civilization had the distinction of being spread across many towns, covering a region about half the size of Europe. Weights and linguistic symbols were standardized across this vast geograph, for a period of over 1,000 years, from around 3000 BCE to 1500 BCE. Oven-baked bricks were invented in India in approximately 4000 BCE. Over 900 of the 1500 known settlement sites discovered so far are in India.

Since the Indus-Saraswati script is yet to be decoded, it remains a mystery as to how these people could have achieved such high levels of sophistication and uniformity in a dispersed complex and with no visible signs of centralized power.

Water Management

Given the importance of fresh water in India, it is no surprise that the techmologies to manage water resources were highly advanced from Harappan times onwards. For example, in Gujarat, Chandragupta built the Sudarshan Lake in late 4th century BCE, and was later repaired in 150 BCE by his grandson. Bhopal's Raja Bhoj Lake, built in 1014-1053, is so massive that it shows up in satellite images. The Vijaynagar Empire built such a large lake in 14th-15th century CE that it has more construction material than the Great Wall of China.

Scientists estimate that there were 1.3 million man-made water lakes and ponds across India, some as large as 2500 square miles. These are being re-discovered using satellite imagery. These enabled rain water to be harvested and used for irrigation, drinking, etc. till the following year's rainfall.

Textiles

Indian textiles have been legendary since ancient times. The Greeks and Romans extensively imported textiles from India. Roman archives record official complaints about massive cash drainage due to these imports from India.

One of the earliest industries relocated from India to Britain was textiles and became the first major success of the Industrial Revolution, with Britain replacing India as the world's leading exporter. What is suppressed in the discourse about India and Europe is the fact that the technology, design, and even raw cotton were initially imported from India while, in parallel, India's textile mills were outlawed by the British. India's textile manufactures were de-licensed, even tortured in some cases, over-taxed and regulated, to civilize them into virtual extinction. Textile and steel were the mainstays of the British Industrial Revolution. Both had their origins in India. The Ahmedabad textile museum is a great resource for scholarly material.

Iron and Steel

Iron is found in countries neighbouring India, leading European Scholars to assume that it came from outside India. Given the similarities between the Vedas and Avesta (a Zoroastrian text), some saw this as supporting the theory of diffusion of iron and Vedas into India from outside. But the fact is that the iron is much older in India. Cemeteries in present-day Baluchistan have iron objects. The earlier iron found in Middle Eastern archeological sites was essentially meteorite material sculptured as rock/stone carvings, and was not metallurgically processed at all. Since iron can be a by-product of copper technology, this could be its likely origin in India because copper was a well-known technology in many parts of ancient India. A smelting furnace dated 800 BCE is found in Naikund (Maharashtra), India. Recent discoveries reveals that iron was known in the Ganga valley in mid second millennium BCE. In the first millennium BCE, the Indian wootz steel was very popular in Persian courts for making swords.

Rust-free steel was an Indian invention and remained an Indian skill for centuries. Delhi's famous iron pillar, dated 420 CE, is considered a metallurgical marvel and swords, now displayed in museums across Europe. The acclaimed Sheffield Steel in UK was Indian crucible steel. The best brains of European science worked for decades to learn to reverse-engineer as to how Indians made crucible steel, and in this process, modern alloy design and physical metallurgy was developed in Europe.

Indian industry was dealt a death blow by the colonial masters who banned the production and manufacture of iron and steel at several places in India, fearing their use in making swords and other arms. In addition, they also ensured that India would depend upon iron and steel imported from Europe.

Zinc Metallurgy

Another important Indian contribution to metallurgy was in the isolation, distillation and use of zinc. From natural sources, zinc content in alloys such as brass can go no higher than 28 percent. These primitive alloys with less than 28 percent zinc were prevalent in many parts of the world before India. However, to increase the zinc content beyond this threshold, one must first separate zinc into 100 percent pure form and then mix the pure zinc back into an alloy. A major breakthrough in the history of metallurgy was india's discovery of zinc distillation whereby the metal was vapourized and then condensed back into pure metal. Europeans learnt the process of distillation for the first time in 1743, when know-how was transferred from India. Until then, India had been exporting pure zinc for centuries on an industrial scale. At archeological sites in Rajasthan, retorts used for the distillation are found in very large numbers today.

Shipping and Ship Building

Shipbuilding was one of India's major export industries until the British dismantled it and formally banned it. Medieval Arab sailors purchased their boats in India. The Portuguese also continued to get their boats from India and not from Europe. Some of the world's largest and most sophisticated ships were built in India and China.

The compass and other navigation tools were already in use in the Indian Ocean long before Europe. "Nav" is the Sanskrit word for boat, and is the root word in navigation and "navy". Using their expertise in seafaring, Indians participated in the earliest known ocean-based trading system.

Forest Management

Many interesting findings have recently come out about the way forests and trees were managed by each village and how a careful method was applied to harvest medicines, firewood and building material in accordance with natural renewal rates. There is now a data-base being built of 'sacred groves' across India. Once again, it is a story of an economic asset falling into disuse and abuse of the dismantling of local governance and disrespect for traditional systems.

Farming Techniques

Indian farmers developed non-chemical, eco-friendly pesticides and fertilizers that have modern applications. These traditional pesticides have been recently revived in India with excellent results. Crop rotation and soil technology that have passed down for thousands of years are traditional practices which India pioneered.

Traditional Medicine

Much re-legitimizing of traditional Indian medicine has already started, thanks in part to many Western labs and scientists. Many multinationals no longer denigrate traditional medicine and have in fact been trying to secure patents on Indian medicine without acknowledging the source. Traditional medicine is now a well-known and respected field.

Mathematics

When Europeans started importing Indian ideas about mathematics, what had been natural to Indian thinkers for a long time was very hard for Europeans to accept. The period of the renaissance of European mathematics can be divided as under :

1. The first mathematics war in Europe was from 10th to 16th centuries, during which time it took Europe 500 years to accept the concept of zero, because the Church considered it to be heresy.

2. The second war of mathematics was over the Indian concept of individuals, which led to the theory of real numbers and infinitesimals, paving the way for the development of calculus. This war lasted three centuries, from the 17th to 19th centuries.

3. The third war of mathematics is now underway and is between computational mathematics (Indian algorithmic approach) and formal mathematics (Western approach).

Additionally, Indians developed many imported concepts including the base ten decimal system, now in global use, and crucial trigonometry and algebra formulae. They made several astronomical discoveries. Diverse schools of logic and philosophy proliferated. Mathematical thought was intertwined with linguistics. India's Panini is acknowledged as the founder of linguistics, and his Sanskrit Grammar is still the most complete and sophisticated of any language in the world.

Relation with Inner Sciences

India's inner sciences of mind and consciousness are simultaneously (a) being appropriated by the West and (b) being depicted as anti-progressive and irrational. In fact, inner and outer realms of enquiry are often viewed as opposites that can, at best, be balanced but not unified. This falsely assumes that the inner sciences make a person and society less productive, creative and competitive in the outer realm. However, contradicting this, India's inner science and outer development co-existed in a mutually symbiotic relationship. A strong inner science will definitely strengthen the outer science since it is the inner world which provides the inspiration, creativity, and knowledge that is necessary in the development of a sound outer science. A strong outer science allows the freedom for the exploration of inner science.

CONCLUDING REMARKS

An exploration free from the phobias against Indian Civilization shows that the West did not come out on top due to any inherent superiority, but, rather due to their cunning and ruthlessness. This also shows that non-Western minds also have the capability to contribute to original technology. India's own English-educated elite should be made aware of these facts to shed its Macaulayite complexes. Since the colonial Indology and world history have become institutionalized over many decades, many of the reference works and popularly used texts are in drastic need of being re-written. The availability of new reference books for scholars would alter the historical assessment of India. Since the current institutions controlling the intellectual discourse do not desire to alter the power equation, the challenge for popularization and documentation of Indian contributions to the world in Science and Techology is not easy. So, various academic and research organizations are required to step up to meet this challenge.

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DO YOU KNOW ?

Q5. How many species of turtles are there ?

Q6. What is the duration of a day accurately ?

EMOTIONAL REGULATION : FUNCTIONAL CATALYST OF CURRENT CENTURY IN STEERING ADAPTABILITY

Nilanjana Sanyal* and Manisha Dasgupta*

The present consumerism-rimmed lifestyle is adorned by the "mask" of "superior intelligence" in the achievement-targeted nexus of pleasure and passion. However, the parlance of emotions often remains vulnerable, consequently resulting in a hike of impulsivity in the conative platter of personality, taking its toll in the clinical domain. Hence, the significance of launching the construct of "emotional regulation" as a chief catalyst in enabling individuals become authors of their life-scripts, incorporating creativity and becoming masters of their socio-emotional economy in the long run.

INTRODUCTION

In an era of jet-set progression of technology, the marks of superior intelligence are predominant in every fold of life. Enhanced cognitive potential is not found to be proportionately balanced with emotional adaptability, rather the cry of the day is to establish "self-identity" at any cost. The rat race of achievement is on, consumerability of materialism rolls down to stretched periphery of social-emotional life boundary. But with it, the brightness of cognition is merging into darkness of depression in the failure of stepping into the desired platform of achievement-fulfillment. Stray emotional disturbances, accumulating unknowingly and having their consistent flow in life circles from multiple sources, result into the bulk of neurosis or behavioural breakdown of clinical concern. The problem, hence, has put up the hoarding of "emotional regulation" as the key necessity in current day peaceful adjustability contexts.

Emotion regulation may be undertaken for a number of goals or purposes like :

- Reduction in subjective distress (owing to feeling oppressed, humiliated, defeated, not accepted, exploited, marginalized, ostracized, etc.) ;
- Reduction in the frequency of unacceptable emotion-related behaviours e.g. physical and verbal acts of aggression) ;
- Accomplishing instrumental-goals e.g. obtaining advice, information and feedback from people in one's social network when dealing with stressors) ;
- Replacing one emotion with a more productive one[1] (such as replacing anger by engaging in positive refocussing).

The functionality of the concept needs to be verified in day-to-day situations as well as in pathological maladjusted behavioural sequences, but definitely with an introductory clarification of the concept.

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DELINEATING THE EMOTION REGULATION DOMAIN

The general concept of emotion regulation can be understood as "All the extrinsic and intrinsic processes responsible for monitoring, evaluating and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals and, can refer to a wide range of biological, social, behavioural as well as cognitive processes[1,2]. Thus the concept unfolds the following features :

Emotional regulation is the process of initiating, maintaining, modulating or changing the occurrence, intensity or duration of internal feeling states and emotion-related physiological processes, often in the service of accomplishing one's goals.

It is central in the development of quality social functioning in individuals.

It also helps enhancing one's subjective well-being.

Hence, product-wise, the concept seems to be beset with certain behavioural dimensions like :

- Restructuring cognition ;
- Emotional understanding and
- Adoption of appropriate action components.

Such features are evident in various behaviour patterns of individuals, in specific modes of expression that bring into picture another associated concept of cognitive emotion regulation.

There are important individual differences in the way people regulate their emotions, some ways of regulating emotions may be more adaptive than others. The basic means of regulating emotions may be a two-fold business ;

- Emotional regulation as an adopted mode of practice and hence more of a habit in specific social ambience, and
- Cognitively understanding the nature of personal emotions and the social-personal need to control it.

The first mode is following the dictums even unknowingly, whereas the second mode seems to be the sign of mental maturity. Signs of problems in emotion regulation are common among different forms of psychopathologies[3,4]. The difference appears to be the product of the fact that individuals suffering from some form of psychopathology are impaired in one or more emotion regulation strategies like self-blame, catastrophising and positive reappraisal[4,5,6].

CONCEPT OF COGNITIVE EMOTION REGULATION

It focuses on the cognitive way of handling the intake of emotionally arousing information[7]. An array of physiological, attentional and cognitive processes seem to lace the practiced emotion regulation. In the fold of submerged cognitive process may exist the contents of selective attention processes, memory distortions, while conscious cognitive radars may utilize the cues of cognitive restructuring, blaming oneself, ruminating or catastrophising.

COGNITIVE EMOTION REGULATION : A DEVELOPMENTAL CATALYST

Well-adjusted, regulated individuals would be expected to be relatively high in the ability to voluntarily control their attention and behaviour as needed to respond in an adaptive manner and vice versa. Research has found that children having deficits in cognitive emotion regulation have problems in social problem-solving or conflict-management skills[8]. They react to inter-personal conflict situations in hostile ways without considering non-aggressive or pro-social solutions ; and they anticipate fewer consequences for their aggressive solutions[9,10].

Such children also have difficulty knowing how to "read" social situations because they distort and/or under-utilize social cues. Negative social experiences with parents, teachers, and peers, impart the result of their lack of social competence, further exacerbate their adjustment difficulties, perpetuate their aggressive behaviour problems and self-regulation difficulties, and reinforce their distorted perceptions and social cognitions[10].

DEVELOPMENT OF COGNITIVE EMOTION REGULATION DURING SCHOOL AGE

In order to understand the process of how such 'emotional element' starts acting as a catalyst in our adaptive mode of behaviour, its developmental roots need to be fathomed. It has been noted that emotional understanding-based regulatory component is a major developmental task[11]. The initial regulation must be provided by the environment. During the school-age years, emotional regulation changes to a more complex and abstract process ; whereas in infancy, it was primarily **reflexive**, guided by physiological discomfort, now it becomes more **reflective**, guided by the child's sense of self and the environment. Moreover, as children develop their own capacity for emotional regulation, the internal or subjective aspects of emotion become separate from the external expression of emotion (or affect the regulated emotion as habit), giving rise to **compartmentalization of affect.** Research does suggest that, there are at least four processes undergoing children's growing ability to regulate their emotions.

- Maturation of the child's neurological inhibitory system, which provides the necessary neurological "hardware" required for the eventual control of emotions ;
- Child's temperament and developmental status ;
- Parental socialization, practiced behaviour and environmental support and ;
- School and teachers' emphasis on emotional education.

CONCLUSION

In fact, the ability to regulate emotionality is an aspect of emotional intelligence so that one is guided by emotions and not compelled by them. People need to be able to govern what they choose to express and what they suppress. They need to stop runaway anxiety. Ultimately, it is the integration of emotion and cognition that lead to good physical and mental health.

Days have changed for us. Stimulations are varied and impinge on nerves and impulses too strongly. Despite superior intelligence as the product of current advanced world, the strings of emotions stay loose and create havocs in negative directions too often. The net result is the hallmark of current century, being the century of "terrorism" and "impulsivity." The lens of mental health is focusing on emotions and emotional intelligence to control the gear of impulses. To usher in such processes, the behavioural catalyst seems to be the one and only concept of "emotional regulation," be it in the practiced mode or else prompted by cognitive flares of mankind.

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DO YOU KNOW ?

Q7. What is the meaning of 'Dinosaurs' ?

Q8. Which is the highest plateau on earth ?

MICROWAVE OVEN & HEALTH

Ammar Ibne Anwar*

The microwave oven is a versatile, time saving kitchen appliance that uses microwave radiation to heat food. Microwaves pass through glass and plastic, bounce off some metals and are absorbed by any object that contains water. All foods contain varying degrees of moisture, no matter how dry they look. Heat is produced as the microwaves agitate the water molecules contained within the food.

Microwave oven, device that uses micro waves to rapidly cook food. Every microwave oven contains a magnetron, a tube in which electrons are affected by magnetic and electric fields in such a way as to produce micro wavelength radiation at about 2450 Mega Hertz (MHz) or 2.45 Giga Hertz (GHz). This microwave radiation interacts with the molecules in food. All wave energy changes polarity from positive to negative with each cycle of the wave. In microwaves, these polarity changes happen millions of times every second. Food molecules—especially the molecules of water—have a positive and negative end in the same way a magnet has a north and a south polarity.

In commercial models, the oven has a power input of about 1000 watts of alternating current. As these microwaves generated from the magnetron bombard the food, they cause the polar molecules to rotate at the same frequency millions of times a second. All this agitation creates molecular "friction", which heats up the food. This unusual type of heating also causes substantial damage to the surrounding molecules, often tearing them apart or forcefully deforming them.

The microwaves cause water molecules in the food to vibrate, producing heat, which is distributed through the food by induction. A special electron tube called a magnetron produces the microwaves. To ensure even heating, the magnetron directs its waves at a rotating metal disk with offset vanes, which scatters the waves through the oven cavity; a rotating platform for the food is sometimes used in addition. Power settings may reduce the amount of radiation by cycling a constant-output magnetron on and off for varying lengths of time, or may reduce the level of radiation constantly produced by an inverter magnetron. The magnetron may be supplemented by quartz and halogen bulbs for browning food, which microwaves do poorly. Microwaves are transmitted, reflected or absorbed by objects, depending on what the objects are made of.

Cooking food with microwaves was discovered by Percy Spencer while building magnetrons for radar sets at Raytheon. In 1946 Raytheon patented the microwave cooking process and in 1947, the company built the first microwave oven, the Radarange. It was almost 6 feet (1.8 m) tall and weighed 750 pounds (340 kg). It was water-cooled and produced 3000 watts, about three times the amount of radiation produced by microwave ovens today. In the 1960s, Litton bought Studebaker's Franklin Manufacturing assets, which had been manufacturing magnetrons and building and selling

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microwave ovens similar to the Radarange. Litton then developed a new configuration of the microwave, the short, wide shape that is now common.

ADVANTAGES OF THE MICROWAVE OVEN

Some advantages of using the microwave oven include :

- It is faster than conventional methods of cooking.
- Conventional methods of cooking use energy to heat oil, water or air microwave ovens only heat the food, so you can save on your energy bills.
- Nutrients are retained in the food.
- Protein foods don't brown when cooked in a microwave. This reduced oxidation means that nutrients like vitamin A and E are less likely to be destroyed.
- Food heated quickly in a microwave retains more nutrients than foods kept hot for a long time, such as those simmered on a stove.
- Potentially dangerous micro-organisms in food tend to thrive in temperatures between 5ºC and 60ºC. When you use a microwave oven, food can be thawed, cooked and served quickly. So it spends less time in the dangerous temperature zone.

HEALTH HAZARDS

Uneven Heating

Food is heated for so short a time that it is often cooked unevenly. Microwave ovens are frequently used for reheating previously cooked food, and bacterial contamination may not be killed by the reheating, resulting in foodborne illness. The uneven heating is partly due to the uneven distribution of microwave energy inside the oven, and partly due to the different rates of energy absorption in different parts of the food.

Acute Dangers

Liquids, when heated in a microwave oven in a container with a smooth surface, can superheat ; that is, reach temperatures that are a few degrees Celsius above their normal boiling point without actually boiling. The boiling process can start explosively when the liquid is disturbed, such as when the operator grabs hold of the container to take it out of the oven, which can result in severe burns.

Utensils such as forks produce sparks when placed in the microwave. This is because while it acts as an antenna, absorbing microwave radiation just like other metal objects such as the spoon, the pointed ends of the fork will act to concentrate the electric field formed at the tips. This has the effect of exceeding the dielectric breakdown gradient of air, about 3 mega volts per meter (3×10^6 V/m), causing sparks to form. This effect is somewhat analogous to the effect of St. Elmo's fire.

Biological Effects of Exposure

Continually eating food processed from a microwave oven causes long term-permanent— brain damage by "shorting out" electrical impulses in the brain [de-polarizing or de-magnetizing the brain tissue]. The human body cannot metabolize [break down] the unknown by-products created in microwave food. The effects of micro waved food byproducts are residual [long term, permanent] within the human body. The minerals in vegetables are altered into cancerous free radicals when cooked in microwave ovens. One of the histological studies with microwaved broccoli and carrots have revealed that the molecular structures of nutrients are deformed by high-frequency reversal of polarity, even up to the point of destroying the cell walls, whereas in conventional cooking the cell structures remained intact.

Some scientists clam that there can be 'microwave sickness'.

The first signs are low blood pressure and slow pulse. The later and most common manifestations are chronic excitation of the sympathetic nervous system [stress syndrome] and high blood pressure. This phase also often includes headache, dizziness, eye pain, sleeplessness, irritability, anxiety, stomach pain, nervous tension, inability to concentrate, hair loss, plus an increased incidence of appendicitis, cataracts, reproductive problems, and cancer.

It has also been claimed that microwaving baby formulas converts certain trans-amino acids into their synthetic cis-isomers. Synthetic isomers, whether cis-amino acids or trans-fatty acids, are not biologically active. Further, one of the amino acids, L-proline, is converted to its d-isomer, which is known to be neurotoxic (poisonous to the nervous system) and nephrotoxic (poisonous to the kidneys). It is bad enough that many babies are not nursed, but now they are given fake milk (baby formula) made even more toxic via micro waving.

One short-term study found significant and disturbing changes in the blood of individuals consuming micro waved milk and vegetables. Eight volunteers ate various combinations of the same foods cooked in different ways. All foods that were processed through the microwave ovens caused changes in the blood of the volunteers. Haemoglobin levels decreased and over all white cell levels and cholesterol levels increased. Lymphocytes decreased. Luminescent (light-emitting) bacteria were employed to detect energetic changes in the blood. Significant increases were found in the luminescence of these bacteria when exposed to blood serum obtained after the consumption of micro waved food.

PREVENTIVE MEASURES

- Make sure that frozen foods are properly thawed in the microwave before cooking, because cold spots may allow bacteria levels to rise.
- Thorough cooking is more likely if you chop the food into similar sized chunks. Smaller portions cook more evenly than large portions.
- The use of cooking bags and lids, or covering the container with plastic film, helps ensure even cooking and destruction of harmful bacteria.
- Ensure a more even temperature by using shallow and round containers, rather than square and high-topped containers.
- Stir food at least once during the cooking process.
- Foods that can't be stirred (such as roasts or quiches) should be left to stand, so that the heat can penetrate more evenly throughout.
- Observe recommended standing times on microwave food products, such as popcorn or pre-packaged meals.
- Avoid cooking stuffed poultry, as it is hard to ensure the stuffing has reached a temperature high enough to kill harmful bacteria.
- Don't cook an egg within its shell. The build-up of steam will explode the egg.
- Liquids or foods can be 'super-heated', which means they may boil explosively when stirred or otherwise disturbed. Always observe recommended cooking times. If you're unsure of how long to cook a particular food or liquid, leave it to cool in the microwave oven before taking it out.

GENERAL SAFETY SUGGESTIONS

- Read the microwave oven's instruction manual thoroughly. Keep it handy so that you can refer to it often.
- Only use microwave-safe containers. Glass or ceramic containers that aren't labelled

'microwave-safe' may overheat and cause burns.

- Never use plastic grocery bags, newspaper or plastic containers for frozen foods (such as ice-cream containers) in the microwave.
- Avoid using plastic containers or film unless the manufacturer explicitly states that these items are microwave safe. Otherwise, compounds from the heated plastic can leech into the food.
- Don't allow plastic film to touch the food. Even plastic labeled 'microwave safe' should not touch food to avoid migration of chemicals from the plastic.
- Use glass containers designed for microwaves to cook high-fat foods, as additives from plastic are more likely to migrate into fatty foods at high temperatures.
- Don't use metal containers or containers with metal trims.
- Always supervise children when they use the microwave oven. Show them how to use it safely and warn them of the possible dangers.

WHAT THE FUTURE HOLDS FOR IRON & STEEL MAKING

Rajesh Kamal and G. J. Mahajan

INTRODUCTION

We have dwelt with technologies being practised, introduced and retrofitted in integrated steel works of today. Now it is time to reflect and gaze into crystal ball as to what the future holds for these integrated steel works, more specifically the integrated steel plants of India-and the steel industry in general of India and the world.

Iron making is likely to see major and visible changes in next four decades or so. An interesting possibility has already emerged in the name of Smelting Reduction even though its current contribution in world production is hardly 1%.

A question arises here as to why we should be so concerned about developments related to iron and steel. Steel has been the prime engineering material due to its high strength to weight ratio, toughness, cost advantage over competing materials (e.g. titanium), easy availability of raw materials and meets stringent requirements for a wide cross section of end applications.

There have been many attempts to replace steel and the attempts are continuing to replace it as the number one engineering material. While these attempts meet with partial success, other applications emerge where steel is indispensable. The result is that steel consumption is the largest of all engineering materials (wood, concrete, aluminium) and all projections indicate that this number one position of steel would be retained even in the next hundred years or so.

* Steel Product group, RDCIS, Ranchi

Reproduced from 'Steel Plant Technologies—an overview' published by Research & Development Centre for Iron & Steel. Steel Authority of India Ltd. Ranchi-834002 ; with permission.

PROJECTIONS OF STEEL CONSUMPTION

Steel has so far proved to be the single key factor responsible for industrial production, and thereby, for economic growth. And it is growing from strength to strength with newer development-both within steel making practice as well as engineering developments, which ask for more usage of steel. So much so, that economic development has become almost synonymous with steel consumption.

Trend studies have revealed that steel consumption is strongly dependent on the state of development of the economy where it is consumed. In this connection, the economies of Germany, UK, USA, and Japan can be considered as developed economies where the consumption rises to a peak and then declines and tends to stagnate.

If we plot the normalised consumption of steel (i.e. ratio of consumption to peak consumption

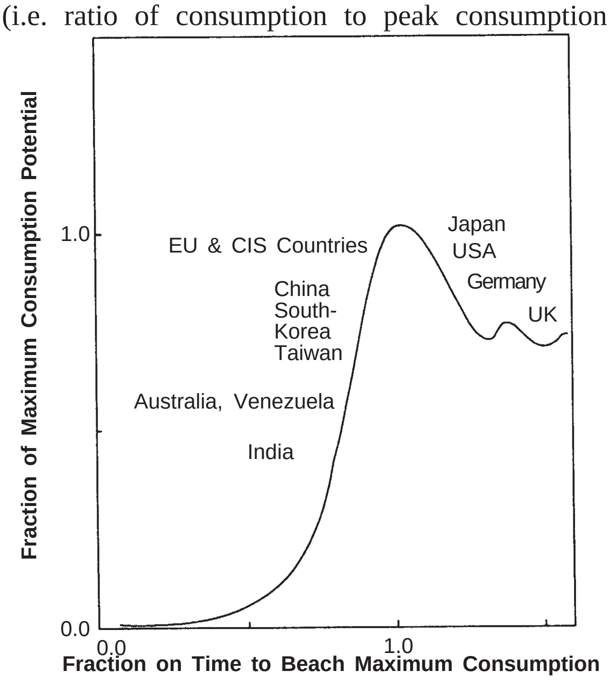

Fig. 1. Steel Consumption in Present Day Economies

value) against normalised time of peak consumption value) against normalised time of peak consumption (ration of years elapsed from a judiciously chosen starting year to the years taken to reach peak consumption) we get a plot of type shown in Fig. 1.

World consumption has not being showing such a trend, possibly the peak has not been reached yet. Since world consumption would actually be superimposition of many such curves in a staggered manner, the peak is expected to be erratic like a mountain range (Fig. 2).

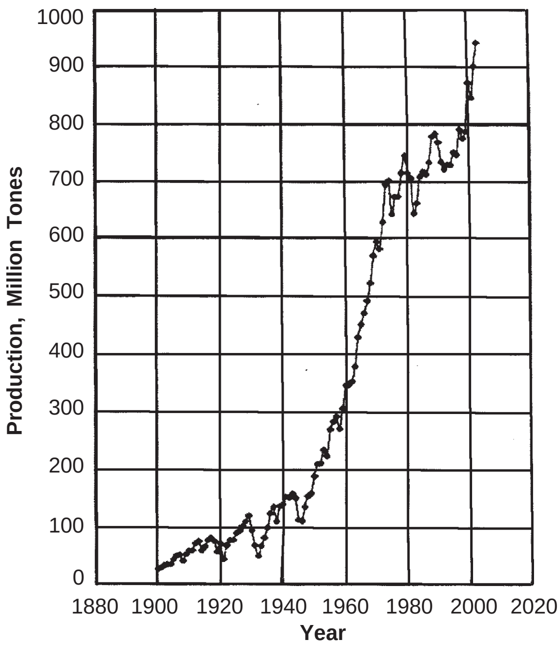

Fig. 2. World crude steel production

China presently is the dominant player in steel consumption pattern of the world. Apart from being the largest steel consumer, it is also the largest importer, and the latter has contributed maximum in stimulating steel production all over the world-as also in India.

For a long time India's steel production and consumption figures were matching, but in 2002-03, India produced about 32.5 million tonnes of finished steel, approximately three million tonnes more than its consumption, resulting in increased exports. In spite of the recent recession in the domestic steel consumption, yearly consumption rate has been consistently increasing. Most of the time the actual consumption has been falling short of projected figures. However, in 1991-93 period, the consumption increased by 21%, averaging 11.5% per year, as against a six decade average growth of 5.5% per year. The six decade average growth in the index of industrial production is also 5.5%, which implies direct dependence of industrial growth on steel consumption.

In-house projection indicated that India's steel consumption would peak to 170 million tonnes by 2050 AD. This projection was made in 1997 based on trend analysis and the outcome appeared very improbable. But since then the changes occurring in the steel industry of China has raised hopes that this type of change is very much likely.

For this to happen, the steel consumption in India will have to increased five fold in the next four decades. This should be made possible through :

- Government thrust on infrastructure development
  - ➢ 'Golden Quadrilateral' project
  - ➢ Other road projects
  - ➢ Development of housing sector
  - ➢ Modernisation of airports
  - ➢ Expansion of railway tracks
  - ➢ Safety and other development programmes of Indian Railways
  - ➢ Additional electricity generation (1 lakh NW in next 5 years and to grow further at a higher rate)
- Connecting major rivers of the country
- 'Sagarmala' project to boost port facilities
- Giving incentives for promoting export oriented industries
  - ➢ Cars
  - ➢ Consumer products, e.g. home appliances

For meeting this increased demand in India, BF-BOF route will continue to play significant role. But its dominance is likely to be eroded largely because of shortage of metallurgical coal. The availability of the same will remain restricted within the country Blast furnaces may not only survive but the numbers may grow based on imported metallurgical coal. But even these imports may prove prohibitive cost wise gradually.

About 70% of iron is extracted in blast furnaces, while over 20% comes from the DRI route (Table I).

Blast furnace and DR technologies have been covered in earlier sections but the balance about 10%, which comes from the Smelting Reduction route has not been discussed earlier and needs to be dealt in detail at this point and has been covered in the next section.

In India, scarcity of coking coal has been forcing adoption of processes involving non-coking coal. The Indian non-coking coals are unsuitable for many applications, but appear ideally suited for treatment in rotary kiln sponge iron making processes-a trend which is likely to continue for a few decades to come. The blast furnace iron making would stay as long as it can run efficiently-would use less and less of hard coke-would inject more of alternative fuels like beneficiated and pulverized non-coking coal, tar, nature gas, etc.

	Present	**Espected After Four Decades**
Total Steel Production	32	150
Steel Production by Hot Metal-BOF Route (Contribution of SR-BOF likely to increase from about 10% to about 20%	20	75
Steel Production in Electric Furnaces (Hot metal + DRI + Scrap) (Contribution of DRI is likely to be maintained at about 70%)	10	75
Matching DRI Production	7	52
Matching BF Hot Metal	20	60

In Table I below, we attempt to predict the situation in India after about 4 decades. The overall global situation would be roughly compatible with the situation in India as regards the contribution of different routes, while the overall consumption would remain roughly stagnant.

Table I : Likely Indian steel making scenario in mid-twenty-first century

(Inferred from 'Steel Demand Forecasts : India 1999-2000'-Steel Times International, 23(4), pp. 14-17 (July '99) (Million tonnes)

While changes in rest of the world are going to be in similar pattern, the DRI or sponge iron part would be of coal based variety in Indian sub-continent while in rest of the world (with possible exception of African continent) the natural gas based sponge iron would predominate. Smelting Reduction Processes like Corex, Romelt and/or other newer processes would supplement the hot metal production from blast furnaces. While blast furnaces would be using a minium amount of hard coke, even this would be supplemented by formed coke or something similr.

DEVELOPMENT OF SMELTING PEDUCTION

The term 'smelting reduction (SR)', meaning melting accompaned with reduction, theoretically encompasses the blast furnace iron making process as well. But by usage, it has come to denote that group of processes, which makes hot-metal-like liquid iron from iron ore or other iron oxides using non-coking coal. Attempts to evolve such a process started as soon as the scarcity of coking or metallurgical coal was felt. Presently, only half percent of total hot metal production in the world is by three plants based on Corex process. More plants based on processes such as Romelt, Corex, Hi-Smelt, etc. are in the pipeline.

In these processes (Corex, Romelt, Hi-Smelt, Ausmlt, Dios, AISI-DOE, etc.), the blast furnace concept has been adopted and suitably modified to eliminate the need for cohesive zone so that non-coking coal can be used directly for reduction. Most of the processes (Corex, Hi-Smelt, AISI-DOE, Hoogovens, etc.) have divided blast furnaces into two. First part caries out pre-reduction of iron oxide, which is coupled to the second reactor where pre-reduced material (highly reduced sponge iron in case of Corex and partially reduced iron oxide in most of the other processes) is smelted with non-coking coal, flux and oxygen and/or air (preheated or otherwise) to make hot metal. Most of the processes use oxygen, while Hi-Smelt uses preheated air. Romelt uses some quantity of cold air apart from oxygen.

In the free board of smelting reactor, the evolving carbon monoxide (CO) gas is post combusted to different degrees in different processes. Single reactor processes, like Romelt, practice very high degree of post combustion, i.e. conversion of more than 70% of $CO + H_2$ in the freeboard gas to $CO_2 + H_2O$.

Of the SR processes, only Corex has been operating ion commercial scale since 1995. A large demonstration unit of Romelt process at Novelipetsk Steel Works in Russia has been operating intermittently since 1985. Demonstration plants on Hi-smelt and Ausmelt processes have also been recently installed.

These newer processes produce liquid iron similar to blast furnace hot metal except for the following differences :

1. All these processes produce very low silicon hot metal.
2. Carbon contents is similar, on an average, slightly more than blast furnace hot metal.
3. Phosphorus level is considerably lower since some phosphorus presumbaly gets transferred to gas phase during smelting reduction.
4. Initially all these processes had problem of high sulphur in hot metal. Corex has apparently solved these problems and now produces hot metal containing sulphur consistently below 0.05%. But on an average, it is still higher than the average sulphur level of blast furnace hot metal

Corex Process

A large demonstration unit of Corex (called C-1000 module) was installed and commisioned in 1989 at Pretoria in South Africa. After initially having a large number of teething troubles, which required considerable modifications, the plant was operated successfully till 1999 and exceeded its rated capacity of 300,000 tonnes per annum. After the installation and commissioning of a C-2000 module at Saldhana Bay under the same company (ISCOR), the C-1000 module at Pretoria was shut down.

The first C-2000 module was installed and commissioned at POSCO (South Korea) in November 1995. The plant is reported to be producing more than 700,000 tpa hot metal.

The second C-2000 unit was installed at Saldhana Bay, South Africa in December-1998. This plant utilises the surplus Corex gas for making DRI in a Midrex unit. Both the DRI and hot metal are put in electric arc furnaces for processing into steel. The Corex unit is reported to be producing @ 824,000 tonnes of hot metal per year. The DR unit produces 832,000 tonnes of DRI per year. The Saldhana unit produces 1.25 million tonnes per year of ultra thin high quality hot rolled coils.

Indian Scenario

The third C-2000 module was installed and commissioned in India under Jindal Vijayanagar Steel Ltd. (JVSL) in August 1999. There were considerable problems in start up and the plant could not run smoothly until more than one year later. But now it is operatng very smoothly although on 100% imported non-coking coal. The second C-2000 unit of JVSL has also been installed and commissioned in April 2001 and is operating smoothly.

Brief Process description

Croex is a two reactor but a 3-stage process. The blast furnace concept has been used, virtually splitting it into two at the cohesive zone interface. Accordingly, a corex plant has a shaft unit, where iron ore pellets (with or without some closely sized lump ore) is reduced by gases emanating from the second unit to make hot sponge iron. This is machanically transferred to the second unit called Melter-Gasifier where it is melted and carburised through injection of both coal and oxygen. In upper parts of Melter-Gasifier a fluidised bed of coal char is maintained where and CO_2 or H_2O is converted to CO and H_2. Since there is practically no CO_2 or H_2O in the gas above smelting bath we say that the post combustion degree $\{(CO_2+H_2O)/(CO_2+CO_2+H_2+H_2O)\}$ of Corex gas is zero.

Proerties of Coal Required for Cored Process

Since in the Melter-Gasifier no CO_2 is formed, the heat requirement in the reactor is met by the conversion of carbon in coal to CO by oxygen putj in through oxygen lances. This liberates les than one fourth of the energy available in coal. Coals containing high ash and high volatiles use up all such avaialble energy in reaching up to the reactor temperature and are therefore not suitable for sustaining the process. This is the reason why hardly any Indian coal has been found suitable for Corex process.

Absence of post combustion means that a lot of energy goes away in the exit gases and consequently the coal consumption in Corex process is much higher than in any other iron making process. However, if the exit gases can be suitably utilised, for example for power generation as in JVSL or for making DRI as in Saldhana Steel the over-all economics becomes quite favourable.

Romelt Process

The sucessful operation of Remelt process has been demonstrated in short spells since 1985 in 300,000 tpa demonstraton unit at the Novolipetsk Steel Works (NLSW). The process has been developed primarily by Prof. Romenets at Moscow Institute of Steel and Alloys (MISA). Steel Authority of India Ltd. (SAIL) had formed a joint venture named Romelt-SAIL India Limited (RSIL) with the three Russian organisations, which had taken part in the development of Romelt porcess, namely NLSW, MISA and Gipromez. Based on the initiative of RSIL, India's National Mineral Development Corporaton (NMDC) is in the process of setting up a Romelt plant of 300,000 tpa capacity at Nagarnar, based on iron ore slimes available at Jagdalpur in Chhattisgarh State. Ground-work has started at site and tendering process is on. Commissioning of the plant is due in 2005.

National Aluminium Company (NALCO) in Orissa has accumulated massive deposite of "Red Mud" which is an iron oxide rich waste from the process of extracting aluminium. NALCO has taken up extensive investigations with a view to setup a Romelt plant of 243,000 tpa capacity, which can use, as input, this waste iron oxide along with iron ore. The plant is proposed to come up near Damanjori in Orissa.

Romelt is a single stage smelting reduction process for making blast furnace like hot metal from iron ore and non-coking coal. The uniqueness of this process is the array of lances used which effects post combustion to the extent of 70% or more, which enables ploughing back of much of energy in waste gas into the process. The process can also accept iron ore and coal of a variety of sizes and quality.

Although waste gases coming out of Romelt reactor do not contain much chemical energy, but the temperature is quite high. For economic viability, it has been found necessary to utilise this sensible heat for electrical power generation.

Hi-Smelt and Ausmelt Process

Both these processes have been developed in Australia and each of them now have operating demonstration plant. Hi-Smelt presently operates a 100,000 tpa "R & D facility". A larger Hi-Smelt demonstration plant of 800,000 tpa is being constructed at Kwinana in Western Australia. It uses preheated air blow instead of normal oxygen lance. 70% post combustion level is maintained and iron ore fines are used as feed, which are preheated and pre-reduced by the exhaust gases in a fluidised bed reactor. The plant is due to be commissioned in the second half of 2004.

Ausmelt process used an LD like vessel, although somewhat wider and with multiple oxygen lances, for carrying out single stage reduction process with strategically located oxygen nozzles for post combustion. A 15,000 tpa demonstration plant is operating. No details are available.

Other Developments on SR

In addition to the above, there have been prominent development work on the following SR Processes :

— DIOS process of Japan

— AISI-DOE process in the US

(*Further development work on these have stopped*)

— Combismelt Process

(This is in fact not a new process but a combination of existing DRI making process and electric pig iron making using DRI. Presently New Zealand Steel uses this concept as also a government unit (No. 3 Mining Enterprise) in Mayanmar).

— Fastsmelt Process

(This is a development by Midrex where combismelt concept is adopted using DRI made in a Rotary Hearth Furnace using cold bonded ore-coal composite pellets. This process has also not been commercialised yet).

Even though the SR processes contribute much less than 1% or total worlds hot metal production, none can deny that among the newer hot metal making installations, SR processes are going to take up significant share. Their competitor is only mini-blast furnace, which is succeeding only as a stopgap arrangement.

LIKELY DEVELOPMENTS IN STEELMAKING & STEEL PRODUCTS

Steel will remain leading technology material in 21st century. Current share of steel in total metal production is 93%, and is likely to remain around this level in the coming decades.

As seen earlier, iron making will continue to be dominated by blast furnace, while significant inroads would be made by DR and SR technologies. But steel making technology still has huge development potential with regard to new manufacturing and processing techniques. Efforts will continue to be deveoted towards enhancement in material properties, which will open up roads to even more applications. Incremental improvement, with short pay back peiod, will continue with thrust for :

(i) Enhanced equipment speed

(ii) Process continuity

(iii) Plant automation

Intense development efforts, however, are likely to be made in automation and product improvement/ development rather than in fundamental process research.

In BOF Steelmaking, it is almost impossible to observe directly what is going on inside. There is no mathematical model, which can fully describe the thermo-metallurgical-fluid dynamic processes occuring inside. Currently, just a part of these processes is fully understood. Thus, there is a lot of scope for enhancing understanding of BOF Steelmaking Process. Developments in BOF technology for improving the process economics will be directed towards optimization of process technology, not just limited to target end composition and temperature, and quality of, and choice of fluxes and raw materials, but also for operation practice for the blowing lance (lance height and blowing pattern), bottom strring system etc., which will all have to be standardized with reference to steel quality to be produced.

BOF vessel design and suspension system shall certainly undergo improvement. Use of magnesia-carbon bricks and slag splashing techniques has resulted in increasing the temperature of the vessel shell, which means increased creep effect. Converter body will need higher creep resistant materials.

Share of EAF steelmaking will continue to grow in slow progression. Use of DC are furnace will lower the specific electrical energy requirement and electrode consumption. Wider adoption of secondary refining will improve productivity in steelmaking and provide cleaner steels. Continuous casting will achieve maturity. High casting speeds may be achieved-around 10m/min., with a goal to reach 12 m/min. Proportion of thin strip and thin slab casting is likely to grow. Long product casters that can cast both light and heavy section products will become reality. Simulation will be an invaluable tool in the development and optimization of casting process for new products for enabling visualization of what is happening in the mould and what causes defects in and influences the micro-structure during solidification.

Refractory materials are indispensable in steel industry. Efforts will continue to reduce cost and consumption of refractory materials as well as cost of refractories per tonne of steel produced. Process development, e.g. optimization of slag composition for improving efficiency of slag splashing in BOF, improvement in life of plunges in RH degasser etc., will also get adequate attention.

New technology package will be developed to significantly improve strip profile and flatness control. The key target of these packages will be to achieve a wide control range, easy to implement control characteristics, flexible pass schedule design, suppression of all types of strip buckles etc.

Increased plant automation is likely to reduce the demand on operators. Robots may be employed to carry out tough production tasks. Processes from blast furnace to rolling will have complete AI solutions. Currently AI adoption is in the decreasing order : Iron making-rolling-steelmaking-others ; in the ratio of around 5 : 3.5 ; 1.0 : 0.5. "Through Process Models" shall be developed and utilized to predict the influence of one process stage on the next to optimize the whole sequence of process from start to finish, taking into consideration the product variety, changes in the width and thickness etc.

With the rising need for lighter automotive materials, there will be increased focus on high strength steels. 590 MPa class steel shall be in commercial production. High performance 780 MPa class, galvannealed high strength steel will also have demand from car manufacturers. 980 MPa, 1180 MPa and 1470 MPa class high strength steels may be developed through expertise in chemical composition and heat treatment techniques. Steels will be produced with ultra fine ferrite grain size down to 5 μm (micrometer) diameter. Obtaining ferrite grains with an average size on 1 μm would make it possible for a steel with a simple chemical composition, normally having a tensile strength of 400 MPa to reach 800 MPa. Faster cooling rates shall be achieved in continuous annealing and galvanizing lines. Cooling technologies and equipment will be developed which will make it possible to produce, starting from the same chemical composition, steels with the strength that can be modulated between 1000 and 1400 MPa.

Demand for high strength steel, more than 460 MPa, for bridges and metallic structure is likely to increase. New steel solutions shall be available to users for variety of applications.

A PEEP INTO THE IRON AND STEEL MAKING PRACTICE OF TWENTY SECOND CENTURY

Making iron and steel causes incremental damage to environment, which has been cumulating over the years. Green house effect of accumulated carbon dioxide in the atmosphere is already affecting global climatic conditions. Strict restructions are coming into force for emission control in automobiles (CO_2 especially).

We expect that within this century, the problem is likely to grow to question of the survival of human race. With this imperative in mind, the next century is likely to permit only those iron and steel making processes, which are safe for the environment. With this compulsion in mind, it should be possible to hazard a guess regarding the iron and steel making processes to the twenty second century.

Environmental concerns would force minimisation of CO_2 emissions from iron and steel making so much so that only the CO_2 emitted in electric melting of scrap or equivalent can be permitted. About 40% of the steel making would be from recycled scrap. The balance metallic input has to come from DRI, which is made from hydrogen reduction of iron oxide (Fig. 3). This hydrogen again may be mostly generated from the electolysis of water. Most of the electric power needs of the entire steel making chain would come from non-CO_2 producing environment friendly route. Hydro electricity, sun power, wind power and geo-thermal power would all be contributors. Power from the waves of sea shore would also be contributing.

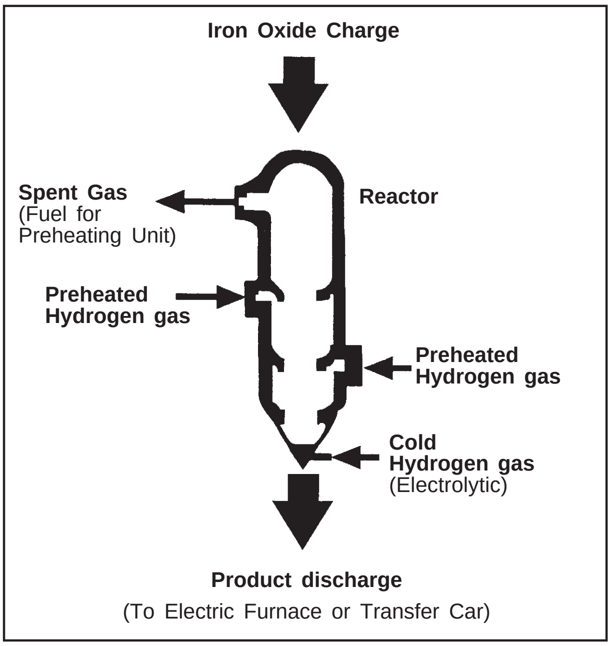

Fig. 3. Future steel making

CONCLUSIONS

The primitive sponge iron making in mud furnaces led directly to steel but intensification of the same has evoled into the present indirect routes predominated by blast furnace and basic oxygen furnace.

Steel is important to human society since it is the prime engineering material due to its high strength to weight ratio and toughness. Steel has been replaced from many past applications but has been found to be necessary in larger amounts in newer applications. Trends indicate that the dominant position of steel as the number one engineering material would be retained at least for next 100 years or so in spite of stiff competition. The method of making steel, however, may undergo major changes.

The trend in steel making is again moving towards more direct processes ending with electric furnace steel making. Future steel making should be supplemented by the input of hydrogen reduced sponge iron apart from recirculated scrap.

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SHORT COMMUNICATION

PEPTIDES THAT PUNCTURE THE BODIES OF BUGS

D. Balasubramanian*

Come summer and complaints of stomach-aches and gastrointestinal infections shoot up. In trying to beat the summer heat, many tend to quench their thirst with the first available mouthful of water. Little thought is given to the cleanliness of the cup or the purity of the water. And the result is stomach cramps at the mildest to severe diarrhoea and dehydration at the worst. The culprits are of course the germs–viruses, bacteria and protozoa– that abound in the unclean water.

Not that we do not fight these invading germs. Over a period of time, we do get used, to some extent, to these microbes and fight them effectively. The immune system of the body offers an excellent defence mechanism that gets rid of the infecting germs by a variety of means. A set of special cells engulf the bacterium, take it inside and pulverize it into bits. The grand names given to the cells that do this awesome task are macrophages and polymorphonuclear leucocytes. Other cells generate special protein molecules called antibodies, each one of which is tailored to grasp a specific invader in a lock and key fit and knock it out. Such a double barrel attack on the invading microoganism, using cell mediated and antibody mediated modes, effectively protects us from the ill effects of the infection.

The remarkable point about the immune system of the body is its memory. When we encounter the invading germ for the first time, we suffer badly. But such close encounters of the first kind prime our bodies in a grand fashion for future. When the same germ attacks us the second time, our immune system recognizes the invader in terms of its cell size, shape and outer surface features, recalls the first battle we had with it, and mounts the defence reaction. The specific antibody to this bacterium, which was produced during the first encounter is massproduced in abundance, as also the phagocytic cells. The defence reaction is more prepared, more elaborate and more successful and the 'memory' is long lived. We have now developed immunity to the invading germ. This, of course, is the basis of vaccines. Edward Jenner, two centuries ago, noted that dairymaids exposed to the cow pox had developed resistance or immunity to the disease. From there to actually inject a (killed or attenuated) virus or bacterium into the body so as to prime it to to develop the immune reaction has been a logical step. During the first encounter with the microbe, the body cells generate the gene for the specific antibody. When the microbe strikes again, this gene goes into action and produces the knock-out antibody in quantity. There are few better well-tuned systems in our body !

Immunology is not the only mode of tackling the infecting organism. Medication is another. Antibiotics, whose history does not go beyond two generations, are very effective. Penicillin, tetracyclines and sulfadrugs are some successful examples. The curious thing is that many of these chemicals are produced by bacteria, fungi, insects and similar forms of life, and are used by these organisms as defence chemicals in order to fight those that invade them. Unlike antibodies, these antibiotics are less specific and more general purpose in nature, hitting out at most invaders. It is this broad-spectrum feature that helps us when we

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take these drugs to fight microbial infections in our bodies. These are medium size molecules, of molecular mass in the range of 400–4 000, and come in a variety of sizes, shapes and chemical formulae. There is generally nothing common in their chemistry or even in their modes of action.

Designing an effective antibiotic is thus a diffcult task since there are no well-formulated guidelines, hints or principles to guide us in the synthesis. What one would like is to have the grammar or the syntax of the process understood. The diversity is too large to offer either a structural clue or a functional unifying principle. Besides, while these antibiotics are effective against many fungi, protozoa and bacteria, they are not generally as good in fighting viruses.

It is here that the peptide antimicrobials appear to present hope. First of all, peptides are simple in construction. The building blocks are twenty different amino acids that can be strung together, as in a necklace. If the chain gets long, it is no longer called a peptide but given the name protein. The twenty amino acids fall into two broad categories. Some of these contain electrical charges (ions) or polar groups which let them interact with water and aid the peptide to dissolve in water. These amino acids are thus hydrophilic or water-loving. The other class is the opposite or hydrophobic (water-repellant) and aid the peptide to attach itself to cell membranes and other similar oily surfaces. A peptide chain generally contains both types of amino acid residues, and will thus have a varying degree of ambivalence in its interaction with water or with membrane surfaces ; the term given is amphipathic.

Over the years, the way a peptide chain can shape itself into various molecular architectural motifs has been well studied. It is possible now by looking at the sequence of the amino acids strung up in a peptide chain, to make a good guess about what shape the molecule will take–the shape of a spiral staircase, a pleated sheet, a wet noodle, or whatever. Pioneering work in this area has been done by Professor G N Ramachandran and his students at Bangalore, and the graphical representation of the shapes that the peptide chain takes is termed the "Ramachandran Plot".

Thus, two leads are available with respect to peptide antimicrobials—their tendency to dissolve in water or to seek membrane surface, and the shapes they can adopt. Both these leads are important in helping us understand the possible mode of action of these molecules. Some clue into the mode of action of such peptide toxins comes, of all places, from the skin of the frog. The frog sweats out a small peptide molecule called magainin, which protects its skin from invading bacteria. Quite an appropriate name, given by its discoverer, Dr Michael Zasloff of the National Institutes of Health, USA, since the Hebrew word *magain* means shield. Made of up 23 amino acids strung together in a screw-like helical chain, magainin is a general purpose antibacterial or germicide, which also effectively fights invasion by fungi and protozoans like amoeba.

The mechanism of how it shields or protects the frog has now become clear from Zasloff's work. The magainin molecule seeks out and anchors itself on the surface of the invading microbe, quite like the molecules of soap that seek out and attach themselves to the oily grime on our clothing during washing. Often, such attachment does not happen just by one, but by several peptide molecules, which assemble thenselves on the membrane into a bracelet or a hollow cylindrical tube. Once this is done, the interior contents of the bacterium can simply spill out and kill the bacterium. Alternately, a lot of water can rush into the bacterium from the outside through this peptide channel or pore and burst the microbe outwards into smithereens. Either way, it is the osmotic imbalance across the cell membrane that causes its death.

The mechanism of the frog peptide self-assembling on the membrane of the bacterial cell and causing osmotic lysis appears to be general. Dr H Boman of the microbiology department of the University of Stockholm in Sweden finds that the cecropia moth secretes a 37-amino acid residue peptide (which he has named cecropin), which behaves similarly in protecting the moth from microbial attack. Certain types of fish secrete a very potent membrane-active peptide toxin called pardaxin, which acts by the same mechanism, as does melittin which is a 26-amino acid peptide of the bee venom. Even some of our own body cells generate a class of peptides called defensins, whose name is eloquent enough. The cobra venom contains, among other things, a peptide that hits at heat muscle membranes.

Peptide antimicrobials thus appear to be better candidates for laboratory synthesis and design. They are simple, they are general purpose, and they can be designed using well-known methods of peptide synthesis. Yet there are problems in this approach, which relate to the very generality of action of these peptide toxins. Ideally, one would want them to act on the invading microbes only and not on our body cells. It would be no good if they puncture the microbe cells and also our own stomach cells or blood cells ; we want to throw the bath-water out and keep the baby ! How then does one build in this antimicrobial selectivity?

Some insight into the basis of such selectivity comes from the work of Dr R Nagaraj and his colleagues at CCMBm Hyderabad. They were concerned with why the bee venom (melittin) is a non-discriminating toxin, attacking and breaking down both bacterial cells and human red blood cells ; while the death toxin from the bacterium *Staphylococcus aureus* (a rather common and nasty microbe that abounds in the hot Indian climate and infects a good many of us) is particularly deadly towards human blood cells but is hardly antibacterial. Both melittin and delta toxin are of the same size (26 amino acids long). They also have the same shape, adopting the amphipathic helical aggregate forms and the channel motif in membranes. They differ only in the number of electrical charges that they have. Melittin, with its five lysines in the sequence, has a surfeit of positive charges while delta toxin, with its near-equal number of acidic (asp) and basic (lys) amino acids residues, has but one positive charge. Dr Nagaraj suggests that it is this difference that can make a peptide selectively antimicrobial, or hemolytic, or both. Vishnu Dhople and Nagaraj have seen that the 16-amino acid long mid-region of delta toxin is not toxic to bacteria or to blood, but if they chemically change the asp residue to a lys, the resultant mutant fragment is rich in positive charge and becomes strongly antimicrobial, but does not affect red cells that efficiently. In other words, changing the electric charge on the molecule can kill a bug or cause anaemia ! It appears that this charge difference can dictate the efficiency and avidity with which the toxic peptide can bind to the (usually negatively charged) outer surface of most bacteria. The red blood cell offers a markedly different surface for the peptide to interact with.

This work suggests the possibility of designing peptide toxins that are specifically germicidal and antibacterial, by judiciously positioning acidic and basic amino acid residues in the chain. Peptide synthesis is now a fairly routine procedure, thanks to the solid-state method introduced by Bruce Merrifield who won a Nobel prize for it, and the more recent tea-bag method of Richard Houghton, both of which involve stringing amino acids one after another in the chain. Automated peptide synthesizing machines are available, literally molecular sewing machines for making peptides and proteins. The era has dawned for designer peptide toxins that are venom for the invading germ and safe for the person using it. Lastly, isn't it interesting that some of the ideas in the area have come from people with rather appropriate names, Nagaraj (the king of snakes), Vishnu (resting on Adisesha) Dhople, Sitaram (synonym for Vishnu) and Krishna (dancing on the snake Kaliya) Kumari?

KNOW THY INSTITUTIONS

DIRECTORATE OF OILSEEDS RESEARCH, HYDERABAD

The Directorate of Oilseeds Research (DOR) has the responsibility to plan, coordinate and execute the research programmes to augment the production and productivity of sunflower, safflower and castor.

The establishment of All-India Coordinated Research Project on Oilseeds (AICORPO) in April 1967 was based on the recommendations of a sub-committee appointed by the Government of India and is the most significant event in the history of oilseeds research in India. The project had its beginning with one Project Coordinator to coordinate and monitor the research programmes of groundnut, rapeseed-mustard, sesame, linseed and castor operating at 32 research centres. Later during 1972, safflower, sunflower and niger were brought under the umbrella of AICORPO and the number of research centres increased to 40. Realizing the need for one national institute for oilseeds, the AICORPO was elevated to the status of Directorate of Oilseeds Research on August 1, 1977 with a Project Director as its administrative head and seven Project Coordinators for these oilseed crops. Subsequently, groundnut and rapeseed-mustard were de-linked from the Directorate with the establishment of National Research Centre for each of these crops during 1979 and 1993, respectively. In April 2000, the AICRP on Sesame and Niger and Linseed were de-linked from DOR.

Location

DOR is located in the campus of Acharya N. G.

Ranga Agricultural University at Rajendrangar, in Hyderabad city on the south-west of Ranga Reddy district of Andhra Pradesh. It is about 15 km away from Hyderabad Railway station and Central Bus Stand and 22 km away from Hyderabad airport. The overall climate is semi-arid with annual average rainfall of 700 mm.

INFRASTRUCTURE

Execution of diverse activities is greatly facilitated at the main campus of DOR housing laboratories of all the disciplines including Biotechnology, Microbial and Biological Control. All laboratories are equipped with modern facilities and equipments with regular upgradation.

DOR's Library contains more than 10,000 books and periodicals, 80 Journals and 4 databases *viz*., AGRIS on CD, CABI Crop Science Database, AGRICOLA, Biological & Agriculture Index (Wilson). It has a Committee Room (20 seats) ; Conference Hall (100 seats) and 5 Glass houses. The Directorate of Oilseeds Research has three research farms : one farm (14.5 ha) located at the campus of DOR, Rajendranagar, Hyderabad ; one at Narkhoda Village (44 ha Alfisols), 7 km West of Shamshabad Mandal of Ranga Reddy district, and the other at ICRISAT campus, Patancheru (16.2 ha vertisols). All the farms have good internal service roads, drainage and efficient irrigation facilities. DOR's hostel provides comfortable lodging and boarding for 28 persons.

Activities

To fulfill the mission oriented objectives, the Directorate has the following spectrum of activities :

- Crop improvement programmes are oriented for augmenting and harnessing the potential of genetic resources and changing the genetic architecture of the existing varieties/hybrids and to create novel plant-types with increased seed and oil yield with better quality and in-built resistance to major diseases and insect-pests and breeder and hybrid seed production.
- Crop production activities are concerned with integrated management of natural resources for sustainable production, identification of remunerative and sustainable cropping sequences for increased input use efficiency and reduced cost of production, exploiting the physiological traits of the crops for higher productivity and stress tolerance and evaluation of oil content and quality.
- The programmes under crop protection endeavor to provide integrated and eco-friendly technologies for disease and insect pest management for sustainable oilseed production.
- The activities of the social sciences aim at economic appraisal of the improved technologies and developing suitable statistical data base management and transfer of improved technologies through frontline demonstrations and training programems.

MAJOR ACHIEVEMENTS

- The Directorate has the distinction of developing first castor hybrid (GCH-3) in the world and the first safflower hybrid in India (DSH-129).
- Fifteen open pollinated varieties and 19 hybrids in sunflower, 20 varieties and 5 hybrids in safflower, 18 varieties and 14 hybrids in castor have been developed and recommended for different regions.
- Developed new male sterile cytoplasm in sunflower from *Helianthus argophyllus* and tagged the fertility restorer gene using sunflower specific simple sequence repeat marker.
- Developed signature molecular marker for public sector bred varieties and hybrids of castor and sunflower.

- First successful attempt has been made for genetic transformation of castor through *Agrobacterium tumefaciens* mediated and direct gene transfer methods.
- Transgenic safflower plants have been developed by expressing the Orf H522 gene from sunflower and are being tested for induction of male sterility microbial insecticide from ICAR registered with Central Insecticides Board, GOI and already commercialized to 8 private entrepreneurs.
- Simple, reliable and rapid artificial screening techniques have been developed fro *Alternaria helianthi* in sunflower, *Alternaria alternata* and *Fusarium* wilt in safflower, *Botrytis* grey rot and wilt in castor.
- Native isolate of *Trichoderma viride* (B-16) highly effective in controlling wilt and nematordes of castor was identified and improved for fungicide tolerance. Talc-based formulation of this strain is found effective against soil borne diseases of pigeonpea, Orf H522 gene from sunflower and are being tested for induction of male sterility.
- About 1328, 7363 and 3292 germplasm accessions have been conserved and most of the accessions have been evaluated for agro-economic traits and resistance to diseases and insect pests in sunflower, safflower and castor respectively.
- A number of remunerative cropping sequences and intercropping systems involving sunflower, safflower and castor have been identified for different regions.
- The region-specific production technologies for maximization of yield in the mandate crops have been standardized and recommended.
- Developed a low cost mass production metholdology for the formulation of DOR Bt-1, a local isolate of *Bacillus thuringiensis* variety *Krustaki* (H-3a, 3b, 3c) which can be used to control lepidopteran insect pests of several crops. This is the first cotton and groundnut. This has also been registered with the Central Insecticides Board, GOI, India.
- More than 130 short and medium duration national training courses have been organized at this Directorate and more than 2,447 officials working throughout the country for research and development in these crops including the scientists from abroad have been trained on the improved technologies. Every year, a number of frontine demonstrations in the farmers' fields have been organized in order to exhibit the potential of the improved technologies. Besides, farmers' day and farmers' *ghosti* has also been organized.

FUTURE THRUST AREAS OF RESEARCH

- Development of sunflower hybrids and populations with increased seed and oil yield with in-built resistance to *Alternaria* and necrosis diseases.
- Diversification of CMS system
- Development of CMS based safflower hybrids
- Development of spiny and non-spiny safflower varieties with high seed and oil yield and resistance to wilt, *Alternaria* and aphids
- Development of wilt and botrytis resistant early and medium duration castor hybrids
- Diversification of parental base of castor hybrids
- Reduction of ricin and RCA through PTGs technology

- Integrated research management for higher nutrient use efficiency and reduced cost of cultivation for sunflower, safflower and castor based cropping system
- Development of bio-intensive integrated management packages for *Alternaria* and necrosis in sunflower ; wilt *Alternaria* and aphids in safflower and wilt *Botrytis* and capsule borer in castor.

SERVICES OFFERED

Consultancy

- Utilization of bio-technological tools for oilseed crops improvement
- Hybrid seed production
- Nutrient and irrigation management
- Integrated pest management
- Data base management systems on oilseeds

CONTRACT RESEARCH

- Analytical service for oil content and its quality
- Projects on nutrient, water, pest and disease management in sunflower, safflower and castor based cropping system
- Testing of genotypes, fertilizer, pesticides and growth regulators
- Formulation of microbial agents and bio-pesticides for crop protection and their evaluation
- Soil and plant analysis for nutrient status

TRAINING

- Hybrid seed production technology
- Hybrid purity assessment using molecular markers
- Production technology for yield maximization
- Integrated pest management
- Mass multiplication of microbial agents and their uses

PUBLICATIONS

- Oilseeds Situation : A Statistical Compendium
- Research Achievements in Sunflower (2006)
- Research Achievements in Safflower (2006)
- Research Achievements in Castor (2006)
- Bio control in Oilseed Crops
- Low cost production technology in oilseed crops
- Strategies for Enhancing Sunflower, Safflower and Castor Production in India
- Diversified Uses of Sunflower, Safflower and Castor
- IPM in Oilseed Crops
- Integrated Nutrient Management for Oilseed Crops.

Contact :
Directorate of Oilseed Research Rajendranagar, Hyderabad, Andhra Pradesh, Pin-500 030
Phone : 040-24015345

Conferences / Meetings / Symposia / Seminars

Third Biennial International Congress on Bioprocesses in Food Industries and Fifth Convention of Biotech Research Society, November 6-8, 2008, in Hyderabad

International Forum on Bioprocesses in Food Industries (ICBF) and the Osmania University, Hyderabad jointly organize the third biennial International congress on Bioprocesses in Food industries and fifth convention of Biotech Research Society. The topics covered would be broadly in the area of food biotechnology, industrial biotechnology, environmental biotechnology and medical biotechnology. Last date of submission of abstract is *20 August 2008*.

Contact : Prof. L. Venkateswar Rao, Convener, ICBF-2008, Dept. of Microbiology, Osmania University, Hyderabad-500007, Ph. No. 91-40-27090661, Fax : 91-40-27682246, e-mail icbfou@gmail.com URL : www.icbf2008.com

International Conference on Radiation Biology and Translational Research in Radiation Oncology in collaboration with Ninth Biennial Meeting of Indian Society of Radiation Biology, November 10-12, 2008 Jaipur, India

This scientific programme of the conference will encompass all the major disciplines of radiation sciences including physics, chemistry, biology, medicines and allied areas. The conference will focus on some special frontline areas on Translational research in Radiation Oncology including molecular cancer imaging, stem cells in cancer, DNA repair, systems biology, radio modifiers and combined modality of radiation and anticancer drugs. The Conference would encourage Radiation Biologists, Medical Physicists, Nuclear Medicine Physicians, Nuclear Medicine Physicians, Radiation and Medical Oncologists, Radiation Technologists, Bioengineers, Biophysicists, Biochemists, Radiation Safety Specialists and those are engaged in pursuit of improving health and quality of life to attend this conference, present their research work and share their professional experience. Last date for submission of abstract is *31 August 2008*.

Contact : Dr. P. K. Goyal, Convener ICRB 2008, Radiation and Cancer Biology Laboratory, Zoology Department, University of Rajasthan, Jaipur-302004, Ph. No. 0091 141-2651199, Fax 0091 141 2656273 E-mail :info@icrb2008.org, website www.icrb2008.org.

Seventh International Congress on Traditional Asian Medicine, September 7-11-2009, in Thimpu, Bhutan

The International Association for the study of Traditional Medicine (IASTAM) will hold its seventh International congress. The theme is 'Asian Medicine : Cultivating Traditions and the Challenges of Globalisation'. IASTAM invites papers on the cultivation of the body, of plants and traditional knowledge and practice, on the challenges faced by the globalisation of traditional Asian medicines, tensions between local and global production, interpretation, professionalisation and evaluation, as well as issues of trade, economy and ecology. IASTAM encourages papers from scholars from all science and humanities discipline as well as from practitioners of traditional Asian medicine (Unani, Acupuncture, Sowa Rigpa, Ayurveda). Proposals on any theme or topic are welcome, but papers that address the themes of cultivation and globalisation will be given preference. Last date of submission of abstract is *1st August 2008.*

Contact : IASTAM-International Association for the Study of Traditional Asian Medicine, Emma Griffin, Wellcome Trust Center for the History of Medicine at UCL, 210 Euston Road, London NWI 3BE, United Kingdom E-mail : iastam.org@hotmail.com

BOOK REVIEWS

MODELLING AND GEOCHEMICAL EXPLORATION OF MINERAL DEPOSITS (170 pages)—*Ashok K. Talapatra*, Capital Publishing Company, 2006 ISBN : 81-85589-43-7

This book attempts to address Modelling and Geochemical Exploration of Mineral deposits with emphasis on concealed deposits and is intended to be a guide to field geologists, students, and research scholars.

The text is divided in seven chapters-two dealing with "Modelling" and the rest discuss Geochemical Exploration. The first chapter briefly introduces basic concepts of modelling while the second discusses on-land and off shore mineral deposits citing Indian examples. The part on Offshore deposits, particularly the Indian beach placers is interesting. Chapters 3 and 4 deal with Geochemical exploration. There are excellent books on the subject but credit must go to the author for discussing Indian case histories. Among non-conventional geochemical techniques, use of mercury and SO_2 for locating concealed deposits has been discussed. However, usefulness of this technique in finding new deposits has not yet been demonstrated in India.

The discussion on usefulness of radiogenic and stable isotopes is by far the weakest part of the book. The notations for the isotopes are given in non-conventional way e.g. 238 U instead of ^{238}U and contain incomplete and incorrect statements. Standard analytical methods in Chapter 6 are also of cursory nature. Geochemical analysis by Spectrograph is now of historic interest. There are standard books on analytical methods that the interested reader can refer to. The Tables in the Appendix will provide ready reference. The type setting is very good, but Figures e.g. 2.5 to 2.10 and 3.2, 3.6, 3.7 a, b, are of very poor quality.

The references run into about eight ages. I could not find even a dozen references from the post-2000 period. There are serious errors (e.g. mismatch of authors' names in text and in References) in language that could have been avoided with some editorial attention. In pages 61 and 62, "Red-ox "spelling is irritating !

Postgraduate students will find the book useful although this will not be of much use to the professional economic geologists.

D K Paul

Department of Geology, Presidency College,
Kolkata 700073.

S & T ACROSS THE WORLD

MUSHROOMS AS PAIN RELIEVERS

Scientists at the Amala Cancer Centre in Thrissur, Tamil Nadu, have found significant anti-inflammatory and antitumour qualities in the extract of Morel mushrooms, which are the world's most expensive and delicious.

They experimented on mice suffering from cancer, using both the extracts and the standard reference drug Diclofenac. The results showed that the extracts could be put to therapeutic use in chemotherapy. According to the scientists, the mushrooms showed significant dose dependent inhibition of both acute and chronic inflammation. The anti-tumour activity of the extract was determined using cell line induced solid tumour and cell line ascites tumour models in the mice.

Inflammation, a fundamental protective response can be harmful in conditions such as life threatening hyper sensitive reactions to insect bite, drugs, and in chronic diseases such as rheumatic arthritis, lung fibrosis and cancer.

The mushroom, which is rare, is found only in Sikkim, Himachal Pradesh, Uttarakhand, and J & K. The scientists obtained the culture of the mushroom from the Institute of Microbiology, Chandigarh, and then grew the fungus on potato dectose broth.

(PTI Science Service, Feb 16-28, 2008)

WIRELESS STEREO HEADPHONES

Even wireless stereo Bluetooth headphones have wires-the ones that connect the left and right speakers. The MXW1 is however device totally without wires. The two piece MXW1 uses a new wireless technology called Kleer, which unlike Bluetooth, permits left and right speakers to link wirelessly. The headphones twist-to-fit design keeps them securely and comfortably in the ear.

The MXW1 includes a small Kleer transmitter about the size of a match box which plugs into the headphone jack of the music source. The transmitter allows the listener to link a second set of MXW1 headphones to share the tunes with another person.

(Electronics Blog. Mar 11, 2008)

ANTI-CANCER DRUG FROM THE SEA

Researchers in the USA have identified a potent new anti-cancer drug isolated from a toxic blue-green algae found in the South Pacific Ocean.

The somocystinamide A (ScA) compound was found in cyanobacterial *L. Majuscula,* also known as "mermaids" gathered off the coast of Fiji in the South Pacific. According to the researchers, the compound is not toxic to the cyanobacteria itself but activates a "death pathway" present on human cells. When the cells of the blood vessels that feed the tumours become activated and proliferate, they become sensitive to this agent.

Dwayne G. stupack, Associate Professor of Pathology at the Moores Cancer Center in San Diego, California, which is collaborating in this research, said that the entire research team was excited to have discovered this structurally unique and highly potent cancer fighting compound. He envisioned that it would be perfect for emerging technology, particularly nanotechnology, which was being developed to target cancerous tumours without side effects.

(Science Daily, Feb 20, 2008)

NEW LNG FUEL SYSTEM

A new high pressure direct injection liquified natural gas (LNG) fuel system has been developed which has received certification from the Australian government authorities and is likely to prove a boon in these days of skyrocketing oil prices.

The system has been developed by a Canada based company. Westport Innovations, which has an Australian subsidiary and has been adapted to the 2008 Cummins ISX heavy duty engine. Four trucks equipped with the system achieved over 1000,000 kilometres in commercial service during 2007.

The high pressure direct injection (HDPI) equipped engine provides power torque up to a maximum of 1650-1850 1b-ft and power of 500-580 hp. On road data from the field trucks have confirmed high natural gas substitution ratios with only 4% to 6% energy provided by the pilot diesel fuel.

(Westport Innovations Inc, Feb 8, 2008)

ANSWERS TO "DO YOU KNOW ?"

A1. 1 × 10 sec,

A2. Antartica is 5 times bigger than India.

A3. Yes on a convex surface like that of a ball.

A4. In ancient time all the continents of Earth were joined together in a giant continent called Pangaea which was then surrounded by a single ocean called Panthalass.

A5. There are 257 types of turtles.

A6. 23 hours 56 minutes 4 seconds taken by the earth completely on its axis.

A7. The terrible lizard.

A8. Tibet, the average height is 4,877 m higher than all the peaks in Alps except two peaks so Tibet is called the roof of the world.

भारतीय विज्ञान कांग्रेस संस्था

14, डॉ॰ विरेश गुह स्ट्रीट, कोलकाता 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

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Website : http://sciencecongress.nic.in
Fax : 91-33-2287-2551
E-mail : iscacal@vsnl.net
iscacal_2004@yahoo.com

Terms of Membership and Privileges of Members :

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

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

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

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

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

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

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

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

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

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

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

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

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E-mail : iscacal@vsnl.net
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APPLICATION FORM FOR MEMBERSHIP

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The General Secretary
The Indian Science Congress Association
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Kolkata-700 017

Stamp Size Photograph

Dear Sir,

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

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

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

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1. Agriculture and Forestry Sciences
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13. Physical Sciences
14. Plant Sciences

(Please type or fillup in Block Letters)

Name (in block letters) : ____________________ ____________________ ____________________

SURNAME FIRST NAME MIDDLE NAME

Academic Qualifications :
(Evidence to be submitted)

Designation :

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

Phone No. & e-mail

Permanent Address :

Yours faithfully

Date : Signature

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

GUIDELINES FOR SUBMISSION OF MANUSCRIPTS

1. Everymans's Science intends to Propagate the *latest message of science* in all its varied branches to its readers and through them, to every one interested in Science or Engineering or Technology. *Research articles* usually meant for publication in periodicals devoted to particular branches of Science & Technology and addressed to specialised sections of the readers, are not appropriate for Everyman's Science. Instead, popular or easily intelligible expositions of new or recent developments in different branches of Science & Technology are welcome.

2. Manuscripts should be typewritten on one side of the paper with double spacing. Articles should be written generally in non-technical language and should not ordinarily *exceed 2000 words.* Articles must be understandable by the average enthusiastic readers with some modest scientific background but outside the field. It should not be a review article in a specialised area. Without being too technical, it must also reflect state of the art situation in the field. *A summary* in 50 words should be submitted along with the paper highlighting the importance of the work. *Two copies* of the manuscript complete in all respects should be submitted. The title should be written in capital letters and name(s) of the author(s) should be given along with the Department, Institution, City and Country of each author.

3. Illustration & Tables : The size of illustrations should be such as to permit reduction to about one-third. Legends and captions should be typed on a separate sheet of paper. Photographs should be on glossy paper with strong contrast in black and white. Typed tables should be in separate pages and provided with titles and their serial numbers. The exact position for the placement of the tables should be marked in the script. Authors are specially requested to reduce the number of tables, illustrations and diagrams to a minimum (maximum of 3)

4. References : References to be given on a selective basis, (maximum of 10) and the order of placement should be numerically with (a) name(s) of the author(s) (surname last), (b) name of the journal in abbreviated form according to the 'World list of Scientific Periodicals' and in italics, (c) volume number (in bold) (d) page number and (e) year of publication.

For citations of books the author's name should be followed by the (a) title of the book, (b) year of publication or edition or both, (c) page number, (d) name of publishers, and (e) place of publication.

5. The Indian Science Congress Association and the Editors of Everyman's Science assume no responsibility for statements and opinions advanced by the contributors to the journal.

Reprints : The communicating author with receive 1 copy of the journal and 10 reprints free of cost.

All manuscripts and correspondences should be addressed to the *Hony, Editor, Everyman's Science, The Indian Science Congress Association 14, Dr. Biresh Guha Street, Kolkata-700 017.* Email : iscacal@vsnl.net. iscacal_2004@yahoo.com, Fax : 91-33-2287-2551

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