EVERYMAN'S SCIENCE

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COVER PHOTOGRAPHS

Past General Presidents of ISCA

1. Sir U. N. Brahmachari (1936)
2. R.B.T.S. Venkatraman (1937)
3. Prof. Rt. Hon. Lord Rutherford of Nelson *(1938)
4. Sir James H. Jeans (1938)
5. Prof. J. C. Ghosh (1939)
6. Prof. B. Sahani (1940)
7. Sir Ardeshir Dalal (1941)

* Lord Rutherford unfortunately passed away before the Science Congress and Sir James H. Jeans presided over the Congress in his place.

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EDITORIAL

THE SCHOOL SCIENCE EDUCATION IMPERATIVE

In the present context of rapid development of global technology base it is imperative that all students in schools should have a firm education in science, mathematics, and technology so that they can cope with the advent of modern technology embracing all spheres of daily life. Tomorrow's work force will be based on the preparation of today's students. However, the students coming out of the schools after completion of the required courses are hardly capable of qualifying for entry level jobs. The general trend in the social perception is that they need higher education either in the degree level courses or in some form of diploma or training programmes. Those students who do not attend any of these courses after their schooling are not considered to be capable of any work that requires expertise. This kind of social enigma percolates from government policy down to the lowest level of administration. Such students are usually left out in the society to trade on their own. The luckier ones can start a small business or manage to get an employment through some channels. Others get some kind of jobs under inhuman terms and conditions.

The school education programme in our country apparently has two major goals : (1) expansion of school education so as to enroll all or as many students as possible and (2) preparation of the students for higher education. In a developing country like ours both are very important. But success rate in both of these fields is not significant. Without improvement of general economic condition it is hard to achieve massive enrolment in schools. Even if we can enroll all students in schools the percentage of students leaving schools before completion of schooling is very high. On the other hand the scope of higher education in our country is still very limited. Only 8% of total population can enter higher education institutions. Hence preparation of students for advanced education in some branches will not help solve the problem if we cannot create more opportunities for higher education. While the national education policy should not neglect any of these problems, one aspect that is not considered seriously is how to utilize the large section of successful school leaving students who cannot afford higher education or are deprived of it for various reasons. The government policy seems to consider them as surplus and from time to time adopt or advise self-employment programmes. But this factor has never been given due importance in framing school education curriculum in any of the central or state boards.

It is necessary to make school science education the number one priority in the national education policy and the educational policy of the state governments. Education in Science does not end up with inclusion of some theorems of physics or mathematics, or some reactions in chemistry or some facts of environment or life science. Science attempts to explain Nature and natural phenomena and utilize the natural laws to improve the way of living. Science has developed by means of practical experiences and subsequent laboratory verification of scientific laws or theorems by actual experiments. All scientific principles and formulations are based on realities of life and quite often from day-to-day experiences. Thus, hands on science experiments are too important to convince the students about the practical necessities and achievements of science. It is very unfortunate that our school system has very little opportunity for laboratory work. There are some routine experiments for students of plus-2 level courses. These laboratories are run in a very casual manner. There is no concept of practical work for students from Class IV to Class X, although science is included in the curriculum and it includes a substantial portion of physical and life sciences. The students are compelled to memorize science for the purpose of examination. They are sometimes satisfied with examples illustrated or worked out in their text books. However, it does not need big investment, both financially and infrastructure-wise, to create opportunities for hands-on experiments in the schools. The materials necessary for demonstration or implementation in the laboratory can be collected from throw-away materials from the household or from private or government establishments. In many

schools the space for locating the facilities may be a problem, though it is not the case in all schools. Another problem may be the availability or willingness of dedicated teachers. But the dedication of teachers is a fundamental requirement of running any school programme successfully.

On the part of the governments it is necessary to take stapes so that practical training is compulsory for high schools right from the beginning of secondary education. This cannot be left to the non-government organizations only as they do not have enough strength to cover all the schools in the country. The school curriculum should contain hands-on experimental courses mostly based on throw-away household, municipal or industrial materials. Schools can take initiative to collect such materials that can be used for instructive training in science and at the same time they should be safe for use by the children. The entire process will not involve any financial expenses. But this would require space, time and endeavour on the part of teachers. The school routine should accommodate practical classes by some readjustment. The teachers may arrange workshops with science teachers in the neighbourhood in order to develop the methods. There should be some guidelines from the affiliating Boards. The primary objective of such training would be to create an opportunity so that the scientific principles that are taught in the class can be explained or demonstrated by real experiments as far as practicable. This can form a base for science training. Such programmes will provide direct experience with the methods and processes of scientific inquiry.

To seek higher levels of performance from all students at the plus two levels, the government should encourage teachers, curriculum-developers, school administrators, and government officials to develop national standards in science including mathematics. There is an urgent need to attract a new generation of energetic and skillful new teachers into the nation's public education system. The government has to create opportunity to invigorate the nation's teaching community with people who have both mastery and a deep passion for science, technology, and mathematics.

For too long, we have thought of our research system in isolation. The research institutions have been created as centres of excellence. They have, no doubt, contributed in a big way in the development of science and technology at the national and international level and played a key role in enhancing our national glory. But the national achievement is still inadequate compared to the international standard and we have a long way to go. Present global scenario makes it imperative that we view the national progress in relation to worldwide events. Academic institutions should continue to play an important role in development of science and technology because of their autonomy, flexibility and inherent quality control, but they should establish direct link between research and education and training in science. The national institutes and universities should have a direct linkage to schools and provide important inputs for science teaching at the schools. This is of immense importance considering the fact that outputs from our schools, both urban and rural, will finally be inputs for these institutions. In the developed countries like USA, research scientists, including some Nobel Laureates, from the most reputed universities, often visit schools and deliver lectures for the school students. On the other hand, there are opportunities for the local school students to visit the science laboratories of neighbouring universities. We hardly hear about such visits in our country. The school students should have an opportunity so that the world of science is unfolded to them. This can attract brighter students to science and present to them a wider view about the prospects and utilities of science.

In the present circumstances science remains a tell-tale story for the students at the moment they have the option to choose subjects. In most cases they have to rely on the advice of their parents or guardians. It becomes difficult to attract the brightest students to science.

Prof. P. N. Ghosh

"Effectiveness is neither an ability nor Talent. It is a habit, a pratice, a self-discipline that must be learnt".
—Peter Drucker

PRESIDENTIAL ADDRESS

THE INDIAN VILLAGE—ITS PAST, PRESENT AND FUTURE

*R. B. T. S. VENKATRAMAN

INTRODUCTION

I take it no apology is needed in these days for talking about any aspect of "village and village life". The city and the town which were holding a complete thraldom over the Public mind all these years are losing their glamour somewhat in spite of their admittedly alluring attractions ; and the "village" would appear to be getting increasing recognition, particularly in our country and in recent times.

I propose to speak to you tonight under the caption "The Indian Village—its past, present and future". You might perhaps question my claim to speak on this subject as all my official life and thought for the last quarter of a century has been linked up almost entirely with sugar-cane. But this very work has often taken me to the countryside in various parts of India and my contact with the Indian village has been fairly intimate. While at my special work I had perforce to witness the pleasures and tragedies of the villager and watch the changes that are steadily coming over the village. Secondly, most of us—in this agricultural land of ours-have come from villages and are in fair contact with village life either directly or through our kith and kin.

One easily noticed change in the village is the migration of the villagers to the town. The richer of the villagers show a tendency to shift themselves to the nearest town or city for the education of their children, for better medical help or for the characteristic amenities associated with urban life. Secondly, the more intellectual of the younger generation, who first migrate to the towns for their studies or to seek employment, do not generally return to the village, but settle in some town which they find more congenial for the full scope of their talents. If they do pay a visit to the village it is either to see an old relative who is too conservative to move to the town or in connection with some matter which renders their presence in the village unavoidable. Such visits are made of as short duration as possible and they get back to the town with almost a sense of relief.

POSITION OF INDIA WITH REFERENCE TO SPACE AND TIME

But before getting into the subject proper it is necessary to record here a few general observations on the position of our country with regard to both space and time view-points. With China, Japan and the South-Eastern islands, India is situated in a comparatively densely populated area of the globe—about half the population of the world being crowded into a tenth of the Earth's land region. This has had its effect on the type of agriculture practiced in the country, the selection of crop for cultivation and the life of the people as a whole.

Secondly, along again with China, India possesses a civilisation and culture which was at least contemporaneous with, if not antecedent to, the civilisations of Egypt, Mesopotamia, Greece,

* General President, Twenty-fourth Indian Science Congress, held from 30th January to 5th February, 1937 at Hyderabad.

and Rome. After making considerable progress this civilisation has, however, remained in a more or less quiescent and petrified state in our villages for well nigh two to three thousand years, little influenced by the great progress made by the west during the later part of the same period. It is only within comparatively recent times that the Western civilisation has come to spread into and influence the countryside. In more senses than one the Indian town represents the dynamic West with all the vigour of youth and the village the comparatively quiescent East. Certain of the problems of the village to be discussed hereafter will be found traceable to the inevitable contact between the two.

ARYAN COLONISATION OF INDIA AND TYPES OF VILLAGES

In early times there were two chief passages into India—one on the North-East through Assam and Bengal and the second on the North-West into the Indus region. The Aryans, who entered the country through the North-West route, first occupied the Indus valley and the Punjab plains and later spread to the East of the Jumna as far as the Saraswathi. Subsequently they spread into Bengal and from there would appear to have sent out expedition by sea to Burma, Ceylon and Java. The Vindhya ranges and the Aravalli hills long acted as an effective barrier against large movements southwards into the Deccan and south India. The country to the South of these ranges remained for long Dravidian, though increasingly influenced by Aryan culture from the North.

The Ryotwari Village

The new Aryan colonist naturally found plenty of land to settle in and the obvious advantages of group formation brought into being two main types of villages. One was the type similar to what is now termed "ryotwari" where each family or group of persons took up as much land as they could cultivate depending on the number of cattle and able-bodied men in the unit. Site for the village was chosen at some convenient spot such as the banks of a river or canal or proximity to other sources of water supply. The persons constituting the village chose a Headman who exercised all power on behalf of the whole community. This types of village was generally associated with peaceful conditions.

Joint Village

The other type called "Joint Village" by Baden Powell was founded by powerful families or clans not necessarily agriculturists. The government of such villages was by the well-known Panchayat system and occasionally a group of such villages belonged to the same clan or owed some kind of allegiance to the same warrior chieftain in return for the protection they enjoyed at his hands. In these villages the cultivating classes were sometimes in the position of tenants. "Ryotwari" villages sometimes got converted into "Joint Villages" through conquest by some warrior chieftain.

THE INDIAN VILLAGE IN THE PAST

Various books such as the *Arthasasthra* of Chanakya (before 300 B. C.), the *Sukranithi* and the *Smrithies* of Manu as well as inscriptions unearthed in recent times, give us a fairly clear picture of the organisation and govenment of the village and its institution in ancient times. The Agamas and the architectural books of South India contain references to the plan and lay-out of the village ; the temple which formed an essential unit in the lay-out influencing and being influenced by the village plan. The villages of South India would appear to have attained a high degree of perfection absolutely unaffected by Aryan influence from the North, so much so that certain authorities hold that some of the Aryan village institutions were copies of the Dravidian. The basic plans as revealed in these villages existing to this day deserve the careful attention of person engaged in town planning and rural reconstruction. The *Manasara* (25 A. D.)

describes in great detail the lay-out plans of villages, towns and forts as well as the ground plan and elevation of houses, palaces, and building for common use like public halls and the theatre.

The Headman

The Headman was an important officer in village government. His office was hereditary and apparently a vestige of the ancient village chief. He was remunerated by grant of inalienable right to certain lands and later by being allowed to collect and utilise certain taxes from the villagers. He was entitled to collect annually, for instance, two shoes from every shoe-maker, two cloths from the weaver, 13 betel leaves (per day) from the betel leaf vender and a cash moiety from the shop keeper. He was Gramani or King of the village.

The Village Panchayat

The Headman was assisted and later on effectively controlled by the village Panchayat. This was a *Council of Elders, not elected*, and more or less self-constituted from the elders of the village who naturally and easily commanded the respect of the villagers. Justice was dispended in the village temple and an oath before the local deity was potent in preventing person from bearing false witness. The Panchayatdars also knew the parties almost personally and were thus able to dispense quicker justice. The Panchayat administered the village funds and thus commanded facilities for catering to village needs. Even after the British came into possession, 22 per cent of the collection was given back to the villages over portions of the Mahrashtra country.

Autonomous Unit

The village was practically autonomous and once the tax from the village as a whole was paid it had little to do with the Central Government and was not affected by change of dynasties. Later on, however, when during the troublous times following the downfall of the Moghul Empire, wars were carried into the villages as well, they naturally had a share of these troubles. In later times larger political units came into existence having overlordship over groups of villages, though even then each individual village exercised a great deal of self-government in matters pertaining to the village. It is interesting to learn that during Chandragupta's times (320 B. C.) there was a permanent organisation for taking census.

Taxes for Common Needs

The village government was carried on in a brotherly informal way, the opinions of the elders carrying much farther than now. Taxes were levied for communal purpose as distinct from those by the Emperor ; and there was a common village fund which entertained the village guests, provided for the indigent and arranged for recreations, shows and performances of acrobatic and jugglery feats. The temple, the village tank, the guest house, as well as other public utility concerns had a claim on this common fund. The central government helped in cases where works of common utility were beyond the capacities of the village. This help was given either by the waiving of certain imperial taxes or by contributions in kind. The tax was sometimes levied in the form of manual labour and this is responsible for the huge and elaborate temples found in the south of India, some of them containing priceless treasures of sculptural and other arts. Occasionally also loans were raised by mortgaging the revenues of the village for definite periods.

Village Life

There was not much sanitation in the modern sense of the word and no scavenging. The *Arthasasthra* lay down a space five cubits wide

behind each house apparently as a sanitary lane. Regular sweeping of the village streets was not common and the watchman who was responsible for sanitation thought his duty done when he pulled any carcases out of the streets. Diseases were naturally low on account of the healthier open life and there was no organised medical relief, though there is a record of such measures during Asoka's time. The kitchen store contained most requisites for common ailments and the elders generally knew a few simple remedies from experience. The science of healing was, however, well-advanced for the then conditions and comparatively cheap being based on easily available herbs and both metallic and organic compounds. Certain of its achievement have won occasional admiration from the highly advanced savants of the modern age.

Lay-out of the Village

The streets were broad. The *Arthasasthra* prescribes a width of 40 cubits for the main streets which were shaped like the "back of the tortoise" to facilitate drainage. Each caste which pursued its own profession lived in separate parts of the village and it was surrounded by a common and free grazing ground. The land during the Hindu period did not belong to the King but to the people who occupied it ; hence perhaps, the traditional and great attachment to landed property which still exists.

The Professions

Each village had a class of artisans who were hereditary and being non-cultivating were given definite shares of grain at harvest. In return for this the farmer was entitled to the services of the artisans both for his household and agricultural needs. Whereas professions like that of the carpenter, the smith, the washerman, and the barber were definitely recognised and provided for in the village organisation, the village Teacher was not in this category as literacy was not considered a communal need. Most villages had, however, a school Teacher who was maintained by voluntary presents from the parents of the children attending his school. During marriages and other important occasions, the householder thought it a privilege and honour to feast the Teacher and his whole band of students.

THE GREAT CHANGE IN THE VILLAGE

Self-contained and Isolated in Olden Times

To realise fully the present conditions of the Indian village and understand its problems it is necessary to briefly notice here the changes that are coming over it and the reasons for that change. The Indian village of ancient times was practically a self-contained, self-governing unit, having but little contact with the outside world. It grew all the crops required to meet all its simple needs and the surplus of good years was stored in the village granaries as a provision against future unfavourable seasons. The people of the village lived like the members of a big family under the accepted leadership of the village elders—the Panchyatdars. Land was plenty, needs few and there was a great deal of contentment. The villager's outlook and knowledge were limited rarely extending beyond the confines of his own village and the villager's life ran an even course from day-to-day. This had been the condition for well nigh two to three thousand years.

Drawn into World Current

During this same period the West, on the other hand, was rapidly evolving itself from a condition even more primitive than that of the Indian village to that of modern times. Various inventions and discoveries had enabled man to gain partial mastery over his environment and both time and space had been largely conquered with the result that it is no longer possible nor desirable for any one to be oblivious of outside world events. The world is getting smaller and drawing closer together and an event in one part of the globe soon produces its repercussions all the world over.

Dawn of the Spirit of Competition

The increase of population has intensified attempts to augment the available sources of food by opening up new lands where possible and the struggle for existence has brought to the forefront the idea of the "survival of the fittest". The spirit of rivalry and competition has sharpened the intellect in certain directions and rights of the individual as such are getting increasing recognition. The religious impulse has steadily got into the background and has to await the convenience of the other more urgent activities of life. Life has become more complicated in all directions. The code of conduct, which formerly was regulated by the simple ten commandments, has now to be regulated by a whole army of learned lawyers and the ever-growing volumes of law books.

Commercialisation on Crops

One very important result of the contact with the West has been the development of the export and import trades which have affected profoundly the kind of crops grown and both the occupation and mode of life of the villager. It is steadily dragging him out of his isolation and throwing him into the world currents of commerce and industry. He is not content to grow crops to meet the needs of his own village but finds it more "profitable" to grow what are termed "commercial" crops for outside markets as distant as New York or London. This has upset the old time food-centred economics of the village and rendering them increasingly money-centred. The more enterprising and intelligent of the villagers are attracted by the commercial life and tend to shift themselves to the nearest town or city temporarily in the beginning but often permanently in the end. It is no wonder that such great changes have brought in their train a variety of problems connected with our villages.

THE PRESENT-DAY VILLAGE

Village Agriculture

Dependent on Monsoons

As agriculture is the sole occupation of the villager its present condition and its effect on the economics and life of the villager are well worth consideration. One outstanding feature connected with Indian agriculture is its great dependence on the Monsoons. In spite of the great irrigation works—some of them the largest in the world—and the steady advance in the matter of tapping underground water, it has been estimated that seven-eighths of our agriculture are yet dependent on the monsoons. Any one who has had to do with crop growing will realise how erratic the monsoons are both in time and quantity of precipitation. The unevenness and uncertainty of results in spite of his best efforts in the matter of cultivation and selection of seed, caused by factors beyond his control—such as drought, floods, and cyclones-render agricultural income unsteady and uncertain.

No Touch with Markets

Secondly, the villager is so little in touch with world markets wherein the results of his labours are evaluated and sold, that a large portion of his profits is intercepted by the intermediate agencies that market his produce. This is why the increase in the export trade has had comparatively little effect on the prosperity of the village as such. It is the towns that have chiefly gained from it. For the same reason there is but little adjustment of the crop areas to the prevailing market demands. A crop is often grown beacuse it has been customary to grow it and not always because there is a demand for it. This results in occasional over-production quickly reflected in a fall in prices ; and there is time lag before its effect is seen in the contraction of area under the crop. This is an uneconomic and backward method of adjustment.

Stress of Population

Thirdly, land available for crop growing has not increased to the same extent as increase in population. True some new lands have been brought under the plough and yields from existing lands have increased somewhat, but such increase is much less than the increase in population. The prevailing sentiments, both social and religious, that directly encourage large numbers of children were definitely needed in the olden days of plenty of land and low population. These are obvious misfits at the present time when conditions are just the reverse. Industrialisation is known to check rate of increase in population. Rice—the main food crop of India and China—is admittedly the most suitable for densely populated areas like the South East of Asia. It gives the maximum return of food with comparatively little manure and poor types of implement and cattle. The increase in population has proved beyond the capacity of even such a crop. This has introduced a spirit of competition instead of the mutual dependence and good feeling in the olden days of plenty. It has been computed that ordinarily agriculture alone cannot support more than 200 to the square mile. In parts of Bengal the stress of population is near about thrice that figure and all dependent solely on agriculture.

Fourthly, possibility of large augmentation in acre production is severely handicapped by a variety of causes such as subdivision and fragmentation of holdings and the prevalence of rigid social customs and religious sentiments which cause the waste of such valuable manures as night soil and cattle dung and adversely affect the business aspect of agricultural production. Both subdivision and fragmentation are interrelated to each other and result from the same cause, viz., the mode of inheritance of landed properties as obtaining in both the Islamic and Hindu laws.

Subdivision of Holdings

When land was fairly abundant and agriculture practically the only means of livelihood, it would appear but obvious justice on the death of the *pater* to divide the land equally among all the surviving members. At the same time there is a limit in size below which it becomes uneconomical to subdivide agricultural land. This bottom limit would obviously differ according to nature of soil, kind of crop grown, availability of assured water supply and other factors ; but one possible correlating factor would be the area that could be commanded by a pair of oxen.

This continuous subdivision has been a long-standing feature and in certain parts has reached a considerable degree of fineness. It has gone so far as to divide the waters of a well, each sharer being entitled to so many hours of lifting water from it. Dwelling houses are also sometimes divided along their lengths with obvious disadvantage to both the units in the matter of ventilation and other facilities. Such subdivision is said to obtain in other countries as well ; in France the holding is sometimes reduced to a single vine or a single tuft of lucerne grass and this condition is said to prevail also in Switzerland, Japan and Germany. But the big and material difference lies in the fact that, whereas in those countries the divided holding is only part of the owner's means of livelihood, in India it is often the sole source for employing him all round the year. Small sized holdings up to a certain limit are not by themselves wholly bad ; in Denmark and Switzerland some of the best types of agriculture are said to be associated with such holdings, but the other circumstances peculiar to our country render them uneconomical in our land.

At present this evil is to some extent counteracted by certain of the sharers emigrating to the nearest towns or to countries overseas. The Indian is, however, so much attached to his land, be it small and unremunerative, that he continues to own it if not forced out by other circumstances.

Its possession is not always as a business proposition but as necessary for status. This leads to the evil of absentee landlordism. In one of the villages in the Bombay Presidency, Dr. Mann found that 36 per cent of the owners had thus gone out of the village.

Fragmentation of Holdings

But perhaps a greater evil than subdivision is what is known as fragmentation. When one wishes to invest on landed properties he does so often by purchasing bits from different individuals and hence located away from one another. When this property is divided after his life time each sharer gets generally a portion from each of the bits of land and thus the holding of each sharer becomes fragmented. This system is practised in the interests of absolute equality in the sharing. Lands, as is well-known, differ some-what from one another and it is considered most equitable that each sharer should have a portion of each bit of land, however distant they may be from one another.

The prevailing sizes of such subdivided and fragmented plots of land depend upon the soil, kind of crop grown and nature of irrigation supply. They are smaller on the banks of rivers such as the Ganges, the Godavery and the Cauvery with their assured water supply and larger in the open rain-fed plains of the Central Provinces and the Punjab. Small holdings are also characteristic of well-irrigated areas, where the lifting is through bullock power. Rice holdings again are smaller than those growing wheat as, in the former case, fields have to be divided into small plots and bunded up to retain the needed water for this semi-aquatic plant.

This state of affairs rules out large scale operations by outside capitalists who have the resources for up-to-date agricultural methods generally beyond the reach of the average cultivator. The number of landlords they have to deal with is too large and one recalcitrant can hold up a whole scheme. The value of large-scale operations in raising agricultural efficiency has been amply demonstrated in other tropical countries like Hawaii, Java and Formosa. Certain of the sugar concerns in the Bombay Presidency which are launching on large-scale growing of sugar-cane are faced with such difficulties. Another disadvantage is that it precludes the fencing of the property, a valuable aid in raising agricultural efficiency. It is claimed that fencing of lands was one of the chief factors in greatly improving agricultural production in England after the Elizabethan period. The constant and unavoidable disputes resulting from these long and irregular boundaries lead to bad feeling between the villagers ; and, it is said, that incendiarism of fodder stacks in the Bombay Presidency is often traceable to such misunderstandings.

VILLAGE CATTLE

The Aryan settlers loved their cattle and valued them highly. A grazing waste round each has been the standard feature of the Indian village ; its width was fixed at 400 cubits during Chanakya's times and in the Moghul days it was as much as the human voice could be heard across. In Vedic times the wealth of an individual was computed by the number of kine and is so in parts of our country even to this day. Unlike China and Japan where the consumption of milk as food is considered a disgusting habit, this article has been highly valued in our land extensively used as food from ancient days. This is fortunate for a country like ours which otherwise is largely vegetarian. Milk was not banned even in the case of the semi-recluse who was denied most other articles of diet. In the Brahmanical period the daily prayer included an invocation for the health and prosperity of the cow.

The cattle represents sometimes the heaviest capital outlay of the cultivator next only to land and he loves them almost to a fault. It is common in the Punjab to lay by, each day, a handful of "atta" (wheat flour) so as to sumptuously feed the

cattle on occasions ; and it is considered an act of charity to lay along the roadside big pieces of rock salt so that the cattle can lick them on their way. A day in the year is set apart as cattle festival when they are decorated and feasted on sweet rice and cakes. In certain parts of the country like the Vizag and Bellary Districts of the Madras Presidency the cattle often occupy the front portions of houses.

But this very attachment and religious regard to the cattle—particularly the cow—is now working to their disadvantage. India is unique in possessing and enormous amount of cattle without making profit from its slaughter. The old and the weak are allowed to deplete the fodder stock of the village with the result that the fitter and hence the more useful ones do not get their due share. Cattle maintenance is not looked upon as a business proposition and the sentiment towards them is similar to that of a rider to the old horse which had served him well when he was fit and strong, or of the lady aristocrat to her pet dog or cat in the West. The sentiment is too deep-seated for a rapid change.

The motor, the oil-engine, and electricity are steadily replacing cattle power (largely of the male sex) for transport and water lifting. On the other hand, the demand for milk and milk products is likely to increase in the future and it is desirable it should be so. Fewer but better type of cattle and tended with greater knowledge of their need, are indicated in the future. Castration in as painless a manner as possible to work out the uneconomic types from the village stock is the crying need of the countryside. The world is getting accustomed to such ides even in the human species. With increasing knowledge of factors determining the sex of the fertilized egg will Science be able to increase the number of herifers as perhaps in the future we might need more cows and less bullocks.

VILLAGE LABOUR

For agricultural labour the Aryan colonists would appear to have employed largely the local people—the Dravidians and aborigines. Even in those early days agriculture was considered somewhat degrading as being non-intellectual. It has to be remembered that those were times when land was plenty—often perhaps virgin soils—and hence parted with its treasures more easily and abundantly than now. The agricultural labourer was employed more or less on a feudal basis and though the work was hard there was considerable affection between master and servant. The "padial" system in parts of South India and the "hali" system in parts of Bombay arose from labourers originally borrowing money against free service stipulated during the pendency of the loan but afterwards not being able to repay. He thus became a perpetual servant till released by death or emigration. The Indian labour is low both in wages and efficiency, certain extremist opinion equating a week's labour of the Indian to a day's of the Westerner.

But the demands of agriculture are such that, whereas at certain periods a large force of labour is needed, there is no demand during other parts of the year. This is particularly the case where the bulk of the area in the village is under the same crop. In the absence of work and hence wages all the year round, the labour migrates to other places with the result that, at the time of peak demand (as during paddy trans-plantation) there is labour scarcity. Crops like the sugar-cane which need labour all the year round, greater diversity of crops or subsidiary occupations are needed for stabilising the labour demand.

THE VILLAGER (AND HIS INDEBTEDNESS)

Having briefly considered certain important aspects of village life, we are now in a position to consider the present condition of the villager himself. Though till recently but little affected by the changes around him, on account of his isolation both mental and physical, he is being made increasingly aware of the changes around by the

extension into the village of such symbols of modern life as the Post and Telegraph, the bicycle, and the motor bus. Frequently also the village is visited by the townsman who is only too eager to demonstrate before the awe-struck villager the elegances and conveniences of urban life. Himself a vestige of the past, he looks with wonder and admiration—and sometimes with fear—at these innovations which, on account of his little or no eduction, he is unable to comprehend fully.

Economically he finds himself in a very disadvantageous position owing to his steadily diminishing agricultural income in contrast with increasing expenditure due to changes in living even in his own household. Innovations in dress and habits and new wants like tea and coffee are steadily forcing up family expenses. While the community life of inter-dependence has ceased to exist, the medieval social structure like the joint family system still persists rendering the villager's life unbalanced.

Indebtedness

Dependent as he is solely on agriculture, the need for money always exists. This is true of the agriculturist all the world over and results from the fact that, whereas agricultural income comes in only at particular times like harvest, his expenditure is of a monthly if not of a daily nature. Extra profits from an exceptionally good year are more often wasted in urbanising his surroundings than being put by as reserve against lean years. The heavy indebtedness of the Indian villager is well-known and has attracted the attention of all that have cared to study the village. In one village studied by him and his colleagues Dr. Mann found that the total debts of the village amounted to about 12 per cent of its capital value and that nearly 25 per cent of the profits of the village went to pay interest thereon. According to Mr. Darling, debts in certain Punjab villages amounted to as much as Rs. 40 per acre, a sum sometimes greater than the annual income from it on the average of good and bad years.

The villagers' debts are also often unavoidable. It has been calculated that nearly 90 per cent of a villager's expenditure is on such essentials as food, clothing, rent, and taxes, thus leaving but little margin for unexpected reverses such as crop failures or floods or sudden cattle mortality. Expenses on marriages and funerals, which to the villager are equally unavoidable because of his traditional ideas, are other sudden items of expenditure. The margin of extra income is so narrow that the loss of a buffalo or the long illness of the working member in the family is known to drop the villager down in the social scale sometimes never to recover to his original position. The only security he can offer against such debts is the land, his only possession in the world, and once pledged he finds it difficult to redeem it.

Village Wastes

While on the subject of the economies of the villager it will be appropriate to consider here the various types of waste that are taking place in the village. Foremost, perhaps, is the agricultural waste resulting from the uneconomic subdivision and fragmentation of land which precludes its cultivation to maximum benefit. Then come the waste of cattle and human labour due to fragmentation, the drain of village money by way of interest on loans raised by the villagers and loss of valuable manures like human and cattle voids. Cattle manure is wasted as it is needed for fuel. It is such a suitable fuel in the Indian household that a substitute alone will be operative in bringing about its repid discontinuance as fuel. Human voids instead of being utilized as in China and Japan, are allowed to render the streets and surroundings unsanitary and poison the clean country air. There is considerable waste of both energy and material resources through adherence to sentiments and habits which, perhaps useful in olden times, are

useless and wasteful under the changed conditions of today.

One important waste which has to my mind far-reaching results is that caused through forced idleness. This is because agriculture, which is often the sole occupation, is not able to keep the villager busy all the year round. This forced idleness is very harmful, changes his whole outlook on life and lowers his character in many ways. No tonic is so good as healthy and steady work all through the year and this is denied to the average villager. The comparative prosperity of villages located near towns or industrial centres proves the advantages of employment all through the year.

Standard of Life

One common complaint laid at the door of the Indian by others and of the villager by the townsmen is what is termed "low standard of life". There exists, however, considerable confusion as to what the term really means and though it is but vaguely understood, it is nevertheless readily restored to, when there is no room for sound and logical reasoning. To put it briefly and in easy language, a higher standard of life may be defined to consist in getting more out of life's opportunities to the advantage of both the individual and his society. A rise in the standard of living must add to the productive efficiency of the individual or it is no *higher* though it may be of *different* standard. All real progress and civilisation is interpretable only on this basis. But when a townsman, weak in physique through wrong and unsanitary living, with a diversity of unnecessary and unhealthy wants and unnecessarily and perhaps also harmfully dressed, talks of his higher standard it is an obvious misapplication of the term. It is a case of a more *expensive* and not *higher* standard of life. A healthy cultured villager with his fewer and simpler needs but greater depth of character is easily the superior.

The merchant, with his desire for commerce, has a tendency to synonymise "higher standard" with "increased wants and greater purchasing power". While an increase in wants as the result of fuller life—such as books, works of art of facilities for quicker locomotion—does represent a higher standard, it ceases to be such when the increased wants are unnecessary, wasteful or harmful to the individual or society.

THE EXODUS FROM THE VILLAGE

The most serious of the unfavourable changes coming over our villages is the steadily increasing exodus of people from the village to the town. There is little doubt that the villages were comparatively more populous in the olden days. The *Arthasasthra* contemplates a normal population of 500 to 1,500 against the present average of about 400. One main reason for this exodus is the growing inadequacy of agricultural income not supplemented by income from other sources. A second reason is the shifting of the main activities of life to the town. Educational facilities and other urban conveniences are increasingly attracting the villagers to the town. Dr. Mann was struck by the significant absence from a Bombay village of youths between the ages of 14 and 20 ; and this is largely true of other provinces as well. They had gone out for education or to seek employent. When a person has lived in the town for some time he often develops a dislike for village life with its limited comforts. He misses in the village various things to which he has become accustomed in the urban surroundings ; he misses the rapid means of locomotion, the quicker life of the town, the facilities for shopping, the pictures and the like. He finds a comparative dullness in the village surroundings which makes him loath to return to it.

Apart from the number, the quality of human material contained in the exodus constitutes a serious drain. Take, for instance, a family of four

sons all of whom had gone to the nearest town for education. The successful ones get employed away from their villages in due course and rarely return to it except if at all in old age. The unsuccessful ones, on the other hand, with nothing else to do perforce return to the village and settle there, thus increasing the pressure on the land often disproportionately to their contribution to the village assets. Secondly, the richer landlords who, by their superior resources, could, if they cared, undertake experiments or launch fresh agircultural ventures, are attracted to the town and leave behind in the village their less resourceful brethern. Similarly, the capable artisan leaves for the town to make the most of his talents. Culture is now town-centred and there is little scope in the village for the full development or unfolding of one's talents. In the olden days when the village was practically autonomous and had its own funds to cater to the needs and amenities of the village the opportunities in the village were greater ; and it was possible to retain in the village at least a portion of the intelligentsia, though even then the best of talents resorted to the capitals or courts of Kings for patronage.

RURAL LIFE AND AGRICULTURE IN CHINA

The one country in the world whose conditions of rural life and agriculture are similar to our own is China. That country presents many points of similarity with ours and a few contrasts.

The Chinese also have a civilisation as old as ours and in ancient days there was a certain amount of contact between the two nations. The national religion of China had its origin in our land and the Chinese sent out an industrial commission to Bihar as early as the sixth century to learn the process of sugar manufacture. The two Chinese travellers to our country, viz., Fa hien (399–414 A.D.) and Hiuentsang (629–645 A.D.) and their writings are well-known. Like its Indian prototype the Chinese village also has been isolated from world changes and the bulk of the people in that country also live in villages and hamlets. They lead a comparatively simple life and their holdings are small. Density of population in China is greater than ours, their agricultural implements primitive and most systems of land tenure existing in our country are to be found in China as well.

But the Chinese are specialists in small-scale farming and are adepts in taking the maximum from their lands. They have made the conservation of human voids for manurial purposes almost a fine art, and their agricultural operations are so intensive that they often raise a multiplicity of crops on the same land. By an extravagant use of human labour which is highly intelligent and cheap, they make for want of efficient tools and scientific equipment. They possess unusual gifts for quality production. We in India are familiar with the peripatetic Chinese silk merchant with his large bundle of silk pieces strapped to his back—a symbol of hard work and perseverance. Human labour is cheap in China and in spite of the existence of modern cotton mills, some of the spinning and a great deal of the weaving is still carried on in the villages as cottage industries. Like us they are also now faced with the sudden inrush into the villages of western achievements and organisation and the solution of our common problems would probably have to be on parallel lines.

VILLAGES IN OTHER LANDS

Danish Village

The villages in Denmark are good examples of what cooperation, education and the linking of agriculture with other industries carried on in the village itself can achieve in the development of small-scale farming. The subsidiary industry in this case centres round the cow and its products. During the decade 1880-1890 the Danish villages were in a bad way from the effects of the aftermath of the Napoleonic and Prussian wars ; and there

was manifest a tendency for the people to leave the village for the town. In that decade the increase of population in urban areas was 325 per 10,000 against the corresponding figure of 21 rural areas. But by the quinquennium 1901–1906 conditions had so altered through organisation and rural amelioration work that the figure rose to 99.

Holdings in Denmark are comparatively small, most of them being not much more than eleven acres. The farmers effect all their purchases and sales through properly federated cooperative organisations and thus get the benefits of large-scale transactions. The cow is an important factor in rural Denmark and aids the agriculturist with steady supplementary income. Sons of farmers get regular training as apprentices before being allowed to take charge of farms. In our country, on the other hand, farming is the one occupation which is not considered to need any training. Such apprentices are said to constitute the chief labour in certain of the Danish farms. Every farmer is educated and well-posted with regard to market trends and prices. He lives in a clean house with a well-built outhouse for his cattle, the whole often forming a quadrangle with a neat garden in the centre.

The State helps in the development of efficient small farms. When a candidate satisfies the local commission that he is fit, possesses knowledge to run a farm and also produces a tenth of the capital, the State finds the other nine-tenths and no repayments need be made during the first five years. The farm is to be redeemed in the course of a hundred years and during this period the unit is neither to be mortgaged nor subdivided. It is said that about 50 per cent of such farmers have made a success, about 30 per cent are just getting on and the rest failures. Such small farms—with the products of the cow as the subsidiary industry—are said to have proved more efficient in adding to national wealth than capitalistic farming on a large-scale.

Swiss Village

A sense of absolute justice and fairplay is said to be the outstanding characteristic of the Swiss villager and this, it is said, has made Geneva the logical seat of the League of Nations. The Swiss farmer also depends a great deal on the cow which he duly insures. They have accident and harvest insurance companies and State insurance against unemployment. The villager commands all modern conveniences like electricity in his village house and every farmer makes his own wine as a cottage industry. The government of the village is vested in a Council who do the work in an honorary capacity.

THE FUTURE OF THE INDIAN VILLAGE

After this rapid review of the Indian village in the past and the changes that have been coming over it up to the present time we are now in a position to consider its future. There is little doubt that the general tendency so far has been for the village to steadily go down in prosperity and importance in contrast to the town which has increasingly drawn the best from the village. The question to consider is, if this is in the best interests of our country and, if not, are any steps needed to place the village in a better position than now. Does the future lie in a greater and further development of urban life, evolving measures that would somewhat mitigate the inevitable disadvantages associated with it or does the situation need radical changes in the village and village life, importing into it certain characteristics of the town ?

In spite of its having become trite, the statement that ours is an agricultural country warrants repetition on account of its far-reaching effects on all our activities. The plough with a pair of oxen is perhaps the one symbol that would properly represent India as a whole with its different classes and communities. Secondly, the rapid increase of population in our country and China has become a

byword and this renders incumbent a further increase of agricultural production. Science has so far not succeeded in growing crops on the roofs of houses or on road-sides in towns and the best achievements of agriculture have been in the countryside. The clearly indicated line of advance for the future, therefore, lies in improving rural conditions and rendering our villages better and more efficient in the discharge of duties set to them by the country as a whole, *viz.*

1. The proper and adequate feeding of the steadily increasing population, and

2. Rearing a healthy stock of men and cattle and maintaining them in a fit condition.

Both town and village are needed for the full and complete development of our country as a whole. The town is a natural and inevitable product in this development. "If God made the country" the town was and is being made by man, His agent, and in response to forces on less natural in the broad sense of the term. Ours has been and still largely is a land of villages but the towns have risen up and are bound to multiply and expand in the future. In recent times there has been a growing tendency to centralise culture and activities in the town to the disadvantage of the village ; and the towns and cities have in a sense grown at the expense of the village.

But each has certain specific advantages and inevitable defects. In crop growing, when one comes across two types both of which possess desirable characters, the crop servant—called the breeder—tries to raise hybrids between them for producing kinds which might combine in themselves the good points of both and eliminating as far as possible the defects of either. This process of hybridisation is neither new nor recent. Nature has been doing this since the beginning of life and the existing crop types are the result of such so-called "natural" hybridisation and selection. A similar procedure is indicated between the town and the village and such a process is already in progress. The open air extensions that have grown round towns in recent years— with compound houses and gardens—indicate the attempt to ruralise the town in the matter of health and surroundings, while the Post Office, the rural dispensary, the school, and even the bus horning its way through the village are in the nature of urbanising the countryside. Suburban colonies also represent such an endeavour to combine the advantages of both country and town life. While the process is already in action it is desirable to speed it up by conscious endeavour.

IMPROVING AGRICULTURAL EFFICIENCY

Elsewhere we have considered certain serious handicaps the present day village agriculture is labouring under. Thanks to the good work inaugurated by Lord Curzon's Government about thirty years ago reinforced and supplemented by the elaborate and far-reaching recommendations of the *Royal Commission on Agriculture* of 1930, we are now in a position to feel that technical advances in agriculture and allied sciences can be taken to have been provided for. The Imperial Council of Agricultural Research, a lusty child of the Royal Commission, has already won back to us a major industry and is engaged in grappling with problems of fundamental importance like marketing.

While on this point I cannot resist the temptation to refer to the outstanding achievements in the breeding of valuable crop types. Our most rapid and effective advance in agriculture has been along this line and today almost every crop is being systematically bred all over the country. Advance in this direction—*viz.*, the improvement of crop type and distribution of its seed—has been the most suitable to our present conditions of comparative poverty of resources in other directions. For the production of these types the resources in the way of plant material of more than one country has been and is being systematically employed.

Combined with substantial tariff protection afforded by a kind Government, it has resuscitated our sugar industry and thus saved a drain to the country of 15 crores of rupees per annum on the average. It is employing a hundred thousand additional labourers in the factories and about 1,500 graduates in these days of unemployment besides the five million extra agriculturists directly benefiting from it. This demonstrates the great value to the country as a whole of industries founded upon our own agricultural products.

That is possible to augment the agricultural income of the villages to a considerable extent is evident from the fact that even in the West, which is much more advanaced in this matter, the opinion is held that further marked advances are possible. A recent theoretical calculation has shown that, under the best of conditions and with the needed machinery and organisation, twelve able-bodied men are sufficient to cultivate 365 acres of sugar-cane and from it supply the carbohydrate needs of as many as 14,500 men and that thirty-five individuals could be fed from the produce of one acre, if properly handled. It is true that these calculations are somewhat theoretical as they assume conditions which do not exist and which it may be difficult to fully materialse, yet they are useful indicators of possibilities in the direction.

The evils resulting from subdivision and fragmentation of holdings have already been noticed. These are beyond the capacities of technical departments to remedy, however earnest or well-organised they may be. They are caused by ideas and sentiments deep-seated in peoples' minds and legislation is the only remedy. It is a matter where we have to help ourselves and submit to certain hardships in the interests of the country as a whole. Other countries have shown the way. In Austria the economic holding is recognised by the law of the country and is both indivisible and unmortgageable (except for short periods). In Italy such holdings are said to be inalienable, indivisible and unseizable. In Denmark a law passed in 1837 provides for the proprietor leaving his farm intact to any one of his children and providing moderate consideration for his other heirs. It is gratifying that certain Provinces have initiated action in this direction.

THE HUMAN ELEMENT

Literacy and Education

As the efficiency of any programme of rural improvement depends primarily on the Chief Agent in it, the villager, it is important to consider means for increasing his efficiency. If we compare the Villager with the Townsman one point in which the latter often scores over the villager is his literacy if not always his education. This is not the place nor is it necessary to detail the various advantages of education or even literacy. Suffice it to say that even in elementary education we have a very effctive weapon for bringing the villager out of his narrow horizon, breaking down his superstitions, placing him in touch with the rest of the world through the printed word and for facilitating the introduction of various reforms for his betterment. In the progressive evolution of the human species acquisition of certain characters such as the "erect habit" are credited with having introduced far-reaching effects. Education belongs to this category.

Though it is true that the village Teacher did exist in the olden days and at least certain classes of the population received some kind of school and even higher education and though there is evidence that reputed universities did occasionally flourish in certain rural parts, regular schooling and education were not considered essential. While, according to the Arthasasthra, the Sukranithi and the Manusmrithi, the carpenter, the blacksmith, the shoe-maker and in certain cases even the astrologer were definitely recognised in the elaborate village organisation, the school-master did not occupy such a position. It was left largely to the priest

class or some men of learning to give instruction in the three 'R's' and take the more advanced students even higher up the scale in return for voluntary gifts from the parents of the boys in their charge.

Education given in the village school should obviously possess the rural and agricultural outlook and be vitally linked with the every-day life of the village. In our boyhood days we learnt more about the geography and history of places we could never hope to see while being comparatively ignorant of our own district and its environment. Such an important subject as the anatomy and physiology of the human body was reserved till the student had mastered the various distinguishing characteristics of the metals and the non-metals or the names of the then two important towns in the Sahara region. There is now a steady and welcome change in this matter. Nature study lessons fit in well with the agricultural life of the villager and I have often wondered why the village vacations should be timed to the conveniences of metropolitan examinations rather than to the busiest agricultural seasons in the village when the boys could perhaps help their parents in the field and gain first-hand knowledge of subjects taught in the school-room.

Intellectual Alertness

A second characteristic of the Villager as contrasted with the Townsman is often the slower moving intellect of the former. This is not mentioned here in a derogatory spirit ; the difference is due to difference in the environment. The every-day struggle with the great forces of nature develops a deeper character to the villager, but in intellectual alertness he is often inferior to the townsman. Agricultural operations are generally spread on the broad land and hence the workers are in comparative isolation, whereas intellectual alertness is greatly accelerated through contact and clash with other minds, a feature of industrial life. The rather extreme opinion has been held that most agricultural improvements themselves have been from men whose intellects have been sharpened by industries and commerce. The linking up of villages with towns and other villages, through better communication facilities, for instance, will remedy the situation.

Business Habits

Yet another common defect of the villager is the lack of so-called "business" habits and "business" mentality. This again is due to his environment and tradition. Nature's processes with which the Village Agriculturist is primarily concerned do not generally need the punctuality of the man of business or commerce. The cow is insured both in Denmark and Switzerland on account of its importance in rural economies. The absence of insurance measures in our villages against crop failures and cattle epidemics, which are by no means uncommon, is largely attributable to the absence of education and business outlook. The villager's income would be both enhanced and rendered steadier by the import of the "business" mentality into his activities such as agriculture and cattle maintenance.

Outlook on Life

The villager's outlook on the world is often narrow because of the isolation and the absence of literacy. Whether he likes it or not, the villager is being dragged into the world currents of commerce and industry and his horizon needs to be broadened by education. His constant fight with forces of Nature over which he has little control, tinges his ideas with almost fatalism. A bad season too often disproves to him the truth in the saying "As you sow so you reap". Industrial activities, on the other hand, are associated with processes which demonstrate the control of natural forces by man and this has a tendency to develop in him certain amount of self-confidence, if not human pride.

Cottage Industries

In this study of the Indian village, the villager and village life, we have frequently noticed the need and advantages of industrialising the village. We have found that industries are desirable in the village to find employment of the people all through the year to stabilise labour, to tone up the villager in various directions and to supplement and steady his income. The large scale industries which have developed in the country—while both useful and important for the progress of the country as a whole—have helped the villager but little. On the other hand, they have adversely affected the village tending to draw labour and brains away from the village. What is needed is the establishment of cottage industries in the village itself so as to improve the conditions for living in it.

It is obvious that the closer such industries are linked up with agriculture and agricultural products the better they would fit in with village economies. Cattle being an important adjunct of agriculture, industries like cattle breeding and production of milk and milk products at once suggest themselves. The value of cattle for agriculture is not confined merely to its use as labour, but the trend of recent work is indicative of their playing a very important part as the store house of the right type of manure for crops. The animal and plant kingdoms would appear to be the counterparts of one unit, each benefiting from the waste products of the other. Bee keeping, the poultry industry, fruit growing and canning and preparation of tinned and infant foods for the benefit of the townsman would fit in well into the village.

Other suitable industries would be the partial preparation of manufactured products in the village itself as a rural industry. Cotton ginneries, seed decorticators and oil presses belong to this group. It saves in the transport of raw material to the central factory, the half-prepared material being generally less bulky than the original raw product. The retransport to the village of the by-products of manufacture, such as seeds in the case of cotton which are needed back in the village both for sowing and as cattle food, is also thus avoided. Minor industries connected with products or articles available in the village or vicinity, such as coconut industry in the West Coast and fish curing in seashore villages help to keep the villages prosperous.

Other handicrafts and domestic industries, where the needed material is imported from outside and worked in the village during the off-seasons, include weaving, dyeing and the manufacture of toys and trinkets. In spite of technical advances there are yet certain industries which lend themselves to be worked in the villages as domestic industries. The manufacture of toys in the Black Forest regions of Germany, watches in Switzerland, cutlery in Sheffield and little fans, flower baskets and ornamental pieces in Japan are of this class and are a great help in supplementing and steadying the villager's income. The mechanical efficiency obtained in the village as the result of such rural industries gives the village a "mistry" class who should prove increasingly useful in the repairs and upkeep of farm machinery and water lifting pumps which are spreading in the country.

Cooperative Organisation

The value of organising on a large scale for increasing efficiency is well-known and widely accepted. Most village activities, on the other hand, have by their very nature to be on the small scale and their being grouped together through cooperative organisations is the only remedy. Through them even the small farmer and producer is enabled to command facilities and advantages generally available only to large-scale units. The purchase and sale of articles connected with cottage industries, for instance, need grouping together through cooperative organisations for best results.

There was apparently a great deal of the "mutual help" and cooperative spirit in the villages

of old. Certain of these are surviving to this day in the form of customs or usages, sometimes transmuted into religious observances and thus commanding unquestioned obedience. In the remote countryside marriage or death in a family is often a village event and is shared by the whole community even in these days. Guests at marriage functions come in with a variety of contributions including provisions for the marriage feast. The inhabitants of a street are forbidden to take food till the dead is removed and properly disposed of and food for the bereaved family is provided by other villagers for the first two days. The spirit needs to be revived and placed on new lines consonant with the modern age.

Amenities of Life

As a class our villages lack the conveniences and amenities of urban life. While perhaps certain of these might be considered unnecessary and a few even harmful, there can be no doubt that the bulk of them are in tune with and are necessary for modern progress which is taking hold of the world whether we like it or not. Conveniences like means for rapid transport, the Post and Telegraph, the Newspaper and the ever-increasing improvements associated with the development of electricity are major blessings which it is desirable should be extended to the villages as quickly and as completely as possible. It is the absence of these in our countryside that is partly responsible for the prevailing distaste to village life. The village is easily healthier than the town in such important factors as pure air and open spaces and if only certain urban facilities are implanted in the village, its attractions for settlement should prove irresistible.

The general tendency for retired Government officials not to return to the village but settle in a nearby town has struck me as unfortunate and is indicative of the general trend. While in certain cases perhaps the decision might be due to urban educational facilities, there is little doubt that the general unattractiveness of village life also enters into the decision. For permanent results the urge for rural improvement should be implanted in the village itself. This could be achieved only by improving the chief natural agent in such work—viz., the Villager—and making it attractive for him to live and have his being in the village itself. Endeavours that are town-centred and take to the village for temporary periods, for lectures, demonstrations or shows—however honest or energetic—have an outside flavour to the villager and do not, threfore, get permanently assimilated into village life.

CONCLUSION

To sum up, there is little doubt that the villages of old were more populated than they are today largely because of conditions prevalent at the time. Those conditions will never return however much or sincerely we may hanker after them. The town and the characteristics associated with urban life are definite products in the march of events and need to be accepted as such. Though there are drawbacks associated with urban life the town has its own good points which need extension into the village to keep rural life in tune with the changes around us. At the same time, the countryside has advantages like open spaces and absence of congestion which can never be reproduced in the town.

Life activities that were village-centred in the past are increasingly getting town-centred to the disadvantage of the former. In the interests of the country as a whole relationship of mutual help needs to be established between the two. The town should extend to the village its greater knowledge, quicker living and the manifold amenities of the modern age. Contributions from the countryside are of equal importance. It alone can produce the raw materials of commerce and industry and thus help in the growth of towns and cities. It alone can

supply adequate and wholesome food to the millions of our land whether resident in the village or town. Lastly, the countryside alone can imbue the urban "business" civilisation with the deeper character and larger humanities which are nurtured in the villager through his more direct and constant contact with the great forces of Nature and of life. Our duty then is clear ; namely, to improve the Village, the nucleus of our country life, and infect its Chief Agent, the Villager, with a chosen culture of the virus of modern age through Education and Industrialisation.

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LACTIC ACID AND LACTIC ACID BASED INDUSTRIES : ECOFRIENDLY IN NATURE

Joydeep Dutta* and P.K. Dutta**

The present article deals with the production of biodegradable polymer, polylatic acid and its monomer lactic acid and their industrial uses. Polylactic acid can be used as a substitute of non-biodegradable plastics. The research on commercially acceptable procedures for lactic acid and polylactic acid has drawn the global attention for its ecofriendly nature.

INTRODUCTION

The lactic acid market is currently at a cut-off point with the commercial reality of polylactic acid (PLA) polymers and lactate esters. Biodergradable and biorenewable polymers are very attractive from environmental standpoint. PLA, among other polymers, accomplishes biodegradability, biocompatibility, bioresorbility, etc. So indeed, it will open many doors in this stellar globe for its environmentally friendly characteristics. Global lactic acid demand was around 86,000 tons in 2001 with the market dominated by the food and beverage sector and the personal care industry. Lactic acid has wide range of beneficial end-uses in these sectors relating to food preservation, flavour enhancement, deep skin treatment, etc. More specialized lactic acid end-uses include dialysis media and pharmaceutical intermediates. Unparalleled global demand growth of up to 14 percent per year is possible provided polylactides and lactate esters are commercially successful. In considering how large these lactic acid complexes could become, Cargill Dow has publicly stated its belief that a 500,000 tones per year polylactide market will exist in the world by 2010 and two additional polylactide plants are being considered. Nexant/Chem Systems has proposed a potential "Mega" complex for combined lactic acid, polylactide with world-scale ester solvent production with overall economies of scale making the products potentially cost competitive with those derived from petrochemical feedstock.

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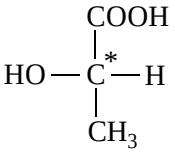
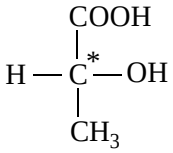
WHAT IS LACTIC ACID

Lactic acid or 2-hydroxypropionic acid is an "Alpha-Hydroxy-acid" (AHA) and was discovered by the Swedish Scientist, Scheel in 1780 being first isolated from sour milk[1]. This gave rise to a whole series of claims and counter claims in the academic literature concerning Scheel's findings. The French Scientist, Fremy produced lactic acid by fermentation and this gave birth to industrial production in 1881. The isolated acid is a white crystalline solid which is hygroscopic. As this is the case, it is typically manfactured and consumed as a concentrated solution of around 88 per cent weight. In this form lactic acid exists not only as individual molecules, but oligomers and polymers. In addition, lactic acid can self-esterify providing a mixture of esters in equilibrium with acid and oligomers. Hence, purifying lactic acid can be a challenge. Lactic acid exists as in racemate form, made up of stereo-isomers as shown below :



L-Lactic Acid



D-Lactic Acid

Synthetic lactic acid made from petrochemical feedstocks is optically inactive, i.e. a racemate mixture. Lactic acid made biochemically by fermentation is optically active and suitable organisms can selectively produce laevo or dextro-rotatory enantiomers. However, salts of lactic acid tend to be found in the laevo state only.

WHY LACTIC ACID BASED INDUSTRIES ARE CALLED ECO-FRIENDLY?

The eco-system is significantly disturbed and destroyed by the extensive use of non-biodegradable materials, for instance, large solidplastic wastes are produced from packaging, public or medical services and travel locations, grocery bags, trash bags, fast food serving and eating utensils, and even flower/plant pots, for disposal systems. Thus the environmental impact of persistent plastic wastes is growing and is a global concern, because alternative disposal methods are limited. Lactic acid based industries have opened a new track to sort out such type of big problems pertaining to environment. And these lactic acids based industries are approaching to offer many possibilities to keep the environment green and clean. PLA, derived from starch-rich grains, has been very attractive for disposable and biodegradable plastic substitutes due to its better mechanical properties. However, PLA is still more expensive than petroleum-based plastics. Biodegradable polymers are generally defined as polymers that are completely converted by micro-organisms to carbon dioxide, water or methane and humic materials. Most of the polymers are resistant to attack by micro organisms; however some polymers with a hydrolysable linkage such as certain polyesters, are readily biodegradable. Scientific tests have been developed to establish biodegradability and most producers have made their biodegradation studies available in order to demonstrate the environmentally friendly nature of these biodegradable polymers. The articles made by OLA are fully biodegradable and biocompatible. Thus, once discarded they undergo degradation and does not cause any deleterious effects on environment. That is why lactic acid based industries are called eco-friendly in nature.

MULTI-USE OF LACTIC ACID

Lactic acid has been used in a wide variety of applications ranging from food to cosmetic to pharmaceutical to industrial applications. It has also been receiving a great deal of attention as a feedstock monomer for manufacturing PLA as a commodity plastic. Furthermore, since lactic acid has an excellent reactivity due to the presence of both carboxylic and hydroxyl group, intriguingly, it can therefore be converted into potentially useful chemicals such as propylene oxide, propylene glycol, acrylic acid, 2, 3-pentadione, and lactate ester[2]. Thus, production of lactic acid would give superfluous advantages from where lactic acid based industries may amplify earning byond their meets.

Lactic acid is mainly consumed in foodstuffs where it plays an important role in food preservation, shelf life and flavour enhancement/ control. In cosmetics, it is used for deep skin treatments. *Classical history often depicts Queen Cleopatra of Egypt bathing in asses milk as a beauty treatment. It is also known that women at the court of King Louis XIV (the "Sunh King") washed their faces in old wine.* These natural beauty treatments contained lactic acid and tartaric acid, respectively. The action of these chemicals was of an exfoliating nature, i.e. an early form of cosmetic dermatology. Lactic acid is produced commercially for use in pharmaceuticals and foods, in leather tanning and textile dyeing, and in making plastics, solvents, inks, and lacquers.

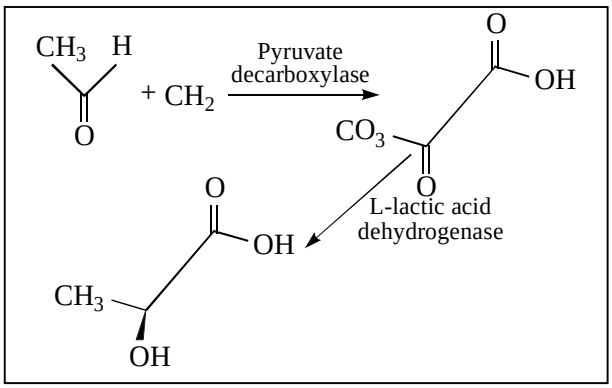
Lactic acid based polyesters are well known and widely studied biodegrable polymers. PLA, a thermoplastic polyester, is suitable for packaging applications, since PLA's glass transition temperature (T_g about 60°C) is above the service temperature and thereof a good barrier material for solvents, flavours and aromas, and a medium barrier

for permanent gases[3]. Additional benefits for packaging applications are good heat sealability and processability with standard plastic equipment. Recent advances in the production process of PLA, together with improvements in the material properties, have also opened up a promising market outlook in the sector of fibres and nonwovens, films, thermoformed and injection moulded articles.[4]

SYNTHETIC ROUTE OF PREPARING LACTIC ACID

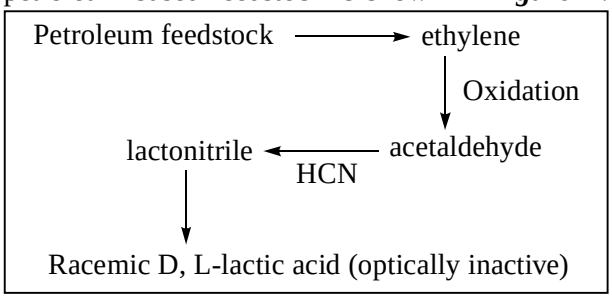
The chemical synthesis of lactic acid from petroleum based feedstock has a disadvantage that the lactic acid produced is only the recemic mixture of L- and D-isomers, whereas microbial fermentation offers the advantages in both utilization of renewable carbohydrates and production of optically pure L- or D-lactic acid depending on the strain chosen. Lactic acid is mainly produced through fermentation processes although synthetic routes also exist. Today Musashino in Japan is the only synthetic lactic acid producer. The scale of lactic acid production has been rising significantly in order to supply feedstock for the production of Polylactide polymer, principally the Cargill Dow NATUREWORKS® plant.

A group of researchers have developed a novel enzymatic reactions and reactor systems having environmentally safe chemical process[5]. Two enzymes chosen to chemically synthesize L-lactic acid are (i) Pyruvate decarboxylase and (ii) L-Lactic dehydrogenase. Generally, pyruvate decarboxylase is used as a catalyst for the decarboxylation reaction of pyruvic acid to produce acetaldehyde. Interestingly, it is also the best catalyst for the carboxylation of acetaldehyde to produce pyruvic acid. Synthesis of L-lactic acid is a one-pot, two-step enzymatic procedure. Pyruvic acid can be easily hydrogenated asymmetrically by L-lactic dehydragenase in the biological system. Therefore, it is possible to produce L-lactic acid from acetaldehyde and carbon dioxide by combining the two enzyme reactions, reverse reaction of pyruvate decarboxylase and L-lactic dehydrogenase. It is a pH-dependent reaction and the percent of yield depends on the effect of pH during carry out the reaction. It has been found the at the pH 9.5, it gives maximum yield of L-lactic acid. Synthetic process is shown in ***Figure–1***.



Figure–1 **: Synthetic process of L-lactic acid from carbon dioxide.**

The chemical synthesis[6] of lactic acid from petroleum based feedstock is shown in ***Figure–2***.

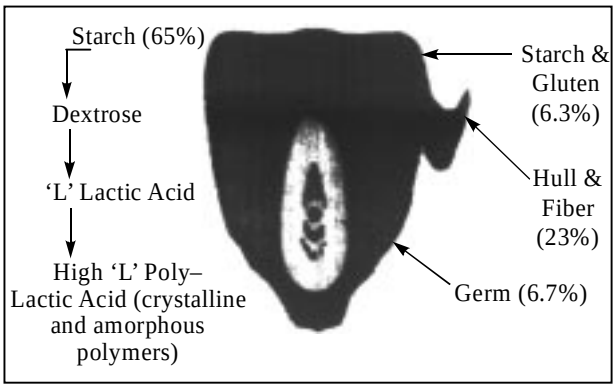


Figure–2 **: Petrochemical route to lactic acid**

FERMENTATION ROUTE OF PREPARING LACTIC ACID

Commercially, lactic acid is manufactured by synthetic as well as fermentation methods. Fermentation processes use renewable carbon sources while synthetic route depends upon non-renewable petrochemicals. Thus, fermentation process is more attractive for countries like India which have poor petrochemical resources. There

exist so many fermentation routes for the production of lactic acid. Production of lactic acid by fermentations from renewable resources is more economical route. The commercial success of microbial lactic acid production is not yet realized. The main reason is the high product recovery cost and complex nature of the biological process. A group of researchers are trying to produce lactic acid by continuous fermentation of lactose by bioreaction and product separation[7]. Using corn as the feedstock, L-lactic acid can be produced by fermentation process[6]. Fermentation derived lactic acid exists exclusively as L-lactic acid. It is shown in ***Figure–3***.



Figure–3 **: Fermentation route to lactic acid**

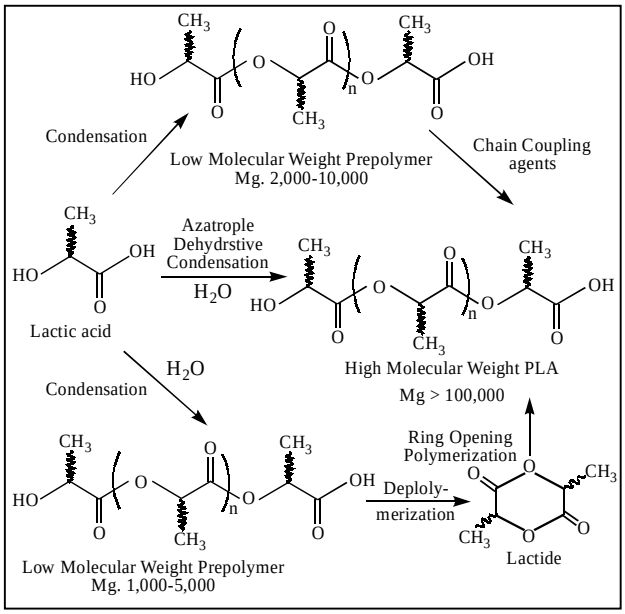
PREPARATIVE METHOD OF SYNTHESIZING PLA

Polylactides are not a new concept. However, in the past producers have been preparing materials in a small scale with biodegradability/ compostability as the major demand driver. Polylactide synthesis proceeds via a lactide intermediate that can use either chiral form of lactic acid or combinations thereof to produce polymers with tailored properties for fibres, thermoforming, even injection and blow moulding grades. Commercial development has paid close attention to polymer processability and performance in addition to biodegradability.

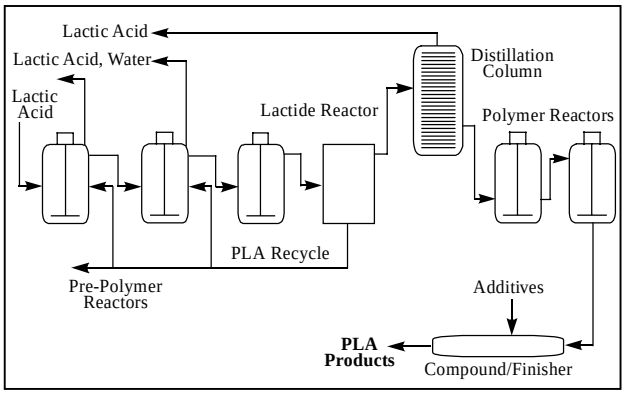
PLA from the NATUREWORK® will be produced at 140,000 tons per year in Blair, Nebraska. As a measure of lucrative economy products of PLA, integration of the corn value chain with Cargill, Purac and Cargill Dow can in effect give polylactide a very competitive cost of production and therefore a price that could compete with certain polymers derived from petrochemical means. In addition, large volume, low cost lactic acid could also give rise to the successful commercial development of cost competitive lactate esters (methyl, ethyl, butyl, etc) as substitutes to those derived from petrochemical sources such as methyl ether ketone (MEK), iso-propyl alcohol (IPA), etc.

To prepare PLA from lactic acid as starting material, basically two routes are considerably chosen (1) Condensation polymerisation and (2) Ring Opening polymerisation. However, no method of enzymatic polymerization of lactic acid is found in literature. Till now production cost of PLA is very high. However, chemical engineers have not yet exhausted all the possible solutions to the problem of cheap monomer and polymer production. The industry is currently working towards reducing the cost of manufacturing biodegradable polymers by increasing production capacity, improving process technology and utilizing low cost feed stocks. Cargill uses a solvent-free process and a novel distillation process to produce a range of polymers. The essential novelty of the process lies in the ability to go from lactic acid to a low-molecular-weight PLA, followed by controlled depolymerisation to produce the cyclic dimer, commonly referred to as lactide. This lactide is maintained in the liquid form and purified by distillation. Catalytic ring opening of the lactide intermediate results in the production of PLAs with controlled molecular weights. The process is continuous with no necessity to separate the intermediate lactide. In contrast, Mitsui Toatsu[8] utilises a solvent-based process in which a high-molecular-weight polymer is produced by direct condensation using azeotropic distillation to remove

water of condensation continuously. ***Figure–4*** illustrates the steps involved in these two processes. A more detailed description of the Cargil process is illustrated schematically in ***(Figure–5)***.



Figure–4. **Manufacturing routes to PLAs**



Figure–5. **Cargil commercial manufacturing process**

MICRO-ORGANISMS CAUSING BIODEGRADATION OF PLA

Microbial degradation of PLA has been studied elsewhere[9]. There have been reports on the degradation of PLA oligomers (molecular weight ~ 1000) by *Fusarium moniliforme* and *Penicillium roquefort* and the degradation of PLA by *Amycolatopsis* sp and by *Bacillus brevis.* In addition, enzymatic degradation of low molecular weight PLA (molecular weight ~ 2000) has been shown using esterase-type enzymes such as *Rhizopus delemer* lipase, hog pancreatic lipase, and carboxylic esterase, whereas proteinase K could catalyze the hydrolysis of high molecular weight OLA. These and other biodegradative studies of PLA have employed a number of available methods of detection. Total organic carbon, analysis of water soluble fraction, Fourier transform infrared spectroscopy, gas chromatography-mass spectrometry and scanning electron microscope have been used to accurately measure the PLA degradation. However, these methods require expensive equipments. On the other hand, simpler methods, namely turbidity measurement, pH measurement and size exclusion chromatography are not as accurate. A new fluorescent assay method becomes available to investigate more fully the enzymatic degradation of PLA.

INDUSTRIAL APPLICATIONS OF LACTIC ACID AND PLA

PLA is a biodegradable polymer derived from lactic acid. It is a highly versatile material and is made from 100% renewable resources like corn, sugar beets, wheat and other starch-rich products. PLA exhibits many properties that are equivalent to or better than many petroleum based plastics, which makes it suitable for a veriety of applications.

It is important that PLA compares well with other popular plastics already used for packaging. It is clear and naturally glossy like the polystyrene used in "blister packs" for products such as batteries, toys, and many others. PLA is resistant to moisture and grease. It has flavour and odour barrier characteristics similar to the popular plastic polyethylene terephthalate (PET) used for soft drinks and many other food products. Tensile strength and modulus of elasticity of PLA is also comparable to PET.

PLA can be formulated to be either rigid or flexible and can be copolymerised with other

material. PLA can be made with different mechanical properties suitable for specific manufacturing processes, such as injection molding, sheet extrusion, blow molding, thermoforming, film forming and fibre spinning using most conventional techniques and equipment. PLA is a nonvolatile, odourless polymer and is classified as GRAS *(generally recognized as safe)* by the Food and Drug Administration in the United States.

The L-lactic acid based polymers may produce polymer which is a linear homopolymer of the molecular size > 70 kDa. The main application field of lactic acid polymer has been medical applications and a number of companies have made their efforts in manufacturing lactic acid based polymers and their products. These medical applications include its usage if carrying different properties in terms of tensile strength, viscosity, purity etc. L-lactic acid polymer exist in three different forms solids that can be used for filling the gaps in bones, solid with tensile strength to produce sutures (stitching material), and the glue form that is mainly applied in joining membranes or thin skins in humans. The proven degradability in biological systems, biocompatibility and the possibility of tailoring the properties to a wide range have made lactic acid derivatives well suited for a range of applications.

A few applications of lactic acid in diversified fields are listed below :

A. Food Industry : ● Meat/Poultry ● Bakery/ Dairy ● Confectionery ● Beverages ● Marine Products ● Fruit & Vegetables ● Sauces and Dressings.

B. Pharmaceutical Industry : ● Parental Solutions ● Nutritional Supplementation ● Dermatological Cure ● Drug Intermediate ● Polylactide Polymer.

C. Industrial : ● Paints ● Metal Coating ● Paper & Textile ● Leather ● Electronics ● Non-toxic pesticides.

D. Cosmetic Industry : ● Skin Care application ● Toiletries ● Oral Care ● Hair Cure Products.

INDIAN SCENARIO

Biodegradable polymers, or biopolymers, are plastic materials produced from natural substances rather than petroleum-based feedstocks. While many biopolymers are in development, one in particular has shown a very bright future. PLA resin can be used for many of the applications currently utilizing polyethylene resins.

Looking to the worldwide research in PLA production, the Indian counterpart had also taken the initiative to utilizing the natural resource for production of PLA as a substitute of polyethylene. The Govt. of India has taken a mega project of economically viable PLA production jointly with the giant private sector company, Reliance Industries Limited. How can PLA hope to compete with polyethylene have been a great question mark? It's difficult to predict the future, but PLA has shown promise and now we'll see why.

Polyethylene is produced from petroleum-based materials which are of course finite in supply. As petroleum reserves decrease in abundance, polyethylene costs will increase accordingly. Continued funding and research will surely force PLA costs even lower. Government regulations may also force disposal and recycling costs for polyethylene up from the current status. Also, a larger PLA market derived from its "green" label may help reduce its costs. So, it would appear that as long as PLA can adjust well to the current polyethylene applications, the future should be bright. The costs of polyethylene will rise and the costs of PLA will decrease, it's just a matter of time right? Don't assume that people aren't doing research somewhere trying to figure out how to produce polyethylene without the petroleum dependency. That would really make things interesting!

CONCLUSION

Day-to-day a vital problem concerning environmental pollution is increasing considerably due to exclusive uses of non-biodegradable articles, for instance, large solid-plastic wastes are produced from packaging, public or medical services and travel locations, grocery bags, trash bags, fast food serving and eating utensils, and even flower/plant pots, for disposal systems. Therefore, industrialists, academicians and other people from distinguished fields have been trying to overcome such kind of global issues by converting such type of non-biodegradable articles into biodegradable articles which do not cause any deleterious effect on environment. This article would be helpful to the industrialists, academicians and entrepreneurs to synthesize lactic acid and PLA for making the environment green and clean.

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DO YOU KNOW ?

Q1. Where did the world's most important food item, potato originate ?

Q2. An inflated ballon is rising through the atmosphere on its own. Is it more likely to burst as it reaches higher altitudes or does it become more stable ? Why ?

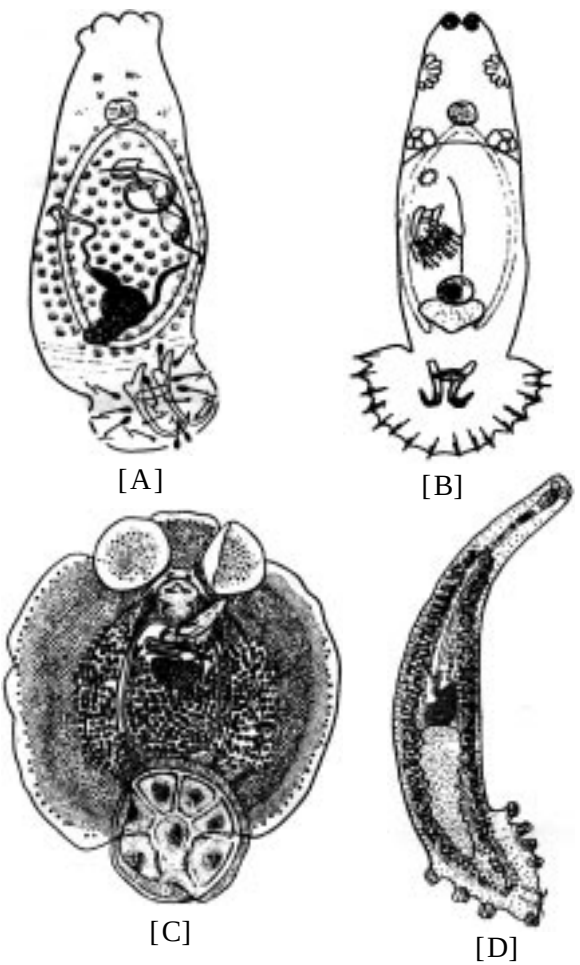
MONOGENEANS AS HAZARD TO INDIAN FISH INDUSTRY

Nirupama Agrawal & Nikhil Srivastava

Monogeneans, common fish parasites are veritable hazard to fish industry. The aquaculture industry has witnessed the robust growth of Monogeneans which caused viral, bacterial and fungal diseases of fishes resulting a huge loss in aquaculture and Aquarian Industry. Some therapeutic measures are suggested to control these fish parasites.

Monogeneas are Platyhelminthes (flat-worms), usually small ectoparasites of fish found on skin, fins, gills and in nasal chambers. They have attachment organs at posterior end of body known as haptor, consisting of anchors, clamps, hooks, suckers or a combination of these. Life cycle is simple with no intermediate host, hermaphrodite, oviparous, sometimes viviparous and larva is known as oncomiracideum. In the past 30 years, the aquculture industry has witnessed a robust growth with an increased awareness of monogenea as pathogenic organisms. Viral, bacterial and fungal diseases are responsible for losses, occurring in aquaculture and aquarium industry. However, the monogeneans often cause greater damage. Crowding and other stressors predispose the fish to monogenean problems. With the rapidity and reliability of modern ways of transportation, several monogeneans have been transferred with the introduction of cultured fish around the World. Dactylogyrids, Gyrodactylids, Capsalids and Mazocraeids (Figs. A-D) are most commonly found and has worldwide distribution as fish parasites.

Dactylogyrids and Gyrodactylids have proved to be dangerous in cyprinid culture, especially to fry, where relatively few parasites can cause severe gill damage. Early stages (fry and fingerlings) of carps are more prone and sometimes it may result in heavy losses. Excessive mucus secretions, discolouration of body, dropping off scales and fading of gills are the most common symptoms. Capsalids occur in marine environment. Some species of Capsalids have been reported to be pathogenic to elasmobranchs. *Neobenedenia* is



Figs. A-D : A. Dactylogyrus longiacus ; B. Gyrodactylus punti ; C. Capsala laevis ; D. Mazocraes gonialosae.

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introduced into various public aquaria through chaetodontid fish and is quite pathogenic to a number of other fishes[5]. Mazocraeids are marine, world wide in distribution and pathogenic to clupeids. Discocotylids has caused serious gill damage to salmonids[6] and Heteraxinids have caused mass mortality in carangids. Most species of monogenea exhibit host-specificity and even site specificity under natural conditions. But in crowded and stressed conditions, host specificity may breakdown. For example *Gyrodactylus salaris* normal parasitize *Salmo salar* but infests several other slamonid species in culture[4].

Gyrodactylus parasitises skin and fins and *Dactylogyrus* the gills, causing epidermal hyperplasia and copius mucus production, which obscure chromatophores, making the skin paler and cause destruction of gill filaments. Heavy infection frequently results in skin and scale shedding. The mechanism of damage in Gyrodactylosis is disturbance of respiratory function of skin. One observed falling off scales from the body, whitish caudal peduncle and fins, due to excessive mucus during infestation of *Gyrodactylus* and some signs of skin haemorrhage[8]. In areas, where the number of parasites was more, the skin peeled off. A heavy infection affects mobility of fish, younger fish being more at risk, a diseased fish becomes more and more weak and anemic until it eventually dies. Since monogenean parasities are attached on the gills, skin and fins of fishes by means of haptor, damage to site of attachment is caused, forming inoculums for secondary infections. Numerous pathological conditions caused by Capasalids include eroded snout with exposed bones, eroded gular and opercular membranes, hyperplastic and necrotic skin in areas of heavy infestation haemorrhagic buccal ulcerations, thickened cornea and adipose eyelids resulting in a chalky white appearance and emaciation, congestion, edema and infilteration of eosinophils, macrophages and lymphocytes, associated with severe inflammatory reactons in dermal and sub dermal layers. Mazocraeids, when occur in large mumbers on an individual host, cause mass mortality in cultured fish population. High intensities might weaken the host, permitting infeaction by other pathogens.

The principles of prevention and control for monogeneans on fish are essentially the same as being adopted for parasities of other domestic animals and humans. However, the problem is more complicated due to aquatic environment that plays an important role in determining the type and effectiveness of treatment. Many chemicals are being used in aquaculture to treat fish for monogenean infestation. Most chemicals used, not only affect the parasite but can adversely affect the host as well. Unfortunately, parasites can develop resistance against chemical treatments. When chemicals, with increased concentration are applied, deleterious effects on hosts can be observed.

As therapeutic measures, baths in various solutions are recommended, **sodium chloride** baths being particularly suitable. **Freshwater dips** have long been used to treat monogeneans both in aquaculture and aquarium industries. Alternate baths of acetic acid and sodium chloride solution gave better results[8]. Baths of **copper sulphate** solution (0.06%) can be also applied. **Formalin** baths for long durations need only low concentratons ; 10-25 ppm are used in indefinitely long baths. Oxygen depletion is associated with the use of formalin[2]. Due to the toxicity of formalin, various workers recommend dipping method for eradication of parasities. **Potassium permanganate** is also used at different concentrations and exposures to treat monogeneans. **Mebendazole** is very effective for removing *Gyrodactylus elegans* after 24 hours. Application of **Praziquantel** is quite recent. It is reported that praziquantel caused a marked vacuolization in the tegument of monogeneans[7]. It is reported loss of motility in 80-90% population of *Pseudodactylogyrus bini,* when exposed to 10 and 30 ppm of Praziquantel for 8 hours[1].

Various species of monogenean parasities cause great damage to economically important fish. In natural systems, they cause few problems but in man made systems (with restricted area), these are able to cause serious outbreaks by means of their significant prevalence and intensities. Most accountable damage can be seen on set of high intensity of parasities. This phenomenon establishes a direct relation between increased availability of hosts and infective stages of pathogens. When conditions are favourable for mass reproduction of parasite, the disease may spread very quickly. Effective prevention and control methods are required to flourish aquaculture and aquarium industry. The best way for managing monogeneans is quarantine protocol. Properly quarantined brood stocks or juveniles should be used for culture.

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DO YOU KNOW ?

Q3. How many sharks are killed every year by fishing trawlers and nets ?

Q4. Who invented scissors ?

Q5. Who supposedly invented the thermometer ?

HOLISTIC MULTI-DISCIPLINARY MODEL DESIGNS FOR NATIONAL SPORTS PROMOTION PLANNING PROGRAMME IN INDIA

Barindra Kumar Basu*

Sports promotion planning programmes can be unified for a small country with a population of more or less of homogeneous sports-demanding biopotentialities. But for a vast country, like India, it is not pertinent to do that. The population is heterogeneous with physical characteristics varying according to geographical distribution, diverse socio-economic, socio-cultural, environmental conditions are varied sports potentials. So target-oriented holistic multi-disciplinary designs for promotion of national sports have been suggested.

INTRODUCTION

Government of India, after Independence, is keen to undertake programmes for promotion of sports in the country. National Council of Sports has also drafted the policy. Coutry-wide regular physical fitness efficiency jambooree and different sports discipline curricula have been included as a step for social welfare. But consistently successful results have not been obtained. Scope of participtionat the grass-root level is neglected. Apparently, there is a traditional idea of strong muscular culture based on 'fair play', on the one hand, and aesthetic idea of the cult of beatuty and grace" on the other. On the contrary as opposed to our expectation sports industry has developed in global context in stead of sports promotion, depriving the general mass of the country[1]. To produce the desired results appropriate steps are to be taken such as mass participation from grass-root level, picking up the proper ones, imparting training to them for performance upto desired standard. Relative contribution of different types of factors to the fundamentals of achievement, on the whole are as fullows : Factors imported by training contribute 27% and population factors 73% of which 26% come from Habitual activity factors $\left(\text{i. e.}, \frac{36 \times 73}{100}\right)$ and 47% are due to Genetic factor not related to habitual activity $\left(\text{i. e.}, \frac{64 \times 73}{100}\right)$.

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SIX BASIC CHARACTERISTICS OF POTENTIALITY FOR SPOTS

These are as follows :

1. Somatic potential features :

Somatometric result of superb atheletes of Olympics indicate the features of potentiality. These reports of selected sports persons from different countries have come out in world literature[3, 4, 5]. However, actuary of characteristics of sports persons in India is not available. Life Insurance Corporation of India maintains its own actuary for own business purpose.

2. Somatotype as potential factor in sports.

Variation in human biological diversity and differencess in individual physique are termed as somatotypes with different classifications. Considering it as rating of phenotype at a particular time, being changeable by training, growth and nutrition or desease it has been used in population studies. Sports performance has been found to be related to somatotype[6, 7]. This is because somatotype is highly related to physique and behavioral variables relevant for performance in sports[10].

3. Choice of sports discipline and selection of sports persons.

Slection of sports discipline according to somatotype rating and selecting sports persons

according to different potential factors have been suggested. But the trend of high specialisation of modern sports persons, as well as the departure of their anthropological and physiological characteristics by two and even three standard deviations from population average have led to the observation that ideal body is not necessarily essential for best performance.

4. Relevant anthropology in sports.

Population segments may some time vary physically. Physical adaptation to variation in topical environment occurs which following Bergmann and Allen "Laws" postulate that within a polytypic warm blooded species, the subspecies, develop increase in body size if the topical temperature decreases. It is further stated that the former causes an increase in linearity of body as well as in limb to trunk-length ratio but a decrease in limb girth. This is substantiated by a population study[8] in India showing variation in stature in male as 168.4 cm average in Punjab, whereas 163.7 cm. in Madras. Some also observed substantial ethnic variations in Indian subcontinent[9] has also been observed in this regard.

5. Relevant Cultural anthropological considerations.

Socio-economic and socio-cultural background influence the potentiality of a sportsperson. In this regard, usually referred factors are family size, number of siblings, family income, health consciousness, family affinity for sports, nutrition and dietatic habit, hereditary disease, addiction etc.

Lastly "Sports culture" environment is an essential component to high quality performance in sports.

PEDAGOGY OF SPORTS PROMOTION

Sports promotion is a process in continuum. To promote sports standard and performance, a holistic approach utilising multidisciplinary scientific and technical advancements, is essential. This stands in line with the thematic principle with follow-through steps described below.

Step 1 : Demographic profile of sports-relevant potential in population.

(A) Sports specific Human Resource potential search following accepted protocols.

Somatic Potential :

1. Physical traits

2. Anthropometric variables for Fractional Body Maas Composition.

3. Somatotyping by anthropometric methods.

Functional capacity potential

The variables are 1. Muscle Components. 2. Anaerobic power. 3. Aerobic power. 4. Reaction time. 5. Cardio-Pulmonary function. 6. Haematology-Haemoglobin Percentage.

Socio-economic and Socio-cultural status of the individual.

(B) Sports-specific regional area resource potential search

1. Population size of the area. 2. Availability of suitable size of areas required for particular sports disciplines. 3. Number of sporting clubs and their status. 4. Types of sports popular in the area.

Step 2 : Statistical treatment .

Country-wide composite demographic profile is to be analysed as follows :

1. Frequency and incidence of sports potentials in particular area of the country.

2. Area and sport discipline specific cross tabulation of frequency and incidence of sports potentials.

3. Calculation of incidence of individuals as per stipulated standard of participation in particular discipline of sport in a particular area.

Step 3 : Implementation of promotion operation

Due to heterogenity of the population mass, regional variation of nutritional standard and physical traits, the promotion policy should not be unified for the country as a whole but a flexible

one with a regional orientation. As such, demographic mapping showing potential areas of the country should be the primary field of operation. But considering the problems, it is a difficult task to solve. Hence, an appropriate panel for sports promotion representing sports scientists. Coaches, sporting associations and Government representatives may take up the following modules of work programme for its consideration.

Module-1 : Sports Science units to be opened at different parts of the country to feed-back the whole programme in line with the Jikei University School of Medicine, Tokyo.

Module-2 : Mass participation from grass-root level to the level of seniors and even of the veterans should be encouraged. Basic potentiality data must be recorded and preserved in an appropriate Data Bank. The training and practice should be primarily organised in local areas without hampering the education, domestic and social environment. This will provide a list of highly potential candidates.

Module-3 : Those selected from among the highly potential candidates may be sponsored to centres of Excellence, with modern type of training and practice under the guidance of best Coaches and with best sports appliances.

Module-4 : Periodical monitoring of the whole programme with analysis and required modifications needs to be done, communication of knowledge of recorded data should be made thruogh data bank to all concerned.

PROMOTION OF INDIGENOUS FOLK SPORTS AND GAMES

Remote areas of India being isolated due to geographical and socio-political constraints, due to improvement after Independence, these are gradually becoming integrated with the main stream forming a cultural honey-comb. Archery, Wrestling, Martial arts, Javelin and Discus throwing, Swimming etc. are examples of some of them. Some are performed with spiritual regard, some are just recreational; yet physical excellence is the prime show. It is required to explore the constraints of these indigenous sports and games in the country. It is pertinent to promote them as national policy for unity and national integrity.

CONCLUSION

With the concept of engineering human factors in sports, and a multi-disciplinary approach to it, the application of the suggested steps is expected to add a successful chapter to the scenario of Indian sports.

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UNDERSTANDING WETLANDS

Ajai Kumar Singh, R. K. Panday & Shalini Singh*

The knowledge of distribution and biodiversity of wetlands is very important at local, regional, national and international level for sustenance of the society. Wetlands perform numerous valuable functions such as recycle nutrients, purify water, attenuate floods, maintain stream flow, reacharge ground water and also serve in providing drinking water, fish, fodder, fuel, medicine, wildlife habitat, control rate of run-off in urban areas, buffer shoreline against erosion and recreation to the human being. In the present article a brief attempt has been made to define wetlands alongwith their importance and classification.

INTRODUCTION

Marshes, swamps and bogs have been well known terms for centuries but in recent years these landscapes have been grouped under single term "Wetlands". This general term has grown out of a need to understand and describe the characteristics and values of all waterlogged areas and then wisely and effectively manage them.

There is no single ecologically sound and universally acceptable definition of wetland primarily because of their diversity and for the lack of clear demarcation between dry and wet environments. In 1971, Ramsar Convention, an intergovernmental treaty on worldwide wetlands conservation, worked out a definition of wetlands as follows : Wetlands are 'areas of march, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salty, including areas of marine water, the depth of which at low tide does not exceed six meters.' In fact, the Ramsar definition goes beyond the areas actually considered as wetlands to 'incorporate riparian and coastal zones adjacent to wetlands' and also efforts to capture 'islands or bodies of marine water deeper than 6m at low tide lying within the wetlands' as part of the wetland continuum. Piecsymaska[1] is of the opinion that wetland is a "store" of accumulated matter of terrestrial and aquatic origin. According to him wetlands must have one or more of the following attributes : (i) the substrate is predominantly undrained hydric soil, (ii) atleast periodically the land supports predominantly hydrophytes and (iii) the substrate is non-soil and saturated with water or covered by shallow water at sometimes during the growing years. According to Gopal,[2] wetlands lie at the interface between the land and open waters and include a wide spectrum of habitats. These are distinct from other ecosystems primarily by their hydrological environment characterized by waterlogging of the soils often associated with submergence to different depths for varying periods of times, and subjected to water level changes of such large magnitude and frequency that are rarely experienced by the biota in terrestrial or true aquatic ecosystems. Cowardin et al.[3] have defined wetlands are "lands transitional between terrestrial and aquatic system when the water level is usually at or near the surface or the land converted by shallow water." According to Waller,[4] wetland is an eco-system of lowland areas where water is commonly accumulated to induce characteristic water loving and water tolerant vegetation and anaerobic humic soils.

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These inundated or flooded basins are fertile, rich, productive systems that rival the most productive natural and even intensively managed agroecosystems.

This unique resource has induced the evolution of uniquely adopted taxonomic groups and species that are found in no other place, including water birds, semi-aquatic mammals, amphibians, reptiles and invertibrates. The flora is even more unique and diverse and is the energy fixing base for complex food chains that result in such diversified wildlife resources. Mitsch and Gosselink[5] have defined wetlands, as 'lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water (**Table-1**).

TABLE 1: CATEGORIES OF WETLANDS.

Types	Characteristics
(A) Inland Fresh Areas	
1. Seasonally flooded basins or flats	Soil covered with water or Waterlogged during variable periods but well drained during much of the growing season.
2. Fresh meadows	Without standing water during growing season ; waterlogged to within a few centimetres of surface.
3. Shallow fresh marshes	Soil waterlogged during growing season ; often covered with 15 cm. or more of water.
4. Deep fresh marshes	Soil covered with 15-90 cm of water.
5. Open fresh water	Water less than 3 metre deep. Bordered by emergent vegetation.
6. Shrub swamps	Soil waterlogged ; often covered with 15 cm or more of water.
7. Wooded swamps	Soil waterlogged, often covered with 30 cm of water. Along sluggish streams, flat uplands shallow lake basins.
8. Bogs	Soil waterlogged ; spongy covering by mosses.
(B) Coastal Fresh Areas	
9. Shallow fresh marsh	Soil waterlogged during growing season, at high tides as much as 15 cm of water. On lowland side deep marshes along tidal rivers, sounds deltas.
10. Deep fresh marshes	At high tide covered with 15 cm to 90 cm of water. Along tidal rivers and bays.
11. Open fresh water	Shallow portions of open water along fresh tidal rivers and sounds.
(C) Inland Saline Areas	
12. Saline flats	Flooded after periods of heavy precipitation ; waterlogged within few cms of surface during the growing season.
13. Saline marshes	Soil waterlogged during growing season ; often covered with 60-90 cm of water ; shallow lake basin.
14. Open saline water	Permanent areas of shallow saline water. Depth variable.
(D) Coastal Saline Areas	
15. Salt flats	Soil waterlogged during growing season ; sites occasionally to fairly regularly covered by high tide. Landward sides or islands within salt meadows and marshes.
16. Salt meadows	Soil waterlogged during growing season. Rarely covered with tidewater ; landward side of salt marshes.
17. Irregularly flooded salt marshes	Covered by wind tides at irregualr intervals during the growing season. Along shores of nearly enclosed bays, sounds etc.
18. Regularly flooded salt marshes	Covered at average high hide tide with 15 cm or more of water ; along open ocean and along sounds.
19. Sounds and bays	Portions of salt-water sounds and bays shallow enough to be diked and filled. All water land-ward from average low tide line.
20. Mangrove swamps	Soil covered at average high tide with 15-90 cm water.

INDIAN WETLANDS

Wetlands occur in areas where precipitation exceeds the potential evapotranspiration leaving an accumulated surplus. Climatically about one-third of Indian sub-continent falls within this category and wetlands are thus common throughout especially in Assam, Bihar, Eastern Madhya Pradesh, East & West Coastal regions, Jammu and Kashmir, Jharkhand, North-Eastern Andhra Pradesh, Orissa, Uttar Pradesh and Uttaranchal and West Bengal. Wetlands also occur in areas where local physiography enables certain areas to accumulate water. The variability in climatic conditions and the changing topography are responsible for significant ecological diversity encountered within the wetlands. Gopal[6] has reported 1193 wetlands covering a total areas of 3.9 million hectares in 274 districts of India. According to Directory of Indian Wetlands (1993), Wetlands in India occupy 58.2 million hectares, including areas under wet paddy cultivation. Majority of the inland Wetlands are directly or indirectly dependent on the major rivers like Ganga, Brahmputra, Narmada, Godavari, Krishna, Kaveri, and Tapti. They occur in the hot arid regions of Gujarat and Rajasthan, the deltaic regions of the east and west coasts, highlands of Central India, wet humid zones of south peninsular India and the Andman & Nicobar and Lakashwadeep islands. The Indo-Gangetic flood plain is the largest wetland system in India, extending from the river Indus in the west to Brahmputra in the east. This includes the wetlands of the Himalayan terai and Indo-Gangetic plain.

Gopal[6] has grouped Indian fresh water wetlands into two major types depending upon the duration of waterlogging : (i) The perennial wetlands with waterlogging throughout the year include habitats such as riverbanks and margins of large lakes or reservoirs and (ii) Seasonal wetlands which dry up completely for varying periods of time depending upon the vagaries of monsoon. Examples are numerous village ponds, fish ponds, paddy fields, river flood plains, etc. Extent of wetlands in India and their classification (Tables 2 & 3) have been discussed by Parikh & Parikh[7] and Prasad et al[8]. respectively.

TABLE 2 : EXTENT OF WETLANDS IN INDIA[7]

Wetlands in India	Area (million ha)
Area under wet paddy cultivation	40.9
Area suitable for fish culture	3.6
Area under capture fisheries	2.9
Mangroves	0.4.
Estuaries	3.9
Backwaters	3.5
Impoundments	3.0
Total area	58.2

TABLE 3 : CLASSIFICATION OF INLAND WETLAND IN INDIAN SUBCONTINENT[8].

1. **Forest** A. Dense B. Open 2. **Arable**, 3. **Wasteland** 4. **Wetland** A. Ponds/Tanks/Lakes B. Reservoirs C. Waterlogged. D. Oxbow lakes/ Cut off a. Turbidity low b. Turbidity Medium c. Turbidity High (i) Aquatic vegetation poor coverage (ii) Aquatic vegetation moderate coverage (iii) Aquatic vegetation high coverage. 5. **Roads** 6. **Major Habotation**.

ADVANTAGES OF WETLANDS

Ecologically Wetlands may be viewed as complex hydrological and bio-geochemical system endowed with specific structural and functional attributes and performing major ecological role in biosphere. The studies under IBP and elsewhere during sixties and seventies demonstrated that the wetlands are among the most productive ecosystems.[9] The major interest in wetland studies was earlier emphasized on migratory bird conservation and other aquatic life. The Ramsar conference of 1971 adopted a convention on wetlands and made recommendations for the conservation of wetlands as waterfowl habitats. More recently, it has been recognized that in addition to providing wildlife habitat, wetlands play a great role in flood control, recharge of aquifer, regulating water quality, treatment of waste waters, reducing

sediments load, production of organic material at rates equalled by few other eco-systems, ground water recharge, dependence of agriculture and animal husbandry in drought prone areas, pollution abatement, biofertillizers, etc.

EPILOGUE

Wetlands are one of the most threatened habitats of the world. Wetlands in India, and in other parts of the world are increasingly facing several threats due to various human activities like rapidly expanding human population, large scale changes in land use/land cover, burgeoning development projects and improper use of watersheds. Significant losses have resulted from its conversion threats from industrial, agricultural and various urban developments. All these activities have led to hydrological perturbation, pollution and their after effects. Wetlands are often described as "Kidneys of the landscape". Hydrologic conditions can directly modify or change chemical and physical properties such as nutrient availability, degree of substrate anoxia, soil salinity, sediment properties and pH. These modifications of the physio-chemical environment, in turn have a direct impact on the biotic response in the wetland. The biota may respond with changes in species composition and diversity and in ecosystem productivity. Wetland conservation in India is indirectly influenced by an array of policy and legislative measures. India is also a signatory to the Ramsar Convention on Wetlands and the Convention of Biological Diversity. In addition to government regulation, better monitoring is required to increase the knowledge of the bio-physcial properties of every wetland resources, alongwith wetland dynamics and their controlling methods.

For floods, first in Mumbai and then in Chennai in the year 2005, the common reason for the misery in both cities can be traced to missing mangrove wetlands and unplanned urbanisation. But Kolkata seems to have learned from these mistakes. The West Bengal government passed an ordinance on November 17, 2005 which will protect the Eastern Kolkata Wetlands. There is a need to enhance research awareness campaign on economic values of wetlands and their biodiversity. Factual information is hard to find or non-existent. Last but not the least, nothing can be achieved without peoples' participation. In developing countries like India, voluntary organisations, institutions or pressure groups can play an important role in conservation of wetlands.

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AQUEOUS PROCESSING OF MINERALS AND METALS : PAST, PRESENT AND FUTURE

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Processing of ores and minerals as well as metals and their compounds at relatively low, often ambient temperatures employing aqueous solutions is known as hydrometallurgy. Occasionally organic reagents are also used. This branch of metallurgy has a long history and it has become increasingly relevant with attempt to win metals from complex and low grade ores. It is more confined to the extraction metallurgy of nonferrous, base and precious metals. Of late, hydrometallurgy is finding newer applications in treatment of wastes and environmental protection. This article presents a brief summary of some contributions of hydrometallurgy in the past, and at present and also some likely use it will find in future.

INTRODUCTION

Hydrometallurgy involves processing of ores, minerals, metals and their compounds at ambient and relatively low temperatures as compared to pyrometallurgy. It had played an important role in early developments in chemistry and metallurgy. The alchemists employed it widely. That pure copper could be precipitated from copper sulphate solution by the addition of iron filings was known as early as the 7th century. With the discovery of electrolysis and electrolytic dissociation of aqueous solutions, hydrometallurgy received a tremendous boost. An outstanding application of hydrometallurgy is pressure leaching of bauxite, the main ore of alumina, which dissolves Al_2O_3 in NaOH to produce sodium aluminate in solution from which pure Al_2O_3 is produced for subsequent electrolysis of Al_2O_3 dissolved in cryolite (Na_3AlF_6) to produce aluminium metal. The alkali leaching is called Bayer process and the entire aluminium production is based on this.

Other selected landmarks of hydrometallurgy may be cited chronologically as follows.[1,2]

7th Century A.D.	Apparent transmutation of iron into copper by Alchemists, $Cu^{2+} + Fe \rightarrow Cu + Fe^{2+}$; in Europe, Cu precipitation from acid solution with metallic Fe.
8th Century A.D.	Discovery of aqua regia by Arab alchemist Jabir Ibn Hayyan (720-813) as known solvent for gold ; used till today in gold refining.
12th-13th Century	To develop inorganic acids for treating ores and minerals by Alchemists.
16th Century A. D.	Heap leaching of copper containing pyrite in the Harz mountains of Germany and in Rio Tinto of Spain.
18th Century A. D.	Production of potash for soap and glass industries by leaching ashes left after burning wood, e.g. in Quebec forest clearing was on large scale.
19th Century A. D.	(a) Electrochemical refining of copper and silver in U. S. A. (1871-72).

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(b) Invention of cyanidation process to treat gold ores with aqueous sodium cyanide and precipitate gold from leach solution by zinc (1887).

(c) Invention of Bayer's process for pressure leaching of bauxite by NaOH solution and precipitation of crystalline $Al(OH)_3$ from sodium aluminate solution by seeding (1887-1892).

The 20th century A.D. saw many entries with a profound technological edge. Some of the commercial successes are listed here.

(a) Electrowinning replaced cementation for copper recovery in Chile (1912) ;

(b) Aqueous ammonia leaching of native copper and oxide ores (Lake superior, Alaska, 1916), development of hydrometallurgical zinc process at Trail and Anaconda (1916) ;

(c) Development of the uranium technology for US Manhattan project to produce an atom bomb ; use of sodium carbonate leaching, ion-exchange and solvent extraction for recovery of uranium and separation of lanthanides by ion exchnage (1940s) ; recovery of magnesium from sea water (1941) ; realization of earlier Romans' evidence on the role of bacteria in copper solubilization in mine sites (1947) ;

(d) Application of pressure leaching technique revolutionized the recovery of nickel from nickel sulphides, overcome the slow kinetics of hydrometallurgical processes, precipitation of pure nickel from leach solution by hydrogen under pressure in autoclaves (1950s) ;

(e) Application of bioleaching technique to gradual use of heap in-situ leaching operations for copper extraction from low-grade ores (1960's) ; solvent extraction became popular for copper extraction (1950-1960s) ; widespread use of pressure leaching to treat different ores of laterites, tungsten and uranium (1960s) ;

(f) Discovery of galvanic action during sulphide leaching, recovery of traces of uranium from spent leach liquors after copper precipitation with scrap iron, pressure leaching of zinc sulphide concentrate with dilute sulphuric acid at Trail and Tammins in Canada (1970s) ;

(g) Hydrometallurgy of gold greatly advanced with widespread application of charcoal technology, and aqueous oxidation of gold refractory ores (1980s) ;

(h) Hydrometallurgical and biohydrometallurgical treatment of different complicated ores like ocean manganese nodules, nickel laterites, complex sulphides, electronic scrap materials etc (1990s).

Essentially, the scope of hydrometallurgy is easily explained by the line diagram shown in **Figure 1** giving a general outline of various possible aqueous processing steps. Also, there are many text books on extractive metallurgy but two have provided special treatise on hydrometallurgy, the authors being Fathi Habashi, Canada (1993)[1] and H. S . Ray, R. Sridhar and K. P. Abraham, India (1985).[2] While the former book highlights the elementary theoretical basis of solution chemistry while laying stress on unit operations, the latter book described industrial and scientific aspects of nonferrous metals production in India and as relevant to the available mineral resources in the country.

Presently, India is placed on equal footing along with advanced countries in the area of hydrometallurgy related research and development. This achievement could become possible due to significant contributions made from Bhabha Atomic Research Centre, Mumbai & Department of Atomic Energy, Govt. of India, Defence Metallurgical Research Laboratory, Hyderabad ; various laboratories of the Council of Scientific

& Industrial Research, viz. Regional Research Laboratory, Bhubaneswar, National Metallurgical Laboratory, Jamshedpur, Central Electrochemical Research Institute, Karaikudi, Indian Institute of

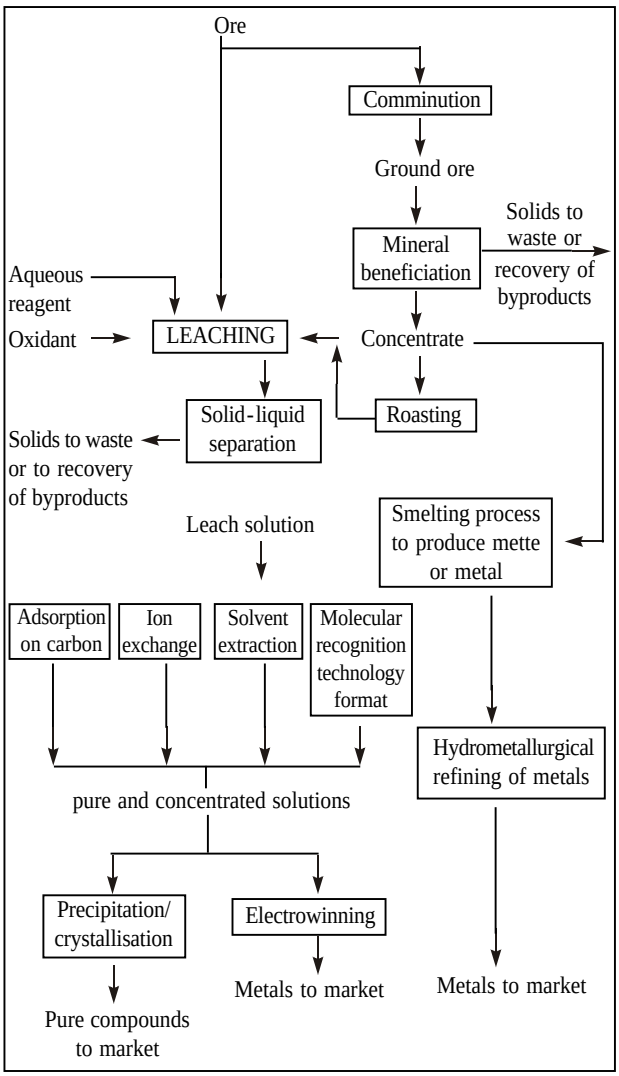

Fig. 1 : **General Outline of Various Possible Aqueous Processing Steps.**

Chemical Technology, Hyderabad, Regional Research Laboratory, Bhopal and others ; academic institution like Indian Institute of Science, Bangalore, IT-BHU, Varanasi, Indian Institutes of Technology and others from various universities, NITs etc. ; Govt. undertaking like, EIL-New Delhi, HZL-Udaipur, HCL-Kolkata, NALCO-Bhubaneswar, IRE-Mumbai, GMDC-Ahmedabad, NMDC-Hydrerabad, Hutti Gold Mines Company-Karnataka, Dept. of Ocean Development & Dept. of Science & Technology, Govt. of India, and others ; professional societies, such as The Institute of Metals, Indian Institute of Chemical Engineers and Indian Institute of Mineral Engineers etc.

PRESENT SCENARIO OF HYDROMETALLURGY

A hydrometallurgical process for the extraction of metal values from ores, concentrates, or secondary materials essentially contains three basic steps—dissolution of the valuable metal in the aqueous solution (leaching), purification of leach solution, and subsequent recovery of values from the purified solution. The terms like *Aqueous Processing* or *Solution Processing* are now increasingly used to denote emerging techniques of hydrometallurgical related leaching processes including solution purification and electrowinning or hydrogen reduction to produce the metal. Presure leaching and bioloeaching are the two special techniques that made hydrometallurgy highly competitive and very attractive to treat the difficult ores in techno-economical and environmental benign ways.

Pressure leaching : Due to obvious reasons, aqueous processing of ores, minerals, metals and their compounds is often performed at ambient temperatures. However, there are frequently advantages to be gained by operating at temperatures above the normal boiling point of the solution (to overcome the slow kinetics of processes) and hence at pressures exceeding the atmospheric pressure. In such cases the term pressure hydrometallurgy is applied. This term also takes care of partial pressures of gaseous reactants that participate in hydrometallurgical reactions (precipitation of metals from solutions). The track record of numerous successful commercial applications has started from the

traditional Bayer process for the recovery of alumina from bauxite, followed by its extensive use in uranium technology, leaching of nickel sulphide, zinc sulphide concentrates and treatment of refractory gold ores. This track record along with recent improvements in autoclave design, materials of construction, process control etc have now made pressure hydrometallurgy regarded and led to its availability as a reliable and cost effective process option. New applications of pressure leaching process include production of refractory metals and molybdenum metal.

A significant success of aqueous processing can be seen in its application for dump/heap/*in-situ* leaching of low-grade copper ores as shown in **Figure 2**. Considerable energy savings and

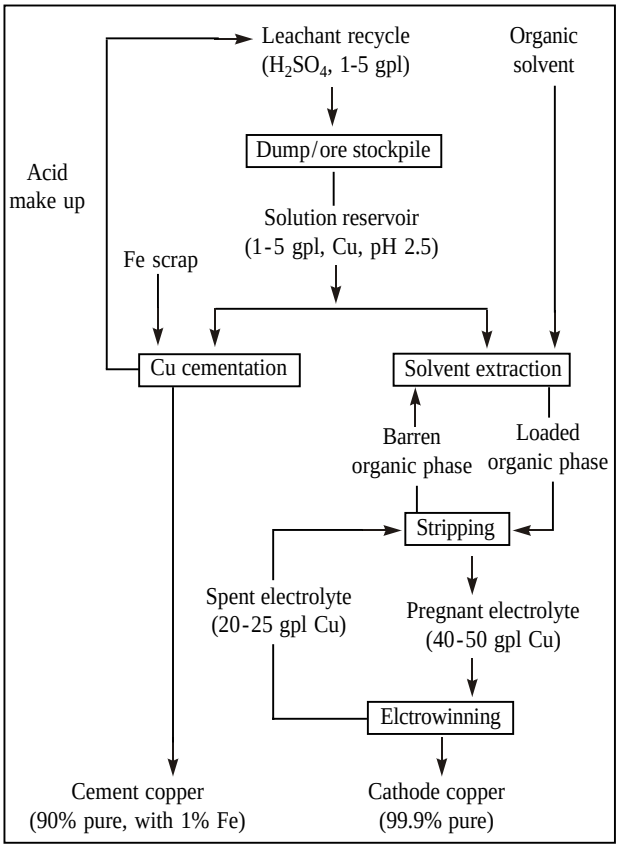

Fig. 2 : **A typical flowsheet for dump/heap/in situ leaching of low-grade copper ores.**

environmental compliance are said to be advantages of such hydrometallurgical process ameliorating the accessibility of the valuable component by the leaching reagent. That is, without removing the material from the waste pile or from the ground, this process produces copper from sources that in the past would have gone untouched, thus reducing the reliance on conventional ore bodies.

Bioleaching : Mining industries, the world over, have enthusiastically adapted biotechnological methods for environmental protection, in recent times. Biomineralisation, biomimetics and biomaterials processing have become topics of interest. Realisation of the potentials of tiny microorganisms inhabiting the earth's crust, fresh water and sea water environments in bringing about a variety of geological, chemical, metallurgical and biological reactions under extreme conditions have opened up a new branch of applied science and technology, namely, biomineral technology.[3]

Some potential aspects of biomineral technology as relevant to the Indian context would include : biomineralisation of Indian deposits by making use of microbial identities as bioindicators of different mineral forms ; biomineral processing to beneficiate ferrous and/or nonferrous ores, refractory and/or ceramic materials ; and bioenvironmental control & bioremediation to address ecological and environmental problems faced by mining industries. The opportunities for bioleaching of low grade ores, mine wastes, tailings as well as metal concentrates include the *in-situ* or solution mining in different areas of copper spray leaching of abandoned stopes, and bioheap leaching of small copper deposits ; bioleaching of zinc ores & concentrates, and biorecovery of zinc & silver from zinc tailings ; biotreatment of sulphidic refractory ores as a pretreatment process for liberation of locked-up gold particles ; and the use of *in-situ* and heap leaching techniques for bioleaching of lean grade uranium ores. In all these cases, the key role played by the bacteria such as *Thiobacillus ferrooxidans* is in a indirect way, i.e. the dissolution brought about by bacterial

metabolite, namely acidic ferric sulphate. India presently do not produce nickel and molybdenum, the strategic metals of high national importance. In this context, heterotropes can be used to solubilize nickel from lateritic ores, a bulk Cu-Ni-Mo concentrate can be subjected to bioleaching for individual and selective metal recovery.

Some of the public sector undertakings may be cited for having taken the initiative to adapt biomineral technology for enhancement of metal recovery from lean grade and waste ore burdens. Those include the Hutti Gold Mines Company Ltd., Karnataka for biotreatment of sulphide gold-bearing ores and concentrates ; Hindustan Copper Ltd. for bioheap leaching of low grade sulphide copper ores at Malanjkhand ; Hindustan Zinc Ltd., Udaipur, for bioleaching of zinc tailings, and the Department of Atomic Energy, Atomic Minerals Division for testing of bioheap leaching of low grade uranium ores.[3]

Solution purification & metal recovery : As on today, enumerable metals and their compounds are produced by electrolytic dissociation of aqueous solutions first produced by dissolving metallic values from ores and minerals using acids or alkaline reagents. Some 80 percent of total zinc produced and 90 percent gold produced worldwide employ a leaching step. Similarly, for a strategic metal like nickel, the new commercial plants installed as of now are all based on hydrometallurgical leaching process using nickel laterites as starting material. To constitute a broad based leaching activity and its application thereof, the downstream processing would be able to handle leach solutions of varying composition emanating from various raw materials, including recycling of metals from obsolete electronic components, spent catalysts, and reactive process residues, recovery of values from effluents generated in many manufacturing activities, e.g. integrated circuits and printed circuit boards, and to recycling water itself.

Some of the modern methods for the separation, purification and recovery of metal ions from leach solutions are solvent extraction (SX) and ion exchange (IX) techniques. The SX technology is today a well accepted unit operation for the separation and purification of rare earth, noble metals, copper, nickel, cobalt and zinc. India, in spite of having sizeable number of publications and indigenous expertise developed over the last three decades, has been able to set up, so far, only a handful of commercial SX plants of smaller capacity of less than 2 t metal/day. However, this would be a harbinger for the metal recovery industry in the country based on a variety of secondary sources. With recent availability of special resins, IX technology is now found useful in environmmental remediation and waste minimization, e.g. application to treating water/ wastewater, removal of heavy metal cations/anions from organic solutions etc.

Electowinning (EW) refers to a proces that produces a metal by the electrolysis of an aqueous solution. The final step in many hydrometallurgical processes is the reduction of the metal ion to a high pure metal product. EW forms a technique for metal ion reduction and plays an important role in a hydrometallurgical flow sheet since it furnishes a product that is directly marketable as a metal or its compound. However, it consumes significant quantitites of energies and warrant a major cost reduction by minimizing energy consumption, e.g. production of aluminium metal, preparation of advance materials like battery grade nickel hydroxide etc. The chemical reduction processes of gaseous pressure reduction, and precipitation/ crystallization have recently become very important for production of compounds from the pure solution. **Figure 3** describes a general scheme for solution purification and metal recovery. It may be cited that a major fraction of the costs of production of a desired metal/compound is constituted by the number as well as efficacy of separations involved

in removing undersirable side products and impurities.

Aquenous Processing from Mint to e-Waste : The selective separation of gold traditionally carried out on a small scale in mints, mainly depends on the gold content and the type of impurities present in the alloys. For example, silver is only soluble from a gold alloy (<25% Au) in both nitric and sulphuric acids, but not gold. For more than 25% gold containing alloys, interestingly, these acids individually cannot solubilise silver, in stead, *aqua regia* (HNO_3 and HCl in 1 : 3 volume ratio) used as leaching medium wherein gold selectively dissolves leaving silver as an inert insoluble solid residue. Such methodologies have presently been explored for recovering precious metals selectively from the abundant secondary sources of alloys/ non-mounted printed wiring boards (PWBs)/printed circuit boards (PCBs) of computers and cellular phones. With stringent implemenation of emerging legislation on the accumulation of electrical and electronic equipment after the usual life times of the final products (termed *e-waste*), it looks that aqueous processing techniques will dominate the future recovery and the recycling of materials found in e-waste as a statutory obligation. Thus, the traditional refining of gold alloy materials in mints is pertinent to the present day efforst made for aqueous processing of electronic scrap to get precious metals present therein.

The competitive edge of hydrometallurgy to the technological advancement of metal extraction is underniable as it constitutes many unit processes and new developments related to : biohydro-

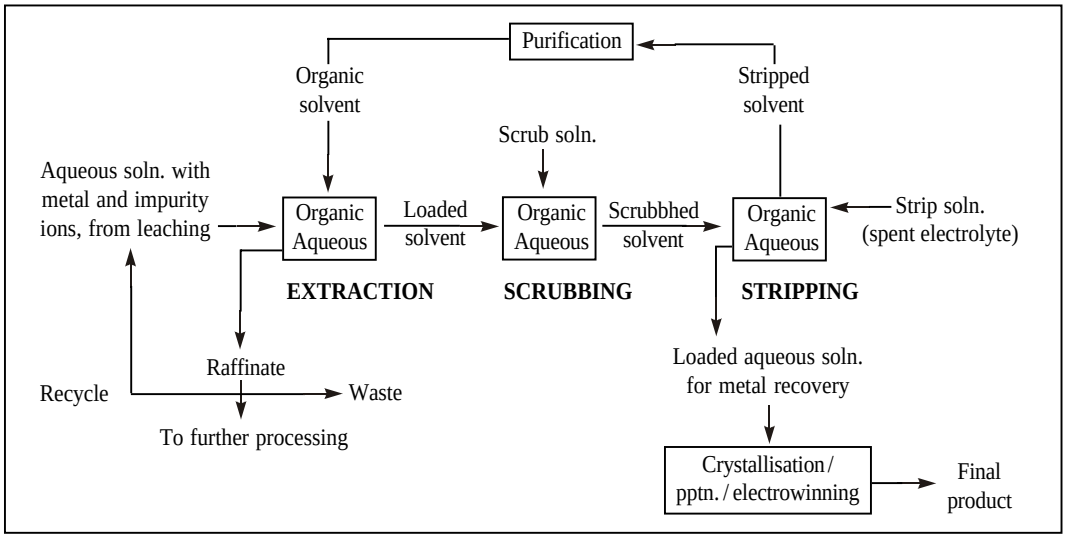

Fig. 3 : **Outline of a general scheme for solvent extraction process.**

metallurgy ; leaching (pressure oxidation, pressure leaching and solution mining) ; environmental applications ; solution concentration and purification by adsorption ; ion exchange, and solvent extraction; process development and modeling ; thermo-dynamic and kinetic evaluations ; plant practices and innovations ; waste water and resource recovery; electrometallurgy ; process mineralogy and characterization etc. This innovative work merits all attention and holds bright future, and new plants being planned, presently, do not suffer on the account of environmental planning.

That, obviously, means the environmental planning and implementation technologies for an existing industry have to take into many constraints. A new plant being planned does not suffer on this account. It is a fact that aqueous processing of metals to have matured only in the second half of

last century in spite of persistent environmental problems such as the generation of reactive wastes, e.g. jarosite and goethite wastes from the electrolytic zinc process, accidental exposure of birds and other species to toxic lixiviants etc. However, the global efforts have continued to address the environmental problems while retaining all the attendant benefits of aqueous processing and thus making its future promising.[4] Such efforts represent the archetype of the ecologically sustainable development which is aimed at reducing waste generation, and, therefore, waste treatment costs, conserve resources, reduce input costs, improve process efficiency and working environment, cut operating costs through recycling and reuse, and create a clean and green local and global environment.[5]

Accordingly, the scope of some potential present day applications of hydrometallurgy pertains to extraction of metals from low-grade sources & complex ores, and treatment of liquid wastes including waste water. This would be in the light of what makes hydrometallurgy or aqueous processing of metals a specialized subject as will be described now.

AQUEOUS PROCESSING–SOME POTENTIAL FUTURE TECHNOLOGIES

(a) Processing of Complex and Lean Grade Ores

In India, today, there is an impressive record of growth of nonferrous metal production, but the country ranks very low in world production of many of the nonferrous metals due to stiff global competition and numerous economic uncertainties. Moreover, the gradual depletion of high grade monometallic ores has necessitated the utilzation of low grade and complex mineral resources e.g. complex sulphide ores, chromite overburden, ocean nodules, etc. and metallurgical; intermediates like calcines, mattes, speiss and scrap. Efforts to recover metals from those sources have led to a search for clean, environmentally acceptable hydro-metallurgical processes. Such an approach would naturally demand for an overall understanding of the integrated operation of several connected unit operations so as to address process optimization and environmental protection.

Complex sulphide ores : Complex and low grade ores are found in large quantities in many countries. These ores have now assumed a wide significance as plentiful resources of nonferrous, base and precious metals. Due to their geochemical affinity, the sulphide ores of copper, lead and zinc commonly occur as fine grained intergrowths along with pyrite (FeS_2) and/or pyrrhotite ($Fe_{1-x}S$) in many deposits thereby posing problems during mineral beneficiation and extraction. Since the individual deposits of Cu, Pb, Zn are now almost fully exploited, the focus during the last three decades has been on prospecting, mining and processing of the complex sulphide ores which are at times of very low grade, but are a major source of base and precious metals. The challenge is to find efficient and selective methods for leaching sulphide ores and concentrates, which are also environmentally accepted. Successful aqueous processing of complex sulphide ores depends on the composition and mineralogy of raw materials and on their leaching behaviour. Thus, any detailed investigation aimed at the dissolution of metal values from complex sulphide ores would be of importance theoretically and industrially.

While hydrometallurgical approaches were proposed long ago, large sums were spent on developing hydrometallurgical processes for treating such off-grade ores only after the second world war. Presently several processes based on acid, ammonia, ferric chloride/sulphate, bio-, etc are being attempted worldwide to treat complex sulphides by hydrometallurgy. Each process route has its unique technological advantage and limitations. The acid leaching processes are fast with corrosion problems and non-selective metal dissolution leads to very expensive down-stream operations. High temperature-pressure operations

have the typical engineering limitations for operation and scaling up. The bioprocesses are too slow and yet to be established for the bacteria-metal tolerance limits.

There is good scope for ammonia leaching operation in India to treat lean grade oxide/sulphide ores. There are many complex sulphide deoposits scattered in the states of India viz. Gujarat, Rajasthan, Uttar Pradesh, Sikkim, Tamil Nadu, Orissa etc. This Laboratory has worked extensively over that last two decades in assoication with Engineers India Ltd. & Gujarat Minerals Development Corporation Ltd. and made a significant contribution towards the development of a process based on ammonia pressure leach, SX and EW for treating sulphide mineral of a single deposit, Ambaji (Ambamata), Gujarat origin and estimated at eight million tonnes. Also, a modern hydrometallurgical test plant having a capacity to process 1 ton of ore/concentrate per day had been set up at the laboratory in collaboration with German Agency for Technical Co-operation (GTZ) for untilization of complex sulphides.[6] Several publications were brought out be the laboratory describing the laching mechanism and kinetics of the process. These are on the lines of giving a general focus of current research areas for optimization of ammonia leaching of sulphide minerals pertaining to : understanding the mechanisms by which selected suplhide minerals are dissolved ; studying the process mineralogy of sulphide ores and concentrates ; studying the chemistry of sulphur species in the leaching of sulphide minerals ; and investigating the influence of electrochemical interactions, surface area changes in solid leach residues during leaching etc for inproving the oxidation of sulphides in selected mineral leaching systems.[7]

Processing of Nickel laterites/Chromite overburden : Nickel can be found in the soil in two different types of mineralisation : sulphidic and lateritic. The laterities can further be divided into two types, oxides/lemonites (containing lower magnesia and nickel) & silicates (containing higher mangesia and nickel). The cobalt contents are typically fairly high in lemonites ranging, however, within limits. Similarly in the sulphidic ores the nickel as well as copper and cobalt contents vary a lot. So far, nickel production from the sulphidic ores had predominated, but in the future, the oxidic ores will play an ever-increasing role.

Traditionally, there are are two types of nickel processing techniques. Pyrometallurgy forms the first type and mainly used in the treatment of sulphidic concentrate & high nickel containing laterites. Second type comprises hydrometallurgical treatment and found applicable to low nickel-containing laterites and in the refining of matte or concentrate. However, the new commercial plants installed as of now are all based on hydrometallurgy only with somewhat different/modified process concepts of pressure leaching & chloride leaching routes applicable for teatment of both sulphides and laterities ; whereas bioleacing, and atmospheric leaching recommended for sulphides and laterites respectively.

In India, millions of tonnes of chromite overburden (COB) stockpiled at Sukinda valley of Orissa poses an environmental problem. Containing about 0.7% nickel and approximately 0.1% cobalt, it is also a valuable source of nickel. A consortium of several national Institutions and Laboratories with Regional Research Laboratory (RRL), Bhubaneswar as the nodal agency has developed a process for recovering high pure nickel (99.9%) with cobalt as a byproduct from this COB. The major steps involved are : comminution, ammoniacal leaching, counter current decantation, ammonia stripping, preparation of basic nickel carbonate, dissolutions, solvent extraction and electrowinning. The process was developed and tested in different stages, viz. laboratory, bench and pilot scale. Then the process had been successfully tested in the nickel technology proving plant (Nickel TPP) of capacity 10t/day COB. This

Nickel TPP established jointly by the Council..... of Scientific & Industrial Research, Govt. of India, and Hindustan Zinc Limited (HZL), Udaipur, had been set up at RRL, Bhubaneswar, with German assistance. Techno-economic flasability report based on data generated from Nickel TPP may well prove the way for.... establishment of a commerical plant near Sukind having a capacity around 20,000 t/annum of nickel and costing approximately Rs. 2000 crore. The environmental impact would be a societal benefit in addressing the disposal & polution problems associated with COB.[5,8]

Processing of Ocean-Floor Nodules : Trillions of tons of nodules are scattered across the ocean floor. Their principal constituents are manganese, nickel, iron, copper, cobalt, and silicious ocean-floor silt ; collectively termed as managanese nodules, can also be called nickel nodules since they are a potential source of nickel. The nodule reserves are constantly a renewed source unlike land reserves. These ocean manganese nodules present a unique resource of valuable nonferrous metals requiring typical extractive methods to suit their intricate physicochemical characteristics. In general there are two major phases of mineralogical importance, namely manganese dioxide and iron oxides. The valuable minor constitutents such as Cu, Co and Ni are disseminated within their two major phases either by adsorption mechanism or latice substitution. Therefore, any extraction process for nodules should be able to unlock the oxide phases to liberate the valuable minor metals. For this, hydrometallurgical processes are broadly divided into two routes, either mineral acid or aqueous ammonia leaching. The parameters controlling both the processes are : mineralogy ; pulp density and size fraction of the nodules ; lixiviant concentration with/without presence of reducing agent. pH ; time, temperature, pressure ; type of reaction vessel, agitation etc.[2,3]

RRL, Bhubaneswar, and Bhabha Atomic Research Centre, Mumbai have developed a significant aqueous processing route. The demonstration plant of capacity to treat 500 kg of nodule/day, recently set up at HZL. Udaipur, by RRL-Bhubaneswar in association with Engineers India Ltd., has been sucessfully operated to test the process to extract copper, nickely, cobalt and managanese metals.[9] The unit operations of the process route include the ammonia leaching (with SO_2 reduction), demanganisation, ammonia removal and recovery, copper SX-EW, bulk sulphide preciptiation. High recovery of copper (90%), nickel & cobalt (80%) makes this hydrometallurgical process highly competitive. The notable feature are the absence of any pyrometallurgical step and with a flexibility to produce metals and compounds if so preferred, e.g. cobalt and nickel as sulphides. These efforts are in line with projected futureg global developments in the field with an eye on commercialization.

There have also been some laboratory scale studies on bioleaching of ocean nodules. Some unresolved challenges are related to aerobic heterotopic reator leaching. Microbially produced ligands/acidulants need to be operated in a two-reactor system in which the first reactor would be used for growth of the desired microbes under optimal growth conditions, preferably in continuous mode. The spent culture medium from this reactor can be bled into the second reactor, containing the ore to be leached. India has a great stake in the commerical utilization of this ocean resource and biotechnology likely to hold a great promise in this context.[3]

(b) Biological Treatment for Environmental Protection/Compliance

Waste water treatment : The requirement of water in mineral benefication and hydrometallurgical industries is very large and source of water supply is often a criterion for selecting the site of a large metal extraction plant. It is said that water requirement to produce a tonne of zince is 70-80 cu.m, and its consumption for steel production is about 100-200 cu.m/tonne. Due

to limited resources of water available at the site, it is imperative to treat and recycle the wastewater most effectively. Moreover, the chemical and metallurgical industries contribute greatly towards pollution of rivers and other water bodies by discharging acids, bases and other chemicals along with heavy metals. When heavy toxic metals of appropriate concentration are also present, some chemical, physical or biological methods are to be used. The water discharged from some mines containing valuable metals such as copper and uranium can be recovered economically using liquid ion exchange processes. Certain bacteria are reported to be effective to breakdown the toxic effluents thereby contributing to a dual benefit of providing quality water as a precious resource in arid zones, and decontamination of plentiful water sources of tropics.

Biochemical process of acid mine dranage treatment : Acid mine drainage (AMD) also called acid rock drainage (ARD) produced by the atmospheric weathering of waste rocks in sulphide mining areas is a serious environmental problem as it contains high concentration of dissolved iron (ferrous and ferric) and toxic metals like copper and zinc. This is one of the causes of the destruction of forests and vegetation today. Recent estimates have indicated that acid generating waste mine sites totalled over 12,000 ha tailings and 350 million ton waste rock in Canada, approximately 20,000 km of streams and rivers have been impacted by acidic drainage in the U.S., and similar situations prevailed in Australia and Sweden. Out of several treatment methods available for mitigating the problem of AMD, the biochemical treatment appears to be the future aqueous process to tackle the problem of how to reduce the volume of AMD and recover some of the valuable metals from therein.[10] The use of biological processes for removing trace metals from effluents and other solutions despite being slow taking several days, effectively promotes bacterially mediated reduction of sulphate to precipitate metal sulphides. The reaction mechanism of sulphate reducing bacteria (SRB) process is expressed as :

$$H^+ + SO_4^{2-} + CH_2O \rightarrow H_2S + HCO_3^- + O_2$$
$$H_2S + M^{2+} \rightarrow MS + 2H^+$$
$$H^+ + HCO_3^- \rightarrow H_2O + CO_2$$

where M represents metal ions like Cu, Zn, Cd, Fe, Ni and Pb, and CH2O the organic compounds used as untrient for the bacteria. The hydrogen sulphide thus produced by SRB and used to proecipitate metals present in AMD, is known as Biogenic process. It produces compact precipitate of metal sulphides which can be processed for metal extraction. Such a biochemical treatment 'reactive barriers' have been installed in mining sites in Canada for treating AMDs.

Another interesting example is said to be the biological treatement of AMDs and other mine effluents in Wetlands using naturally growing plants like *Sphagnum* moss or *Typha* cattails, the latter being generally more tolerant of acid mine waters. These plants and organic substrate provide sites for bacterial attachment and colony development. The plants also release oxygen into the sediments via their roots. In addition, in the lower anaerobic zone, SRBs occur, which produce metal sulphides by the reaction earlier described.

In India, all the industrial initiatives made so far, as regards the application of aqueous processing of mineral and metals, mark only a beginning and lot of gray area to be covered. A mission-oriented, dedicated and time-bound national policy is the need of the hour for adaptation of hydrometallurgy for environmental compliance. Immediate commercial applications would include the biodegradation of toxins such as cyanide during oxidation of refractory gold ores, ion exchange processes for rare earth separations, treatment of nuclear fuels, and monitoring of water quality, use of wetlands and ecological engineering for renovation of contaminated and disturbed landscapes etc.

CONCLUDING REMARKS

The chronological developments that took place over a long period clearly show that hydrometallurgy has matured into a highly specialized field for extracton of nonferrous metals, viz. treatment of sulphide ores of nickel zinc and gold. Some promising technologies of aqueous processing are identified as : processing of complex and lean grade ores like complex sulphides, chromite overburden/nickel laterites and ocean-floor manganese nodules ; biomineral technology ; and use of biochemical processes for environmental compliance, especially for treatment of acid mine drainage. A concerted effort needs to be made with a great emphasis on sustainability and recovery aspects so that future applications enjoy much scope for diversification.

ACKNOWLEDGEMENT

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DO YOU KNOW ?

Q6. What is tabloid?

Q7. The four corners of the Pyramids face which directons?

Q8. Do twins have identical fingerprints?

SOMETHING TO THINK ABOUT

DISCOVERY OF A NEW MONKEY

H.S. Ray*

Countless species of animals disappeared from the face of earth in the past as a result of natural cataclysms. Some more disappeared in the last two centuries because of senseless slaughter by man. While species continue to disappear very few new and unknown species are discovered, such a discovery being always an exciting event. During the last century or so there may be less than 10 new species that the western world became aware of. The natives living in remote regions or jungles, of course may have been aware of their existence. There are, for example, reports of existence of a huge cattle called, Kouprey, in the jungles of South East Asia and there is a clear picture as evidence. If it still exists, then interbreeding with existing cattle may in the opinion of some Western experts, revolutionise beef production. The Bonobo earlier considered to be pigmy Chimpanzee, is now known as a distinctive animal all together.

As regards the monkeys, many believed that they had seen them all-grey bodies, black bodies, short noses or bulbous noses, tail-short, long or even resembling that of lion. Some fail to note that lemurs of Madagaskar, which jump around like monkeys are not monkeys at all but have descended from dogs. Apes, which have no tails must not be confused with monkeys which are distinguished by their tails.

There is now excitement amongst mokey lovers because of the news of new species discovered recently in Tanzania (Science, 20 May 2005, p 1103, 1161)

Two groups of this new species have been almost simultaneously spotted in the locations by researchers led by Zoologists. The first group was working in Ndunu Forest Reserve to locate and study a grey pink-faced monkey called Sanje Mangaby but instead the group suddenly spotted a brown black faced Mangaby sporting an upright crest on the forehead that made the animal look 'punky'.

At the same time, another group, in the Southern highlands 350 km. away was actually looking for an animal–an unusual monkey–the local hunters often talkd about. This proved to be the species found 350 km. away. After interchanging notes, the two groups called the new species 'Lohocebus Kipungi'.

This large nosey monkey had been described earlier. Of a 30–40 m ancestry, this monkey does not have the loud 'whoop gobble' call of other tree dwelling monkeys but only a soft 'honk burk'. It exihibits a curious behaviour when confronted. Just before fleeing, the male does a fantastic head shaking as if it wants to admonish the onlooker.

Researchers believe that there may be three groups with minor variations and one may have close relatuion to baboons. Unfortunately, these monkeys restricted to just about 120 sq. km. area total and perhaps a total population of only 500 in each forest is an endangered species.

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SHORT COMMUNICATION

THE SAHARAN ANT AND THE LIZARD — "MADE FOR EACH OTHER"

D. Balasubramanian*

Life is full of surprises. This point is driven home us every time we see nature shows on television or read geography and natural history magazines. There is practically no place on earth where there is not some form of life or the other—in the frigid Arctic and Antarctic circles where it gets as low as—59°C, in the hot springs of water that well up from the ground, in the pressure cooker-like superheated steam chambers found near the Galapagos Deep in the Pacific Ocean and in the Gobi Desert, Thar, Patagonia and Sahara where the daytime temperature climbs upto + 57°. The key word or the mantra for survival of all these life forms is adaptation. Not as much a word as a behavioural trait that has been wired into the genes of the organism, so that the capacity to cope with environmental stress is inherited. That way, not just the organism but the species as a whole can survive. How this trait is established is what Charles Darles Darwin termed as the "survival of the fittest".

Most life forms on earth cannot tolerate temperatures of 50°C or above. If unprotected beyond a minute or two, the organism tends to dehydrate. Its tissues get scalded and the result is paralysis and eventual death. How then do animals and plants survive and even thrive in the Sahara? Consider the desert lizrd called *Acanthodactylus*, which tolerates such high temperatures. One of its ancestors turned out to be a "freak", which was able to handle the high temperatures much better than its brothers and sisters. This could have been due to many reasons. The freak lizard could, for example, have had calloused skin and feet that were not sensitive to the heat. Or it may have had and an alteration in its genes that produces a thicker skin. It probably looked ugly and was the object of scorn and pity—but then while its siblings were fainting away in the fierce desert heat, this so-called freak was able to cope better. Now, if this freak were to pass on this "thick skin gene" to its children, they in turn could cope with the desert heat better than their cousins !

What is the result several generations later ? The freak kids of *Acanthodactylus* are thriving while the "normal" cousins have simply withered away and died off. What was "freak" has now become normal since it has survived, and what was "normal" is now extinct !

The Acanthodactylus is endowed with another ability which is helpful and, in fact, vital. It chooses to burrow close enough to the hills or colonies of the Saharan silver ant called *C. bombycina*. Now, these are the only ones amongst the ants and insects that can handle the midday Saharan Sun. Thus, when these little creatures are foraging for food in the sand, the lizard emerges from its burrow and feasts on them. Considering the fact that no-one other than the silver ants are out in the Sun, the lizard feeds exclusively on them—and on nothing else !

One may well ask—what of the silver ant itself ? What about its adaptation—should it not adapt itself to the fiery world, cope with it and

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survive ? Its only purpose in life cannot be just to be eaten up by the thorny-fingered spiny-toed lizard (acantho–thorn or spine, dactyl—toe or finger).

The answer to this question comes from the fascinating work Drs R and S Wehner of the University of Zurich, Switzerland and A C Marsh of the University of Namibia at Windhoek. They have found that while other desert ants such as the one called C. bicolor forage all through the day, the silver ant bombycina does so in a dramatic and explosive fashion. Much of the day they stay holed-up in their colonies since the odd ones that go out eaten up by the thorny-toed lizard that feeds on them exclusively. Instead, they wait for the temperature to rise to the scalding range of 47° to 54° and send a sentry ant or two out to look for any exhausted or dead lizard that might be lying out in the sun. The sentry looks around and upon finding one such lizard, quickly returns and reports to its mates that the time is ripe for the hunt. Not as much say it as spray it—it secretes a salivary liquid which stimulates its nest-mates. Indeed, as the researchers found, the silver ant is the only species among the ants that uses such a scent or pheromonal signal.

Now comes the dramatic outsurge within a matter of 10 minutes, and usually around 1.00 pm. as many as 150 ants come out of the nest every minute, seize the opportunity and make clean work of the lizard. Time is of the essence here, since the silver ant runs the risk of getting fried to death if it stays out too long at those temperatures. Even in those ten minutes, it has to cool off often enough by pausing under the stalks of dry leaves and shrubs. Much of the day the ant is the prey but during this short burst of ten minutes at midday, the prey turns predator.

All that the ant can do is to exploit the small thermal window of seven degrees between 47 to 54°C. Any lower and the ants would be eaten up and any higher and the ants would be heated to death. *C. bombycina* is forced, as the authors say, to exploit this thermal window where the lower limit is set by predatory pressure and the upper by heat stress. Curfew is a way of life with them—the curfew lifts for ten minutes per day. Break the curfew and certain death awaits ! Interestingly enough, the word curfew itself is rather apropos here in an inverse way—it comes from the early English term "cuerre-feu" meaning put out the fire so the enemy would not know you are there.

The Wehner–Marsh study has interesting morals in other ways too. It is only too often that critics flay scientists and exhort them to do applied research or question the use of basic research. Does it matter whether the silver ant eats the lizard or the other way around ? Is this of any consequence–why should we spend precious money and time doing such "pure" research ?

Think about it for a moment. The human body and brain would go haywire at a temperature of 43—44°C . What is the secret in the proteins and enzymes of this lowly ant that we can learn from, so that we can treat and cope with heat strokes? Second, can we use these ant enzymes for clinical, commercial or synthetic purposes ? Interestingly, one such enzyme was isolated a few years ago from a bacterium that grows at high temperatures called Taq polymerase. This enzyme has revolutionized biotechnology since it helps in synthesizing genes in large amounts, starting from miniscule amounts. Thirdly, what is the trick that the ants use in storing food reserves and energy within? It appears that they get to hunt but one a day and have to share the game between hundreds of nest-mates. Can we learn from them how to save, conserve and reserve our own food? After all, it is not the first lesson that these industrious creatures have taught us humans over the years.

KNOW THY INSTITUTIONS

DELHI INSTITUTE OF PHARMACEUTICAL SCIENCES AND RESEARCH (DIPSAR)

The Delhi Institute of Pharmaceutical Sciences and Research (DIPSAR) has been one of the pioneer institutes in India in area of Pharmacetical Sciences since 1964. Department of Pharmacy of Kashmeri Gate Polytechnic was moved to the present attracting campus spread over 10 acres, in South Delhi in 1979 as College of Pharmacy (COP), the name was changed to DIPSAR at the end of 2003.

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Objectives

● To undertake, promote and coordinate systematic and scientific work in all aspects of pharmaceutical sciences. ● To cooperate and collaborate with other national, foreign and international organizations in the field of health care and pharmacy. ● To establish and maintain a research and reference library in pursuance of the objectives of the pharmacy profession and equip the same with books, reviews, magazines and other relevant publications ; and ● To do all other activities considered necessary for the attainment of the objectives for which the institute has been established.

This Institute has been identified by AICTE as a Quality Improvement Program (QIP) Cell for continuing pharmacy education to teachers of various colleges. It has conducted 14 short-term courses for the teachers of pharmacy colleges in India through QIP during 1999-2005 on various topics given below—

- Screening and Developments of Drugs (1999)
- Screening and Developments of New Drugs (2000)
- Recent Advances in Drug Delivery System (2000)
- Trends in Novel Drug Delivery System (2001)
- Analytical Techniques (2001)
- Recent Advances in Analytical Techniques (2002)
- Advances in Pharmacology (2002)
- Advances in Herbal Drug Technology (2003)
- Recent Advances in Pharmaceutical Sciences (2003)
- Recent Advances in Pharmacology (2003)
- Recent Advances in Pharmaceutical Sciences (2004)
- Recent Advances in Pharmacology (2004)
- Recent Advances in Pharmaceutical Sciences (2005)
- Frontiers in Pharmaceutical Sciences (2006)

It has been the host institution for National Doctoral Fellowship Scheme (NDF) and Early Faculty Induction Programme (EFIP) for career advancements in various disciplines of Pharmacy in research and academic areas.

DIPSAR is experiencing a fast academic growth excellence and commitment to challenges of the 21st century and in its highly competitive environment, the institute is capitalizing on its strengths in areas such as academic innovation, comprehensive training and flexible educational delivery systems. DIPSAR has a total strength of approximately 520 students including Diplomas, Bachelors, Masters and PhDs in various disciplines of pharmacy i.e. Hospital Pharmacy, Pharmaceutics, Pharmacology and Quality Assurance. Till date, it has produced more than 2200 D. Pharm, more than 1100 B. Pharm, more than 325 M. Pharm and dozens of PhD's.

Almost 100 percent of the students are placed in different multinational and national pharmaceutical companies of repute.

The campus encompasses the institute building with a well-established library, an animal facility (registered by committee for the purpose of control and supervision of experimentation on animals vide registration no. 215/ CPCSEA for breeding and animal experimentation), a herbal garden, Medicine, Antidote and Poison Information Center (MAPIC), a rain water harvesting center, an auditorium (capacity 450 persons), a seminar hall, a utility block consisting of food court, shops, gymnasium, indoor games, etc., two hostels, a sports complex, a guest house and 37 residential quarters for the staff. A rabbit and guinea pig run has been created recently.

Some of the present laboratory facilities are :

● Ocular Pharmacology Laboratory, ● Anti-fertility Laboratory, ● Genome Research laboratory, ● Indian system of medicine (ISM) Laboratory, ● Radiommunoassay (RIA) laboratory, ● Modern Information Technology center, ● Central Instrumentation Laboratory.

Research Activities

Institute has been engaged in the research

activities of national thrust e.g. screening and development of antifertility, hepatoprotective, anti-diabetic, anti-inflammatory drugs. The development of novel drug delivery systems and drugs for ocular diseases are also a field of interest. Several faculty members have been sanctioned research projects from various funding agencies :

- Post—Coital Antifertility Agents, biotechnological investigation for *in-vitro* production of pharmaceuticals in cultures of medicinal plants, standardization of selected indigenous herbal drugs and development and evaluation of matrix tablet for cardiovascular drugs are funded by UGC.
- Screening of medicinal plants for the management of Glaucoma, studies on the impact of environmental pollution on the eye are funded by DST.

For further information, Please contact :

Director,
Delhi Institute of Pharmaceutical Sciences and Research (DIPSAR),
M. B. Road, Pushp Vihar, Sector-03,
New Delhi-110017, INDIA.
Web-site:http://www.dipsar.in
E-mail: pharmaquality@hotmail.com
Phone No. +91-11-29554649, 29553771.
Fax. No. +91-11-29554503

ANSWERS TO "DO YOU KNOW?"

A1. In Peru, South America.

A2. It rises because it is lighter. As it goes higher, the drop in atmospheric pressure makes it expand which makes it more likely to burst.

A3. About 100 million.

A4. Leonardo da Vinci.

A5. Galeleo.

A6. A Newspaper half the regular size and content is often juicy and entertaining.

A7. N. S. E. and W.

A8. No.

Conferences / Meetings / Symposia / Seminars

Date	Topic	Contact
20-25 August, 2006	8th International Congress of **Plant Molecular Biology,** Adelaide : Australia.	**ISPMB Congress Secretariat** Sally Jay Conferences, PO 2331, Kent Town, South Australia-5071, Australia. Email : ispmb@sallyjayconferences.com.au
19-20 September, 2006	15th APSI Scientists Meet 2006 and National Conference on **Vistas in Microbiology and Plant Sciences,** Haridwar	**Dr. S. K. Gupta** New Secretary, APSI 675/6(770) South Civil Lines Muzaffarnagar-251 001, U.P.
6-8 October, 2006	76th Annual Session of **The Indian Academy of Sciences,** Mumbai	**Prof. P.K. Seth** The National Academy of Sciences 5, Lajpatrai Road, Allahabad-211002 Email : nasi@sancharnet.in/ allahabadnasi@gmail.com
27-29 October, 2006	National Symposium on **Medicinal & Aromatic Plants for the Benefit of Rural Poor,** Kolkata	**Ms. Angana Datta** Institute of Advanced Studies, RKVM, Kolkata-700058 Email : rvm@cal2.vsnl.net.in
1-3 November, 2006	National Symposium on **Instrumentation,** Gwalior	**Prof. G. Mohan Rao** General Secretary, Instrument Society of India, Dept of Instrumentation India Institute of Science, Bangalore-560012 Email : isoi@isu.iisc.ernet.in
13-15 November 2006	7th Asia-Pacific Conference of **Medical Virology,** New Delhi	**Dr. Shobha Broor** Department of Microbiology All India Institute of Medical Sciences, New Delhi-110029 Email : shobha.broor@gmail.com
20-22 November 2006	8th Annual Meeting of the Indian Society of Radiation Biology (ISRB) & 5th Lowrad (Low Radiation) International Conference on **Low Dose Radiation Effects on Human Health and Environment,** Varanasi	**Prof. Y.B. Tripathi** Dept. of Medicinal Chemistry Institute of Medical Sciences Banaras Hindu University, Varanasi Email : yaminiok@yahoo.com
26-29 November, 2006	XXI **Carbohydrate Conference,** Delhi	**Dr. A.K. Prasad** Dept. of Chemistry, University of Delhi Delhi-110007 Email : ashokenzyme@yahoo.com

Date	Topic	Contact
27-30 November, 2006	4th International Symposium on **Bio-control and Biotechnology,** Madurai.	PG Department of Zoology and Research Centre, Lady Doak Colege, Madurai, Tamilnadu.
6-8 December, 2006	First International Conference on **Digital Information Management,** Bangalore	**Secretary** Christ College Hosur Road, Bangalore-29, India Email : princi@christcollege.edu.
8-11 December, 2006	75th Annual Meeting of the **Society of Biological Chemists (I),** Delhi	**Prof Rajendra Prasad** School of Life Sciences Jawaharlal Nehru University New Delhi-011 Email : rp47@hotomail.com.
18-21 December, 2006	**Global Sustainable 2nd Biotech Congress,** Nagpur	**Prof. S. U. Meshram** Rajib Gandhi Biotechnology Centre LIT Premises, RTM Nagpur University Nagpur-440033 Email : rgvbe_sum123@rediffmail.com
29-30 January, 2007	International symposium on **Study of Rainfall Rate and Radio Wave Propagation at Ka Band with Special Attention to Vertical Profile of Rainfall Rate and Attenuation,** Salem	**Rajasri Sen Jaiswal** Sona College of Technology, TPT Road, Sona Nagar, Salem-636005 Tamilnadu, Email : senoritta_in@yahoo.co.in
20-23 March, 2007	International Symposium on **Medicinal & Nutraceutical Plants,** Macon.	**Dr. Anand K. Yadav,** Agricultural Research Fort Valley State University GA 31030-4313, USA Email : yadava@fvsu.edu
29-4 April, 2007	1st Medicinal and Aromatic Plants Conference on **Culinary Herbs,** Antalya, Turkey	**Prof. Ibrahim Bakir** Department of Horticulture Faculty of Agriculture, Akdeniz University, 07058 Antalya, Turket Email : ibakir@akdeniz.edu.tr/ kturgut@akdeniz.edu.tr

BOOK REVIEWS

INTRODUCTION TO MELTS, MOLTEN SALTS, SLAGS AND GLASSES *H.S. Ray,* Published by Allied Publishers, A-104, Mayapuri, Phase II, New Delhi-110 064 ISBN No. 81-7764-875-6.

Prof. HS Ray, as he has himself mentioned at the beginning of the Book, has gone back to his roots when writing this Book.

Prof. SN Flengas introduced H S Ray to the subject of molten glasses many decades ago. As far as I know, after completing his Doctoral work in the UK, H S Ray worked for a while in the glass industry there before returning to IIT Kanpur/IIT Kharagpur. The insight into glasses that H S Ray has developed over the years is clearly evident in this book. As usual with all books of Prof H S Ray, it contains a lot of useful information and is written in simple language. As a result, it makes a difficult subject easily comprehensible to readers not directly connected with the subject. I fall into the latter category–my earlier association with fused salts/molten slags was when almost 40 years ago, I began my Doctoral work in Imperial College and had the privilege of rubbing shoulders with Prof. B. Steele, Prof. C. B. Alcock and Prof Denys Richardson who worked in this area intensively and had a large number of Doctoral students working on various problems. I see that Prof. H S Ray has referred to their work extensively when preparing this book.

Although this book, like the book on 'Energy in Minerals and Metallurgical Industries' is also brought out by Allied Publishers at almost the same time, somehow, to me, this book does not appear to be as slickly produced as the former. The diagrams lack clarity in many places, may be because the subject itself is more complicated. Again, the style of introducing Chapters with quotations and ending the Chapters with some worked out examples has been followed in this book is indeed commendable.

The book will be used as reference by students, researchers and others working in the field of fussed salt, metallic glasses and slages at high temperature.

HS Ray needs to be complimented on a wonderful effort.

Amit Chatterjee

ENERGY IN MINERALS AND METALLURGICAL INDUSTRIES—*H.S. Ray, B. P. Singh, Sarama Bhattacharjee, and Vibhuti N. Misra,* Published by Allied Publishers, A-104, Mayapuri, Phase II, New Delhi–110 064, ISBN – 81-7764-874-8.

When a teacher who has the basic merit, the necessary background and then years of experience both in teaching as well as in other fields (like research), in the twilight of his professional career decides to put together all his thoughts / experiences / aspirations in the form of a book, the outcome can only be exceptional.

This is exactly what has happened to Prof. H. S. Ray, who along with his co-authors (BP Singh, Sarama Bhattacharjee and Vibhuti N Misra) has published (through Allied Publishers) a most informative, reader-friendly and wonderfully laid out book entitled "Energy in Minerals and Metallurgical Industries". This book not only contains information in this field available in different sources concisely and precisely in a 500 odd page book, but has also worked out examples, a glossary of terms used in the field, and even conversion tables that are required when collating information on energy. What more can a reader wants ? It is indeed a 'gift' from Prof. H S Ray to the metallurgical fraternity at large. All

students of metallurgy will certainly use this book in the years to come and those who do not have it as a text book / reference book when they were engaged in studying Metallurgical Engineering will regret the fact that such a book was not available earlier.

I particularly liked the style in which the book is presented—quotations from various sources at the beginning of each Chapter add a touch of 'romance' to what is a relatively 'dry' subject. If there is one criticism that I can make about this book, it would be that consistency, for example, even in the units in which energy consumption is presented for various situations / furnaces / industries, is lacking.

Just to highlight how much I enjoyed reading the book and how involved I was to go through its contents carefully, I would like to add that the quotation 'Gold for the mistress, ...' at the beginning of Chapter 7 is from Rudyard Kipling (not anoymous as claimed on page 377 of the book).

Like many others, I will keep the book with me and refer to it in the days ahead.

Amit Chatterjee

Adviser to the Manging Director
The Tata Iron and Steel Company
Jamshedpur

S & T ACROSS THE WORLD

HYDROGEN FUEL GETS A BOOST

The Government of India has unveiled an ambitious plan to put one million hydrogen fuelled cars on Indian roads and generate 1000 MW power from hydrogen by 2020 through public-private initiatives.

The plan for hydrogen fuelled cars which is aptly named Green Initiative for Future Transport (GIFT), aims to develop and demonstrate a hydrogen powered engine and fuel cell-based vehicles ranging from small cars and taxis to buses and vans.

The effort to generate electricity from hydrogen is called the Green Initiative for Power (GIP) and envisages the development and demostration of a hydrogen fuelled engine and turbine as well as fuel cell-based decentralized power generating systems.

The need to shift from a hydrocarbon energy economy to a hydrogen economy is recognised the world over, and this plan will put India in the forefront of the global hydrogen energy economy, thus providing sustainable energy security for the future.

(VATIS Update, Jan-Feb 2006)

GENETIC CHANGES AFFECTING PROTEINS

Scientists in Oregon University, USA, have been able to reach back 450 million years in time to reconstruct the evolution of two hormone molecules and their "receptors", the protein molecules that allow the body's cells to respond to the hormones.

The researchers have been able to trace back the stepwise genetic changes that allowed a single ancestor molecule to produce two different modern receptors, one for the hormone aldosterone, which regulates kidney and brain functions, and the other for the hormone cortisol, which regulates the body's response to stress.

To reconstruct the changes, the team first examined the receptors of several ancient vertebrate species, including lampreys and hagfish. Then applying standard statistical methods, they showed that the two receptors found in most present day vertebrates originated from a gene duplication that occurred about 450 million years back. Eventually they inferred the gene sequence of the ancient receptor, synthesised it in the laboratory and characterised its functions.

According to officials of the National Science Foundation which partly supported the research, the findings bear out the utility of computational approaches to study the structure of ancient molecules, and provide a window as to how evolution works.

(US National Science Foundation, Apr 9, 2006)

NOVEL DRUG-DELIVERY CATHETER

Christos Panotopoulos, a Greek neurosurgeon, has developed an innovative catheter, which can deliver drugs locally and can evacuate pathological fluids from the body.

The catheter is made out of a particular type of polymer which allows for a unique level of control over the diffusion of drugs into the tissue. It also avoids the problem of blockage found in many other systems, and it optimises the irrigation and aspiration of the tissues as the treatment proceeds.

The initial targets for treatment through this catheter are certain types of brain haematomas and some types of recurrent malignant tumours of the brain which do not respond to or cannot tolerate existing treatment. It is hoped that localised chemotherapy using the new catheter would eliminate the side effects associated with existing treatments.

Dr. Panotopoulos has now secured the assistance of the Innovation Relay Centre Network to commercialise his innovation.

(IRC Network, Apr 2006)

TOMATO EXTRACT FOR LOWERING BLOOD PRESSURE

A dietary supplement derived from tomatoes which is sold under the brand name of Lyc-O-Mato has been found to help in lowering blood pressure.

Researchers in Israel found that a daily dose of tomato extract helped lower blood pressure in men and women with mild hypertension. On an average, their systolic pressure–the top number pressure reading–dropped 10 points, and the diastolic pressure or bottom number reading also fell significantly.

The tomato extract contains lycopene, an antioxidant which along with vitamins C and E helps neutralise oxygen free radicals that are a natural byproduct of metabolism. These free radicals are believed to contribute to a range of chronic diseases including high blood pressure and heart disease.

(Health News, Jan 15, 2006)

FORM IV

Rule 8

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I, S.P. Mukherjee, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date :
15th May, 2006

S.P. Mukherjee
Publisher
Everyman's Science

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भारतीय विज्ञान कांग्रेस संस्था

14, डा० 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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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. They may contribute papers for presentation at the Science Congress and receive, free of cost, reprint of the Proceedings of the session of any one section of their interest. A Sessional Member has to pay a subscription of Rs. 250/- (for foreign U.S. $60) only.

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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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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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5. Earth System Sciences
6. Engineering Sciences
7. Environmental Sciences
8. Information and Communication Science & Technology (including Computer Sciences)
9. Materials Science.
10. Mathematical Sciences (including Statistics)
11. Medical Sciences (including Physiology)
12. New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. Physical Sciences
14. Plant Sciences

(Please type or fillup in Block Letters)

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

Academic Qualifications :
(Evidence to be submitted)

Designation :

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

Phone No. & e-mail

Permanent Address :

Yours faithfully

Date : Signature

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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INSTRUCTION TO AUTHORS FOR PAPER PRESENTATION AT THE 94TH INDIAN SCIENCE CONGRESS TO BE HELD DURING JANUARY 3 TO 7, 2007.

A. PAPER PRESENTATION (ORAL/POSTER)

1. All papers to be submitted for presentation at the 94th Science Congress must be sent to the **Concerned Sectional Presidents**. Each paper must be accompanied by *three copies* of abstracts (within 100 words, without any sketches, tables, etc.) and a copy of the full paper. The name of the Section where the paper is to be pressented should be indicated. The model format for abstract is given below. The addresses of Sectional Presidents are given in the website : *http:www.sciencecongress.nic.in*
2. Each author is entitled to submit only two papers.
3. All authors must be **members** of ISCA. Corresponding author must give a declaration that authors/co-authors are members of ISCA.
4. Papers should reach on or before **September 15, 2006**. The abstracts of these papers if approved will be printed in Part II of the Proceedings of the 94th Indian Science Congress. Papers (along with abstracts) received after **September 15, 2006** will not be considered.
5. Contributed papers would be presented primarily by way of posters. Authors of the accepted papers will be advised by the concerned Sectional Presidents about preparation of posters. Size of each poster should be **1 meter × 1 meter** and should be neatly prepared which can be read from a distance of 3 feet.
6. To encourage scientists, the Indian Science Congress Association has introduced a number of prizes for **Best Poster** presentation in January, 1999. A maximum of **Two** prizes of Rs. 5000/- in cash along with a certificate will be awarded to the best presentations in each Section during the valedictory function of the 94th Indian Science Congress.

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