# CONTENTS

# EDITORIAL

## SCIENCE AND SCIENCE EDUCATION

Countries across the globe are concerned about Science Education—its intent and content, its reach and foci, its contribution to well-being as also its cost-effectiveness. (Incidentally, social scientists would argue that well-being is a wider concept than welfare, including as it does non-welfare characteristics of social states and acknowledging the centrality of human rights in collective living.) Science—as a ceaseless quest for truth that inheres in matter, energy and life and that has to be brought out through experimentation and abstraction—is not necessarily guided by an urge to enhance well-being, nor even motivated by anything beyond the sheer pleasure of knowing the unknown. Science Education, on the other hand, is an exercise that has a mission, that is guided by a strategy suiting different times, places and cultures, that follows a planned course of action and is expected to yield some definite results related to human well-being and not just welfare. No doubt, Science and Science Education are not altogether disjoint entities. Developments in Science do influence the content and purpose of Science Education and Science Education, in turn, has an impact—remote if not concurrent—on future developments in Science.

The broad goal of education, as such, is to equip the recipients with knowledge and skill appropriate and adequate to the discharge of responsibilities at the work-place, in the family and in the society at large. The same should be true for Science Education also. In fact, Science Education should play a big role in national and international development, ensuring that development implies distributive justice beyond growth. Science Education as well as the scientific establishment encompassing institutions of all forms and at all levels that are engaged in teaching and research in Science and Technology have been generally guided by policies that are specific to realities prevailing in different nations and at different times. Science Education as an institutional acitivity consumes resources that are not unlimited in availability, though one may fine-tune the difference between expenditure and investment.

An important perspective for Science Education (incorporating technology) is to provide manpower in right numbers and of the right quality to man

(a) *s* and *T* laboratories including *s* and *T* museums

(b) Institutions imparting science education at different levels and in different areas of Science

(c) Research and Development set-ups in industries

(d) Non-government organizations engaged in Science popularization efforts

(e) Missions to negotiate at international dialogues on issues like environment, energy, space, ocean development, etc.

It should be borne in mind that Science

Education is a form of liberal education and should not be treated as professional or vocational education. That way a major objective of Science Education should be to create a scientific temper, a sense of curiosity to know the unknown, a spirit to raise questions and seek answers, a frame of mind that does not accept or reject some ideas, methods and practices simply because they are well-accepted in the society or simply because they sound bizarre or unscientific. There have been disturbing trends in writings on Science Education where authors tend to carry a message that whatever can not be explained and/or verified in terms of the current state of scientific knowledge should be branded as unscientific—something that reminds us of two-valued logic. This has been stretched to criticize certain documented notions, techniques and practices which have not been adequately studied and comprehended as something unscientific.

Speaking at the national level, Science Education should

(a) make the nation capable of meeting the basic needs of its people

(b) make the nation feel proud of its achievements in certain sectors, and

(c) contribute to the growth of Science as a body of knowledge.

Science Education at least in terms of its basic principles and tenets should be introduced right from schools when participants are prone to ask questions and are not inhibited by traditions and norms. Science Education at all levels should focus on the following features

(1) interdisciplinarity among different branches of knowledge, particularly when dealing with the basic problems of population, production, energy and environment

(2) experiments and live demonstrations of various types of natural and induced phenomena

(3) access to modern facilities (to the extent possible)—may be on a shared basis—for placing participants at the current edge of knowledge, without compromising on the need for encouraging creativity and competence to improvise

(4) linkage to life at home, on the streets and in the society with less emphasis on avoidable debates on controversial issues

(5) encouragement to and appreciation of creative spirit and entrepreneurship of the learner.

To make all this happen, the system of Science Education including the resources available to it has to be much better managed. Necessary infrastructure has to be provided, adequate incentives have to be offered for maintaining excellence, appropriate mechanisms have to be developed for self-assessment and bench-marking, and advantage has to be taken of methods and practices that have been proved to be productive. One may advocate the use of Total Quality Management concepts, methods and practices in this context.

***Prof. S.P. Mukherjee***

***To be conscious that you are ignorant is a great step to knowledge.***

***—Disraeli***

## PRESIDENTIAL ADDRESS

# THE PROBLEM OF EVOLUTION

LT. COL., R. B. Seymour Sewell.,*

M.A., SC.D.(CONTAB.), F.Z.S. F.L.S., M.R.C.S., L.R.C.P., I.M.S., F.A.S.B.

**Experimental Modification of Bodily Structure**

The problem of evolution is one of that has within recent years attracted the attention of numerous workers in very different branches of scientific research. It is a problem that affects the chemist and physicist equally as much as the botanist or zoologist or even the psychologist, and if even the problem is to be solved it will require the combined efforts of all those workers.

What then is life ? It does not usually require any very great knowledge or ability to tell whether a thing is living or not ; but bound up in the act of living are a number of different and often complicated processes. All the possibilities and potentialities of the most complex animal or plant are inherent in and originate from the smallest and most primitive member of the great biological kingdom. A living organism, whether it be as small as an amoeba or as large as a whale, is capable of carrying on such complicated changes as are necessitated by

1. The ingestion or taking in of food ;
2. The digestion or the preparation of food that has been ingested, thus rendering it suitable for
3. Assimilation or the building up of the materials derived from the food into the tissues of the animal ;
4. Respiration or the taking in of oxygen and the giving out of carbon dioxide gas ;
5. Irritability or the reception and transmission of impulses and sensations ;
6. Movement, either of the animal as a whole or of its, integral parts ;
7. Extension or the getting rid of waste products, and
8. Reproduction or the carrying on of the race.

All these functions are performed by the substance that we know by the name "Protoplasm" and, so far as we know, each mass of protoplasm, if it is to perform all these functions, must contain a small central body termed a nucleus. Now protoplasm is a highly complex chemical substance consisting of an aggregate of molecules and these in turn are build up of atoms. Each atom consists of a number of ions in a state of constant movement, and certain Physicists[1] have reached the conclusion that life originates from a dual system of these ions. As one of them describes it,

* General President, Eighteenth Indian Science Congress, held during 31st January to 5th February, 1931 at Nagpur.

"certain ions assume an intra-atomic position, thus forming an immaterial Z-system which is incapable of chemical combinations ; the other enveloping ions constitute the material Y-system, the development of which is controlled by the immaterial Z-system, which leaves the material one at death. Living matter is invariably of dual constitution... In the living organism, life is an intra-atomic quantity and it is this which determines the living state.... The possibilities of the evolution of any forms that arise are strictly limited. Most existing species would be only specific and fixed in essentials, since the limit of their evolution was reached long ago, because of the constitutional limitations of reactions possible to a life form. When this limit is reached the species becomes fixed." That is a summary of the conclusion reached by a Physicist and whether we understand it or not, there are but few Zoologists, I imagine, who would be inclined to admit that the majority of species have reached the limit of their evolution, let us, however, examine such evidence as we possess, regarding the possibility, or the reverse, of such a statement being correct.

Commencing from the first living organism there has been an uninterrupted line of descent till we reach the present forms that are inhabiting the world today. As has been pointed out, the son is not merely "a chip of the old block" ; he is a direct descendant not only of his father but of the very earliest forms of animal life. Species are not discrete forms of life ; they are, on the contrary, portions of a continuous stream or flow that has been going on through countless ages in the past and may continue to go on through the future ; from time to time the direction of the stream has been changed and has spit into two or more channels but there has been no break in the continuity.

One of the first stages in the course of evolution was the change from the non-cellular to the multi-cellular state and the consequent formation of body. Specialisation of function, however, had appeared in the animal kingdom long before this cell-formation, for in the non-cellular organisms we get evidence of definite organs, such as a mouth, motile organs, such as flagellae and cilia, excretory organs as the contracting vacuole, and a controlling centre, the nucleus. What then was it that caused so fundamental a change as that from the non-cellular state to the multi-cellular condition ? These non-cellular organisms, the Protozoa, normally undergo growth and development and then by a process of fission give rise to two or more daughter cells that separate and in their turns grow and divide ; and one suspects that some change occured either in the animal self or in its surrounding that led to the inability of the daughter cells to separate and thus, with a loss of independence, gave rise firstly to a multi-nucleate protoplasmic mass, or syncytium, and then to a colony of cells, which is the first stage in body-formation. Such a syncytial condition is actually met with in nature among the Protozoan. In these, as in other higher animals, the crucial of the functions of the cell rests ultimately with the nucleus and there is a direct relationship between the nucleus and the cell mass. In the more primitive forms we find a single nucleus in the animal, though in more advanced forms we may get two or more nuclei in the single protoplasmic mass ; in either words

these forms are *synctia*. As a rule the cell mass and the number of nuclei have a very definite proportion ; though this proportion may change at different stages in the life-history or in different external conditions, much as variation of temperature or increase of food. As evidence of this I may cite the work of Popoff[2] on *Paramoecium* and that of Looper[3] on *Actinophrys*. If now in such an animal the amount of nuclear material, which may be in the form of one or more nuclei, be upset, the amount of protoplasm in the animal, and hence its total size will, as a rule, be altered in a corresponding ratio, though this ratio may for a time be upset. Hegner[4] has shown that in Arcella dentata, a Protozoan with normally two nuclei, one nucleus can be removed. On reproduction taking place individuals with only one nucleus are produced and the animal is of smaller size, and furthermore, such individuals appear for several generations. The result is particularly interesting for we appear to have here a definitie temporary transmission of an acquired traumatic character. The condition is not, however, permanent, for ultimately the bi-nuclear form will be restored by a process of aborted fission, the nucleus undergoing division but not the protoplasmic mass itself, so that we again get two nuclei in the one animal and now the size of the animal is found to be larger than the original bi-nuclear ancestor, but this condition also only persists for a time and ultimately the size becomes normal again. Comparable results were also obtained in *Arcella discoides*. A smaller result has been obtained in one of the primitive plants, *Spirogyra bellis*, under the influence of cold, some of the cells becoming greatly increased in size and possessing enlarged nuclei ; and such cells have bred true for over a year.[5] This change in the relationship of nucleus and cell mass is, however, not universal, for it has been found by Burnside[6] that biotypes of unequal size are not produced by inequalities in the amount of nuclear material in *Stentor coeruleus*. That a tendency towards incomplete fission of a parent cell and the consequent formation of a large or "monstrous" form, with an increased cell mass and an excess of the normal number of nuclei, exists in nature can be proved by traumatic injury of an invidiual or by the effect of drugs, X-rays, or overcrowding on cultures of these non-cellular animals ; in such cases we get the production of monstrous forms in which two individuals are partially fused together in consequence of incomplete fission, or even of an apparently normal single cell with double the normal number of nuclei and a consequent increase in the bodily size. Even without the direct application of any abnormal condition such individuals may occur and it has been recorded that in a culture of a protozoan, Uroleptus mobilis, on one occasion two individuals came together in the normal process of conjugation but after the usual interchange of nuclear material, when, as a rule, the individuals again separate, this separation did not take place and the result was the formation of a double or monstrous form. This double individual subsequently underwent division and bred true, the offspring also being double for as many as 367 generations.[7] Similar examples of double organisms have been recorded in Glaucoma scintillans by Chatton[8] and in an amicronucleate *Oxytricha* by Dawson[9]. In this latter case twinning occurred in a normal culture and from these twins a pedigree strain

was bred for 102 generations before the culture died out.

It thus seems probable that the first stage in the process of evolution was that in which the nucleus of the cell undergoes division but the protoplasm of the animal body is unable to form isolated cell masses. This syncytial condition is met with in the ectodermal layer of the sponges and is found even as high in the animal scale as the birds, in which the earliest formation of the developing ovum is also a syncytium. Still later, the condition is reached in which the body is composed of separate and discrete cells, and we get the formation of a colony.

Associated with the change from a syncytial condition to the calling state there was of necessity a radical change in the conditions of the life under which certain members of the colony live. Now the first essential of any body is that it must have a definite shape and structure. In the very lowest of the Metazoa this shape tends to be a sphere. Commencing from a single cell, subsequent division into numerous daughter and granddaughter cells, that may spread in any direction unless retrained by contact with some foreign objects is bound to give us this type. The first stage was thus in all probability the production of a more or less spherical mass in which all the cells were situated on the periphery, the interior of the colony being hollow. Such a condition is found today in the animal Sphaerozoum and in Volvox, that is claimed by both Zoologists and Botanists. As soon as a colony becomes solid there is of necessity a differentiation of function. With the increasing organisation of the animal body certain parts take on definite functions and for the proper performance of these it is necessary that the parts occupy certain equally definite positions in the body. Clearly, those cells that are situated on the outside are in a position to receive stimuli from the surroundings or to capture food particles, take the gases necessary for life, etc. while those in the center of the mass are completely cut off from these functions. In accordance with this change in coditions we find a differentiation of function in the constituent parts of the body-mass ; one group of cells, connected with the exterior, takes on the function of receiving and transmitting stimuli ; another group of cells becomes adapted to the performance of movement and are known as muscle-cells, others take on the function of support, for a colony or body of any size must have some supporting mechanism, another group of cells takes over the process of digestion, while others again serve the function of excretion. Finally, we get one group of cells whose sole function is that of reproduction and the maintenance of the race. With this formation of a body there goes hand in hand the absolute necessity for the formation of discrete cells, each having a definite surface area. The cells of the body continue to perform many of the functions that we have seen to be inherent in Protoplasm, namely, assimilation, response to stimuli, movement, and excretion. All this activity necessitates the continual taking in of oxygen and the giving out of carbonic acid gas, to wit, respiration, and this process, as well as the taking in of food and the giving out of dissolved excreta, can only be carried out through the surface of the cell. There must, therefore, be a certain definite square area of surface for every cubic unit of cell-substance ; and we seem here

to have an explanation of the fact that all such cells are of small size.

If, now, we compare the conditions of life of the various groups of cells in the body with the primitive non-cellular animals, one cannot fail to see that, associated with their specialisation of function, there has gone, not only a loss of independence, but a gradual loss of certain powers ; and it is this loss of function that I wish to emphasize. The first power that most, if not all, of these groups have lost is that of digestion ; originally digestion took place within the cell, the food particles being ingested and then digested, but in the higher multi-cellular animals even the stomach cells or those of certain glands intimately connected with the process, such as the salivary glands or the pancreas, only produce the digestive ferments, the actual process of digestion being carried on outside the cells themselves in the cavity of the stomach and intestine. Again, with the exception of the genital cells all the others have lost the power of continuous reproduction, since this is, apparently, dependent on occasional conjugation with a similar cell from another colony, or in the higher animals with fertilisation between the ovum and spermatozoon. The result of this loss of function is that these specialised cells can only reproduce their kind for a limited time. As you are all doubtless aware, tissues can now be grown and cultivated in *vitro* in the same manner as bacteria, and it has been shown that under such conditions the cells continue to reproduce by what is known as the amitotic method.[10] The time during which such a tissue culture may be continued may actually exceed in duration the normal period of life of the animal itself, but whereas the life of the animal can be transmitted to its offspring, that of the culture must ultimately come to an end.

The essence of reproduction is the abilitiy to initiate and subsequently to direct the differentiation of the daughter cells that result from the continued division of the parent cell. This process, which in the highest members of the animal kingdom resides solely in the genital cells and has been completely lost in all the others, was not lost suddenly. In many of the lower animals we still get the power of reproducing the whole animal from a small part, and in such comparatively highly organised animals as the Crustacea or even the lower Vertebrates we still find the capability of reproducing lost parts.

During development in the higher animals, the ovum divides and re-divides and these resulting daughter-cells have an ultimate destiny that under normal conditions is definitely fixed. From the cells of the "blastula" state arise the three primary layers–Epiblast, Mesoblast, and Hypoblast, and each of these as we know from our observations, gives rise to definite parts of the body and serve definite functions ; epiblast is essentially the layer from which is derived the outer covering of the body and the organs of the senses ; mesoblast gives rise to the muscles of the body and the supporting skeleton ; and hypoblast forms the digestive organs. Under normal conditions there is a definite polarity in the ovum from which the body is developed, certain part of the egg-cell giving rise to the definite structures ; in certain cases this polarity depends clearly on the position of the egg and is the result of the interaction of a number of

forces, conspicuous among which is gravity. One very good example of this is to be found in the egg-capsules of the common cockroach (Periplaneta australis). In this animal the female lays a capsule containing 16 eggs all arranged in two rows and as development proceeds these eggs all develop in exactly the same way ; the embryo is always situated from the very first with the head towards the crenated ridge that runs along the top of the capsule and the ventral aspect of the larva is turned inwards towards that of the corresponding larva on the opposite side of the capsule. It seems clear that this fixed position is due to the forces acting on the egg, for one can hardly suppose that the mother cockroach invariably places all the separate eggs in exactly the right position. It has further been shown that in the very early stages of development out of the original four cells produced by the division of the ovum two can be destroyed and yet the other two will give rise to a complete and perfect animal while in one of the mammals, an Edentate, the nine banded Armadillo, a female at each litter produces four offspring, all identical and of the same sex, each having arisen independently from one of these four cells.[11] It is thus clear that even the polarity of the eggs is not absolutely fixed and this seems equally to be the case even in the highest forms for Newman[12] in his studies on Twins has shown that in the human being the fixation of the body-form does not exist in the ovum but is developed at some stage after the development of the egg has begun. But it appears probable that this fixation occurs at an even earlier stage as we pass up the animal scale.

There can, I think be little doubt that among lower animals the developing body is influenced by its surroundings to an extent that we, at the present time, but dimly appreciate, and this was probably still more the case in the past among the lower organisms, in which the body was and is far more plastic than it is in higher animals. Can anyone, who has studied the work of Loeo and his school, doubt that the general shape of the body is *not* a matter of haphazard mutations, some of which proved to be favorable, while others were unfavourable and so were ultinately destroyed by natural selection, but is due to the action on the organism of definne forces and influences ? I have already pointed out that differentiation of the body into various organs is met within the lower animals, such as the Protozoa. When such animals reproduce by fission into two there is a differentiation of the protoplasm into such organs as the animal possesses, so that each daughter-cell is fully provided with mouth, nuclei, excretory organs, and the like, but we also in these animals meet with the exact opposite phase for a process of dedifferentiation is carried out both before conjugation and also before encystment, and in this phase the gullet, the vibratile membranelles, and other structures tend to disappear. Such dedifferentation may also occur spontaneously in a culture, to be followed again by redifferentiation, the animal once more reforming its lost parts. In somewhat higher animals this process becomes even more striking. Let us take the case of the Hydroid Campanularia; if this animal be brought in contact with a solid substance it shrinks up into a shapeless mass, but if if be then restored to its natural surroundings it once again reforms itself into

stalk, body tentacles, etc., and whichever way one turns the shapeless mass the final product is the same, the stalk is at one end and the tentacles at the other. We thus get a new *Campanularis* whose structure and parts are not due simply to its internal organisation but are so much a direct reaction to external forces and condition that the point where the re-growth shall begin may be fixed at the will of the experimenter. The change is not a mere reversibility from a fully-formed animal to a blastula or syncytium but is a completely new process. Again in an animal such as *Hydra*, which normally has a mouth at one end and a base at the other, we can by altering the position of the animal reverse the formation or even produce a double condition, there being a mouth at each end. Similar results have been obtained in other members of the Hydrozoa, such as *Corymorpha*. In this latter animal a cut piece of the stalk will normally regenerate a head and tail from opposite ends of the cut piece with the head up and the tail down, so that there would at first sight seem to be a definite polarity. Child[13], however has shown that if a piece of the stalk be treated with certain chemical reagents of a strength sufficient to inhibit growth but not to kill the organism this polarity is upset and on being returned to normal conditions heads and tails may appear in almost any direction and even from the middle of the growing portion. Very similar effects have, again been produced by Julian Huxley[14] on the developing larvae of certain Echinoderms ; he has shown that the effect of transistory immersion in weak solutions of certain poisons, such as KCN, $ZnSO_4$, Hg-salts, etc., or even starvation, may produce dedifferentiation, the larva losing its characteristic shape and degrading into an unmodified mass of cells. If this mass be then removed from the harmful solution before the process of poisoning has gone too far and is again placed in the sea water, redifferentiation into a normal larva with its various structures is possible. This process of dedifferentiation and redifferentiation of the body is in certain cases a normal process and has been brought to a high degree of perfection in the Insecta, where are find that during the pupal stage changes take place in most of the different parts of the body, so that the structure of the final adult animal, the imago, is very different from that of the larva stage, the caterpillar.

We can, however, carry matters further than this. The work of Willson[15] and others have shown that in the sponges the animal can be broken up into its constituent cells, by first mincing finely and then straining the resulting fragments through a fine sieve, and yet these individual cells will subsequently come together again and will actually unite to form a sponge once more. Similar experiments performed on Hydroids such as *Pennaria tiarella* and *Eduendruium carneum*, show that the individual cells first unite to form an undifferentiated mass and from this mass a complete regeneration of the animal takes place, both ectoderm and endoderm being reformed. In this re-formation of the animal it has been shown that the most primitive type of cell, the amoebocyte, can reproduce most of the other types of cells, whereas such specialised cells as the desmocytes and choanocytes can only reproduce their own kind. In certain cases, such as in *Moniezia* it has been shown by Child[16] that the dedifferentiated cells can actually become converted into germ

cells. Further research along such lines has shown that the regeneration of the animal after dissociation is actually specific in, character ; thus if the cells of two different species such as those of *Microciona* and *Stylotella* are mixed, the cells of each species will coalesce but not those of different species, thus cells from *Microciona* will unite with other cells from *Microciona* but not with cells from Stylotella[17]. There would thus appear to be a definite attraction between cells of the same species, so that they tend to unite together and under the influence of the external surroundings this union must be carried out in a perfectly definite manner.

As we pass up the scale of the animal kingdom we find that this power of dedifferentiation and redifferentiation and hence the power of regeneration of parts of the body is gradually lost. For a full account of this interesting phenomenon I would refer the reader to the exhaustive work of Korschelt.[18] In many of the higher invertebrates and even in the Amphibia and Reptilia of the vertebrates there still resides the power to regenerate parts that have been lost, though in the case of the more evolved forms this seems to be limited to the external structures, such as the limbs in certain Amphibia or the tail in some of the lizards, but when we arrive at the highest vertebrates all that the animal is usually able to do is to heal the damaged part by the formation of scar tissue. Yet even in these higher states of life we find that there still, resides in the developing embryo a certain power to form organs and parts from cells that normally would not give rise to them. It has been shown that in the developing larva of *Amblystoma punctatum*, the normal ear, as in all vertebrates, develops from an otic vesicle that is budded off from the brain ; if, however, this otic vesicle be removed, the tissue round the site, that normally would take no part in the formation of the ear, can to some extent take the place of the vesicle that has been removed and forms an ear of sorts, while if the vesicle be transplanted to some other part of the body, it undergoes much less development than in the normal situation, though it still develops into an ear[19]. Again, if the developing optic cup, which is also an outgrowth of the brain be transplanted to the thorax or abdomen, the skin over it will form a lens. There is thus some reaction between the various parts of the body that has a direct influence on the development of the various organs, the presence of one organ causing a characteristic development of the cells in the immediate neighbourhood ; such a process is known, by the name "correlative differentiation."

As evolution proceeds there has been acquired a stability or fixation of the bodily form so that the developing embryo is but little, if at all, affected by gravity or other normal external conditions ; there is thus a definite arrangement of organs and structures, so that in examples of any given species there is but little variation and the organs do not encroach on one another. The mechanism that thus controls the character of the individual parts is generally supposed to be the production within the developing body itself of certain chemical substances, known as Hormones, that circulate in the blood and control all the various developing masses. In the Crustacea it has been shown that growth is not uniform throughout the body but that certain parts grow more rapidly

than others and that the rate varies in the two sexes. These Crustacea, which develop by a series of moults, are particularly suitable for a study of this kind, involving the accurate measurement of the various parts of the body and limbs and a mathematical analysis of the proportions in each succeeding stage. In the Copepoda the most rapid growth in the body occurs at a level of the 3rd segment of the abdomen and from this point the rate of growth becomes less as we pass either forwards to cephalothorax or backwards to the furcal rami. In certain appendages of the crabs *Uca* and *Maia*[20], we find similar areas of rapid growth or, as they are termed, growth centres near the tips of the thoracic appendages. Similar results have been obtained in the crab *Inachus* by Shaw[21] ; by Tazelnar[22] in the appendages of the Indian prawn, *Palaemon carcinus*, and Kunkel and *Robertson*[23] in the Amphipod *Gammarus chevreuxi* Sexton. In the Copepoda again the main growth centre in the 1st antenna is "situated at about one-third of the length of the appendage, namely in the 9th or 10th segment. The increase in size, or "heterogonic" growth, is found to differ in the two sexes and is associated with the development of the secondary sexual characters and in such cases we appear to have two fators at work, the ordinary hormone that controls development in both sexes and a sexual secretion that modifies the degree of development in either sex.

From the evidence that I have put before you, and I may perhaps here be permitted to point out that I have only given you a fraction of all the evidence that has been accumulated during the past few years, it would seem clear that the development of an animal is dependent partly on external influences and partly on internal conditions and the cases that we have been considering point to the conclusion that in the lower animals it is the external conditions that exhibit the greatest influence and, furthermore, that in the lower forms of the Metazoa the whole animal, even when adult, can be profoundly modified by changes in its environment, whereas, as we pass up the animal kingdom this effect of the environment becomes less and less and its place is taken by an internal regulation mechanism, existing in the living animal itself. If this be so, then by altering these external conditions we should be able to produce changes in the development and structure of the lower animals and but little, if any, in the higher. Numerous methods of effecting, such alteration will doubtless occur to many of you ; during the past years an enormous number of such experiments have been carried out and in the time that is left at my disposal I can mention only a few. I have, therefore, for the most part confined my attention to those experiments in which such changes of environment have been utilised as might reasonably be supposed to have occurred in nature, or those similar to such changes. The various functions of protoplasm, as all will admit, are brought about by, or at any rate are accompanied by changes in the constituent atoms and molecules. It has been thoroughly well-established that the characters of an animal are transmitted from parent to off spring by minute particles, known as "genes", that are connected together in the chromosomes of the nucleus, and two workers. Przibram[24] and Morgan[25] have independently put forward the view that these genes are individual molecules. Any alteration in the ionic movement in or the atomic composition of these protoplasmic

molecules must presumably result in an alternation in the character or composition of the protoplasm itself and so of the animal as a whole. A nerve-impulse, travelling along a nerve, is accompanied by an electrical change that can be demostrated and similarly a contracting muscle also gives an electric response, due apparently to a change in the physico-chemical condition of the proptoplasm at the moment of contraction. By the activity of the protoplasm complex chemical substances are broken down into more simple substances and energy is set free ; such a process is known as "katabolism". On the cessation of activity, or even during its continuance simple substances are built up into complex bodies, a process known as "anabolism", while other substances, the result of the breaking down of the energy-forming compound, that are unsuitable for the future use of the body, are got rid of by excretion ; and corresponding changes must have been going on in all organisms, in whatever stage of development of evolution, since life first appeared on the earth. These activities, then, can be set in motion or varied by changes in the physico-chemical conditions surrounding the organism or cell and, like all chemical processes, can be slowed or accelerated by appropriate changes in the surroundings. Changes in the viscosity of the protoplasm of the non-cellular organism can be brought about by various salts, some producing liquefaction, others causing a gelation and slection[26], while the influence of certain chemical salts on the activity of the cells of the body is well-known to all students of physiology. It is also well-known that a rise of temperature accelerates chemical changes and the same holds good of living matter. In so-called cold-blooded animals, in which the temperature of the body varies with that of the surroundings, a rise of temperature is accompanied by an increased velocity of movement[27] that is directly proportional. On the other hand, a lowering of the temperature causes a slowing of the frequency of the heart beat in *Daphnia*[28]. If this lowering of the temperature is rapid there is a definite lag before the slowing of the heart beat reaches equilibrium ; and this lag possesses a time-factor that corresponds with and appears to be due to the increase in viscosity of protoplasm as a result of cooling. Again an alteration in temperature will considerably affect the rate of development, a higher temperature accelerating it and a lower causing retardation. The rate of division (fission) in Paramoecium can be increased or retarded by corresponding changes in the temperature.[29] In the case of the eggs of certain Insecta (Orthoptera), the difference in rate of development has been found to be strictly proportional within those limits of temperature at which it is possible.[30] So dependent on the temperature is the rate of development that if one side of an egg only be heated, then development on that side will be more rapid than on the other and the embryo will become bilaterally asymmetrical. But the changes brought about by alteration in temperature may be much deeper seated than this and not only the rate but the whole character of the developing animal may be changed. Monstrous forms can be produced in a culture of *Paramoecium caudatum*[31] by reducing the temperature to 3°C and then allowing it to rise again to the normal

temperature of the room. Every student of Zoology knows that changes in the season may so affect the Water-flea, *Daphnia pulex*, that the female, which during the summer months has been producing parthenogenetic eggs that develop into females, will with the onset of autumn commence to produce thick-shelled eggs the develop into males and the same is true of other Cladocera. Probably, this is to some extent the result of a lowered temperature causing corresponding delay in development, somewhat similar to the results obtained by Hertwig, who has shown that delayed fertilisation of frogs' eggs causes an increase in the number of males. Temperature changes, however, may in a similar manner even affect the animal after it has left the eggs stage ; Witschi[32] has shown that the effect of extreme heat on tadpoles is to cause a change of sex from female to male. Normally, sex differentiation occurs in the 4th week or after 28 days ; but in those tadpoles that had been exposed to a temperature of 32°C for varying periods, there was not a single female, though in the control eggs Witschi obtained 26 of each sex. In those treated with heat he found that 53 showed changes towards the male condition and 62 were typical males. There can be no doubt that the effect of the exposure was to so alter the genital organs that they changed from female to male. Goldschmidt has found that a temperature of 37°C is able to produce deep-seated effects on fruit flies and finally, Plunkett[33] has shown that an increase in temperature causes a change in certain characters in *Drosophila melanogaster*, one result, among others, being the diminuation in the numbers of hairs on the segments of the body.

Mere alteration in the normal conditions of light and darkness may set up deep-seated changes in the animal. As an example I may cite the effect of absence of light on the Aphidae. In continuous light wingless Aphids produce, almost exclusively, wingless offspring. If, however, the exposure to light be reduced, then winged offspring will commence to appear ; the most effective proportion of light and darkness in the production of winged forms offspring is 8 hours' sunlight to 16 hours' darkness and the effect on the character of the offspring makes its appearance in two days. If, however, darkness be combined, with starvation the effect is even more marked and the production of winged forms begins after only 15 hours[34]. It has recently been claimed that changes in the amount of nutrition may of itself affect the ultimate sex of the "Flourbeetle" *Trebolium confusum*, Duval[35]. The sex ratio is in this case not a simple relation of the nutritional condition, for slight starvation of the larvae (i.e., 1 day) causes an increase in males and more prolonged starvation an increase in females. The author suggest that a certain number of specimens of either sex may have the sex changed to that of the opposite and that this is brought about by the bio-chemical and biophysical state of the body fluids acting on the germ cells. These effects, I would point out, however they be produced, are not on the animal itself, but on the germ cells within the body of the animal, the effects being thus only visible in the next generation. A condition of semi-starvation may however, produce changes in the individual if applied early enough. In the case of *Drosophila melanogaster*, Plunkett[36] has shown that, if applied in the early stages of life, it may cause

the production of forms with a marked decrease in the number of hairs on the body. But the effects are comparatively trival and, indeed, may almost be termed pathological.

In certain of the insects, such as the bees, it is now recognised that we get in nature a variety of forms, the production of which appears to be due to difference in feeding in the early larval stage, and it has been proved that the addition of a substance such as Manganese salts to the food of the Butterflies will result in the production of a melanotic mutation that breeds true.

In the case of Rotofers, Tinesinger has shown that when the female parent was subjected to traces of alcohol, there was a marked shortening of life and a reduction in the number of eggs that were laid ; and this latter character is transmitted to the off-spring for two generations and then disappears. A similar result was obtained by Noyes[37]. Stockard[38] has got results of the same nature in a mammal, while Chaudhuri[39] has shown that injection of alcohol into the male parent mouse very considerably alters the sex-ratio in the offspring, the number of male offspring being increased ; in birds, however, Pearl[40] only obtained a reduced fertility in the egg, and these which were fertilized gave rise to perfectly normal offspring. Whitney[41] has found in Rotifers that whereas a anty diet produces in the 2nd generation only females, a copious diet causes the appernce in the 2nd generation of 95% males, showing that there is, as a result, a change in the eggs from which the daughters develop and that this change affects the grandchildren. Similar result has been obtained by Shull in his studies of the effect of external conditions, such as a manure solution, on the sex-determination of the offspring ; he found that whether a female is to be a male producer or a female producer is irrevocably decided in the growth period of the parthenogenetic egg from which that female hatches, that is, before this egg is actually laid, the effect of the external condition thus being on the *grandparent*.

If variation in the amount of sunlight or the amount or quality of the food supply can produce such effects, one would expect to find that such agencies as ultraviolet radiation, radium-rays, and X-rays were even more efficient, and such is undoubtedly the case. Taking first the effect of ultraviolet radiation on the non-cellular protozoa, it has been found that exposure to such rays for periods as short as from 2 seconds to 2 minutes, either every day or on alternative days, is sufficient to produce well-marked results in a culture of Chilodon uncinatus[42], a holotrichous ciliate of the family Chlamydodontidae ; a number of modifications were produced among which were a race that closely resembled a different species, *Chilodon cucullus*, and this modification continued for generation after generation for months and even persisted after encystment and the production of a tailed form that bred true for 48 generations other changes were the production of fused individuals or twins, similar to those that I have alerady mentioned. The effects produced may be summarised into the following groups.

1. Mutations that continue after encystment and conjugation.

2. Modifications that persist for some time and bred true, but die out with encystment or conjugation.

3. Temporary variations which disappear after 3 generations, and

4. Abnormalities that cause death.

It has been found in practice that the effects of these types of radiation on developing higher animals are not produced uniformly but that there is a much more marked effect in cetain regions of the animal body than in others, the effect apparently depending on the activity of the part. The work of Hyman and Bellamy[43] has shown that the various organs of a body are not all equally active ; thus in sponges the region round the osculum, or the exhalent aperture, is more active than the rest of the body ; in Hydroids the tips of the tentacles are more active than the body and this latter more than the stem ; in Medusae the tips of the tentacles and margin of the umbrella are most active, while in flat-worms the two ends are more active metabolically than the central part. In a developing animal there is a definite metabolic gradient ; as a rule the head end is metabolically the most active, but this may, at any rate in part, be due to the complexity of this region, for it has been found that the rate of metabolism is definitely related to the complex character of the organ, the more complex the greater the metabolic activity. Now the higher the metabolic gradient the more susceptible is the part to outside influences such as radiation or poisons.

Experiments on the developing hen's egg[44] showed that if the rays were directed against the shell, no results were obtained, but if a window was made in the shell, so that the rays could pass through, then a number of changes took place, among which were the production of double monsters or the duplication of parts. One result obtained showed that whereas there is normally a definite polarity in the developing egg, certain parts giving rise to definite organs, the effect of radiation is to stop the development of certain organs and the growth takes on the characters of a neoplasm or tumour. The parts most affected are those that have been shown[45] to possess the greatest metabolic activity, such as the developing Primitive streak, the speical sense organs, limb buds, and those regions where foldings or flexures are about to take place.

The effects of radium rays or X-ray are very similar to those of ultraviolet radiation, but in the majority of instances the effects produced are pathological in character ; Muller has dealt with the effects of radium and X-ray and Babcock and Collins have studied the effects of emanations from radio-active rocks on fruit-flies.

There is thus ample evidence that it is possible to modify the processes going on in an animal by changes in either its external or internal environment. But in nearly all these cases that we have been considering it is found that in the higher animals, changes in the environment, if applied to the adult, produce as a rule little or no direct modification and where any effect is produced, the result lies in the direction of pathological or even lethal changes. Environmental changes if applied to the early larval stages or to the egg itself may be effective, though here again in the highest forms the result is usually pathological. Changes applied to the adult, may, however, affect the offspring, though not the parent. In such cases the effect of the altered environment is to produce in the egg only a comparatively slight structural change

yet sufficient to affect the actual constitution of the molecules of the chromosomes of the nucleus and, if this can be done without causing the death of the organism or a loss of the power of reproduction, the result is to produce something new and, if this change be transmitted to the progeny, then the results is the production of a new species.

To sum up all the evidence that I have put before you it would appear that throughout the whole evolution of the animal kingdom, with the attainment of each higher stage there has been a loss of some power or function. The change from a non-cellular stage to that of a multi-cellular organism caused the loss of at least one function, namely, that of continuous reproduction, in all cells except those of the genital organs. Later on, the actual shape of the organism becomes more and more fixed and less and less susceptible to external changes, and development has to proceed along definite lines, a head forming at one end and tail at the other regardless of the position of the developing egg ; and that can be achieved in the way of changes in the genital organs or the genital cells themselves, which still retain, in some degree and possibly to a considerable extent, the susceptibility to changes of environment that existed in the lower organism in times past, is the production of comparatively insignificant variations in the more or less superficial characters or else changes of a pathological nature. There has thus been a gradual loss of plasticity. The lines along which an animal must normally develop, become more and more fixed and conversely the degree to which it can be affected gradually becomes less and less as we pass up the scale, while the period of existence in which an animal can be influenced is more and more limited and this limit is reached at a progressively earlier stage in its development. It would thus seem that after all the physicist may be right and that in the higher forms of life, including ourselves, we may be rapidly approaching the stage when further evolution is becoming impossible. If that be the case, then we are equally rapidly approaching the stage when, unless we have become completely superior to our environment and can ignore any and all changes in our external conditions, the existing higher animals and especially the human race will disappear from off the face of the earth to make way for some form of life that has not as yet become restricted in its power of response.

**REFERENCES**


1. G. Augusta, "What is life?" introduction by Karl T. Compton and Raymond Pearl, Charles G. Thomas, Springfield, Illinois, 1928.
2. M. Popoff. *Arch. f. Zellforsch*. III, 124, 1909.
3. J. B. Looper, *Journ. Exper.* Zool., L. 31, 1928.
4. R. Hegner, *Journ. Exper*. Zool., xxx. 1, 1920.

   (A number of further references to this subject are given in the three, papers quoted above, R. B. S. S.)

5. J. J. Gerassimoff. *Zeitschr. f. allg. Physiol.*, 1. 220, 1902.

6. L. H. Burnside, *Journ. Exper. Zool.*, LIV. 473, 1929.

7. Gray N. Calkins, *Journ. Exper. Zool.*, XLI, 191, 1925.

8. F. Chatton, *Conts. Rends. Acad.* Sci., CLXXIII, 393, 1921.

(I have not been able to refer to this paper. R. B. S. S.)

9. J. A. Dawson, *Journ. Exper, Zool.*, XXX. 129, 1920.

10. Margaret R. Murray, *Jour. Exper. Zool.*, XLVIII, 467, 1927.

11. A. S. Pearce, "*General Zoology*" Revised Edition. p. 291, New York, 1929.

12. H. H. Newman. *Biol. Bull.*, LV. 1928.

13. C. M. Child, *Journ. Exper. Zool.*, XLVII. 243, 1927.

14. J. Huxley., *Biol. Bull.*, XLIII, 210, 1922.

15. H. V. Wilson, *Journ. Exper. Zool.*, Xl. 281, 1911.

16. C. M. Child., *Anat. Anzieger*, XXIX, 1906.

17. Paul S. Galtsoff., *Journ. Exper, Zool.*, XLII. 183, 1925.

18. E. Korschelt, "*Regeneration and Transplantation*," Berlin, 1927.

19. W. Kaan, Helen, *Journ. Exper. Zool.*, LXVI, 18, 1927.

20. J. S. Huxley, *Biol. Zentvalb.*, XLVII. 151, 1927.

21. M. E. Shaw, *British Journ. Exper. Biol.* VI. 145, 1929.

22. M. A. Tazelaar., *British Journ. Exper. Biol.*, VII, 165, 1930.

23. Kunkel and Robertson, *Journ. Mar. Biol. Station, Plymouth*, XV. 665, 1928.

24. Hans, Przibram, *Proc, Royal Soc., Edinburgh,* XLIX, 224, 1929.

25. Morgan, *Proc, Royal Soc., London*, Series B, XCIV, 1922.

26. Floyd John Brinley, *Protoplasma*, IV, 177, 1928.

27. Hans, Przibram, *Arhiv fur Entwicklungsmechanik,* XXVIII, 561, 1909.

28. Jan., Belebradek, *Protoplasma*, LII. 317, 1928.

29. William H. Mitchell, *Journ, Exper Zool.*, LIV, 383, 1929.

30. J. H. Bodine, *Journ, Exper. Zool.*, ZLII. 91. 1925.

31. C. F. de Garis, "*Journ. Exper. Zool.*, XLIX, 133, 1927.

32. Witschi, *Journ, Exper. Zool.*, LII, 267, 1928.

33. Charles R. Plunkett, *Journ Exper. Zool.*, XLVI. 181, 1927.

34. Franklin A. Shull, *Roux Arch. Entwicklungsmech. Organ.* CXIII, 1928.

35. F. G. Holdaway, *Nature*, 131, 1930.

36. Charles R. Plunkett, *Journ. Exper. Zool.*, XI.VI. 181. 1927.

37. Bessie, Noyes, *Journ. Exper. Zool.*, XXXV. 225, 1922.

38. Charles R. Stockard, *Journ Exper. Zool.*, XXVI. 119, 1918.

39. A. C. Chaudhuri, *Brit. Journ. exper. Biol.* v. 185, 1928.

40. Raymond, Pearl. *Journ. Exper Zool.*, XXII. 125, 165, and 241, 1917.

41. D. D. Whitney, *Journ. Exper. Zool.*, V. 1, 1907.

42. Mary Stuart, MacDougal, *Journ Exper. Zool.*, LIV, 95, 1929.

43. Hyman and Bellamy, *Biol. Bull.*, XLIII, No. 5, 1922.

44. Marie A. Hinrichs, *Journ. Exper. Zool.*, XLVII, 309, 1927.

45. Libbie H. Hyman, *Biol. Bull.*, LII. No. 1. 1927.

The Association has since been maintaining a website *scienceongress.org* in which contents of Everyman's Science including the list of articles, notes etc. along with their full texts are available beginning with Vol. No. 39 issue No 3.

# PRACTISING COMMUNICATION TECHNOLOGY FOR DEVELOPMENT AT GRASS ROOT LEVEL IN INDIA

Pradeep Nair and R. C. Tripathi *

**Communication technology based services come into picture predominantly to enlist the participation of rural masses in the process of development. They are oriented towards dissemination of information, education, training and guidance to rural masses to chart out their own developmental programmes.**

**The paper briefly analyzed six major initiatives taking place at grass-root level in different States of India providing access to rural populace to new communication technologies. A broad range of services are provided to a large cross-section of rural masses through these six low cost, self-sustained, community owned projects viz. LOKMITRA at Himachal Pradesh, BHOOMI at Karnataka, Warana Wired Project at Maharashtra, GYANDOOT at Madhya Pradesh, TARAHAAT and JAN MITRA at Rajasthan.**

## INTRODUCTION

Today, it is paradoxical to say that Communication Technology is only associated with the markets and capital-intensive methods of production of Developed Countries and it has any relevance for a country where many millons still lack basic necessities of life. That is why a number of efforts are underway in India and other developing countries to provide concrete benefits of communication technology for rural population.

Communication technology is playing a very important role in achieving greater economic gains. Development through communication technology services at grass-root level does not mean only increased rural market based economic activity. It also includes improvements in the capabilities of the population, such as education, health and nutrition, family welfare, etc. Communication technology services are also educating and moblizing rural populace to actively participate in democratic decision making process.

Further, communication technology has a potential role in increasing the efficiency of government. For both government and private provision, one of communication technology's main direct benefits is in increasing efficiency by economizing on resource use in the operations of firms as well as in market transactions. Information that would otherwise be conveyed through face-to-face contact, post, courier, print delivery, telegraph or telephone may instead be communicated in digital electronic form via internet. Efficiency gains from internet use are not automatic : the

* Department of Journalism & Mass Communication, University of Lucknow, Lucknow, U. P.

telephone, in particular, is an efficient means of communication for many types of information. Efficiency benefits of communication technology services are not restricted to the communication itself. Communication technology can improve the efficiency of the telephone network at rural and remote areas, and thus it can make it possible to track and analyze different forms of communication. Word processing, maintaining accounts, inventory management and other such activities that may not require long distance communication are also becoming more efficient by new communication technologies.

## COMMUNICATION TECHNOLOGY AND DEVELOPMENT

In the words of Gunner Myrdal, the renowned economist, "development is a collective transformation of the entire social system which not only ensures that everybody should have the basic necessities of life but also that the decision making process in the society must be participatory." No doubt, today the communication technology services are fulfilling this basic criterion very effectively.

The facilities of communication technology are not limited only to providing information for rural development at grass-root level, but it has also given rise to new information resources and has opened new improved communication channels for rural communities. Communication technology has made successful attempts to solve the menace of Digital Divide by bridging the gap between development professionals and rural people through initiating interaction and dialogue. Communication technology is creating a worldwide linkage for sharing the knowledge across the globe.

In the present era, communication technology services are generating new possibilities to attack the problems of rural poverty, malnutrition, inequality, gender difference and environmental degradation. But the question of importance of communication technology for rural development is accompanied by the dilemma for decision makers and multilateral funding institution : should the very limited resources for rural development be applied for developing communication technology capacities or they can best be used for other high priorities such as schools, hospitals, roads, etc. Clearly there is a grave concern about the possibility of wasted, poorly utilized or unspent resources in communication technology application for rural development. But when we consider the output of these programmes, the importance of communication technology out shadows all controversies.

## APPLICATION AREAS

In developing countries, Communication Technology based services are reaching out to a vast majority of urban as well as rural people in cost effective manner. These services are integrating people by exploring new information resources. They are making successful attempts to solve the menace of Digital Divide by bridging the gap between the have nots of the developing countries and the haves of the developed countries.

The application of communication technology services in most of the rural areas has been devised with the following aims :

(1) To provide better health care facilities and more information about the treatment of deadly diseases ;

(ii) To provide transparency to the rural masses in case of public administration and Panchayati Raj System i.e. to provide information regarding taxes, saving schemes, rural development programmes, policies, planning, etc.

(iii) To provide current market rates and information to the farmers and thus helping them in direct dealing worldwide.

(iv) To provide farmers information about new methods of cultivation and also providing them the knowledge about various developments taking place in the fields like Horticulture, Pisciculture, Animal Husbandry, Sericulture, etc.

(v) To improve the literacy rate, particularly of rural females that can have a lasting impact on rural poverty by making them self-sufficient.

## SOME COMMON PRACTICES

In the present era of communication technology, information has come out to be an important resource that, if exploited properly, can work wonders. In spite of the fact that the computer revolution is spreading practically in every arena of human endeavour and especially in banking, railways, defence, a somehow little impact has been noticed on the rural sector. The target of communication technology based services considering rural development is to provide the relevant information to any farmer in a remote village by means of accessing hierarchy of information bases. Consultancy regarding diseases, pest-alerts, animal health, weather condition, small scale industries, rural credit system, water and sanitation are the key needs of the rural community.

Some common practices of communication technology based services practiced at grass-root levels ar as follows :

## RURAL PORTAL AND RURAL CAM

Information and communication services to rural masses should be improved through the creative use of communication technology services. National media like radio and television covers the rural issues only at macro level because of time shortage. The state media looks after regional disparities in rural matters. Communication technology can go a step further by providing the individual solutions round the clock in local language by creating knowledge tree using audio and video clippings.

Rural portals are envisaged as a search engine that can act as a guide to the existing rural and agriculture related web information and web services. It will support locating relevant information on the portal or other rural websites via the area wise classification. Rural and agriculture extension departments should focus on providing relevant information about development issues in e-format over World Wide Web (WWW) via internet.

A web cam is a device that sends pictures from a video or still camera onto the internet so that you can view the images on someone's web page. When web cam is used for the benefit of the rural people, especially farmers, it is called **rural cam**. For example, a corn cam monitors a designated corn field, a soya cam monitors a designated soyabean field and a dairy cam monitors different parts of a dairy

operation. This concept is called as **virtual farming**.

Rural cam can be useful for farmers by viewing live picture from experimental field locations around the world on internet. Farmers can compare their field response with experimental fields. They may decide to seek expert advice if experimental field's response is altogether different from what farmers are getting. Rural cams can prove to be a useful technology to large group of agriculture practioners over the internet. Rural cam can also be useful to educate rural masses about development issues.

## ELECTRONIC RURAL MARKETS

Farmers' needs vary with season, crop, weather and location. So most of agribusiness services need to be regional in scope. Many farmers and small scale industrialists do not have so much time or information access to make and implement informed marketing decisions because commodity prices are always changing. So, they can get information on comprehensive agro marketing and risk mangement programmes from any e-commerce site based on agriculture and rural marketing just by clicking on a link. Acquiring inputs like seeds, fertilizers, pesticides, agricultural implements, loans and credits, self employment schemes and training, etc. is possible via E-rural sites from anywhere in the world. At present, personal credit card is the effective mode of payment for e-commerce which is a cumbersome method for farmers and small scale rural industrialists in availing e-agricultural and rural market facilities. A credit card can be easily made at panchayat level so that each and every person under that panchayat may be able to use that credit card.

### E-weather

The growing of crops to feed the populations of the world is directly affected by climatic change. Food production is directly and totally dependent on favourable growing conditions. Role of communication technology in weather forceasting is two folded i.e. generating weather forecasts and its dissemination to the farming community.

In this concern, the agro-meteorlogical advisories are very useful to farmers for scheduling of irrigation to save water, and choosing the optimum timing for spraying of pesticides, application of fertilizers etc. Now a days, these weather bulletins (e-weather bulletins) are available on internet and by this the farmers are frequently using this data in planning their routine agricultural activities.

### Public Information Kiosks (PIKs)

Public Information Kiosks are basically acting as information-cum-communication centres for rural development. They are helping in creating awareness among the rural population about various on-going rural development schemes, programmes, and policies and thus cater their information needs in local language. These PIKs are also facilitating communication services through telephone, STD, fax, e-mail, etc.

The most salient feature of PIK is that the rural people have access to information/data collected on aspects like development programmes, agriculture, employment, education, health, land records, socio-economic information relating to the mandal and villages under the

mandal and who-is-who in the area. Internet as a source of global information is also used to capture information relevant to the clientele group.

The minimum financial investment required to establish a PIK is near about Rs. 5 to 7 lacs and the equipments required are P III computer, printer, scanner, photocopying machine, telephone and fax machines.

The technology provided by PIK is not location specific. But the information/data available pertains to the local level where the centre is located and caters to the needs of the local people from the area. It is also planned to tie-up these information-cum-communication centres with distance education centres and to establish them as their local centres.

**E-choupals**

Traditionally, choupals are community gathering places in the village where locals meet to discuss issues and iron out their problems. In the digital age, e-choupals are gradually revolutionizing the way Indian farmers do business.

The concept of e-choupal was pioneered by one of India's largest exporters of agricultural commodities, Indian Tobacco Company's International Business Division (ITC-IBD). E-choupals constituted on internet enabled kiosk in a village which is manned by a prominent local farmer who is familiar with computers, known as the '*choupal sanchalak*'. The setting up of each e-choupal entails an investment of between Rs. 1 to 3 lacs.

The *sanchalak* man of the kiosk is in touch with ITC representatives and guides farmers on the use of the technology. Given the levels of literacy and infrastructure limitations the *sanchalak* acts as the interface between the computer and the farmer. Farmers can use the kiosks to check the current market prices of their commodities, access market data, get information on local and global weather and best farming practices. Presently, near about 2,500 internet kiosks were established in villages by ITC across 18 states of the country. The total investment was near about Rs. 1500 crores.

**Simputer Practices**

In a developing country like India, where nearly 50 percent of the population is unable to read or write and the median income is as low as $ 30 in rural areas, simply providing access to computers and the internet just isn't enough. In most developing countries like India, the very cost of a computer can amount to more than the average workers annual salary. In an attempt to surmount the prohibitive cost of this increasingly essential piece of IT hardware, researchers in developing countries have begun to take matters into their own hands by designing low-cost computers that address the particular needs of their nation's more disadvantaged populations.

A team of Indian scientists and engineers to create a way for people with limited literacy and computer skills to take advantage of the wealth of information on the net. The team has dveloped a small, powerful computing device called the "Simputer"-stands for "simple inexpensive mobile computer"–that reads out the text found on web pages in a number of India's many native languages.

Simputer, which costs around $ 200, is slightly larger than the popular Palm handled computer and has a built in browser, e-mail software, a text-to-speech program for several Indian languages and an MP3 player. The machine runs on widely available AAA batteries.

Simputers are marvels of efficiency and cost savings. They save licensing fees by using free, "open source" Linux as the computer operating system software instead of MS Windows. The handheld Simputer packs powerful processing power, a touch sensitive screen, a modem and an removable memory card slot into a device slightly bigger than today's pocket PC.

For the 95 percent of Indians that do not currently have access to, the internet services, one of the most useful feature is the Simputer's "smart card" port. By this card many individual can share a single machine by using their smart cards to activate their own personal accounts. Simputers can even appear in country's ubiquitous telephone kiosks, where an entire village can take the advantage of internet access.

So we can say that developing countries need a technology that would help them to take communication technology to the remotest villages. In India one billion information-hungry people are waiting to practice Simputer to bring digital information to their door steps and to bridge the gap. In this concern, it is really good to know that grass-root efforts are taking place everyday.

## BARRIERS TO COMMUNICATION TECHNOLOGY APPLICATIONS

In any developing country, like India having a lot of social and political problems, it is not easy to plan and execute communication technology based services for development at grass-root level. Even after 57 years of independence and development, the rural areas are still remaining underdeveloped in every respect. There is about 40 percent of the rural populace who are below the poverty line. They do not have the provision for the second square meal in a day, roof over their heads, good health and environment. Everyday they are suffering from poverty, unemployment, illiteracy, ignorance, injustice and inequality. Thus, rural people are still alienated from the mainstream of national development due to lack of information, education, guidance and training pertaining to rural development programmes. Then some other common barriers to communication technology applications are as follows :

1. ***Lack of local information*** : The most far-reaching barrier of practicing communication technology based services in developing countries is the scarcity of the kind of information that users wanted most i.e. local information about their community. Lack of information potentially affects a great number of Indian net users.

2. ***Literacy barriers*** : On-line content has been primarily designed for internet users who have discretionary money to spend. The vast majority of information on the Net is available for those who have an advanced literacy level. A large percentage of Indians do not have the reading and writing skills necessary for functioning in everyday life. Near about 45 percent Indians are affected by literacy barriers.

Further, the content that is available on the internet for masses are mostly in the elite

languages, the highest of which belongs to English.

3. ***Absence of tool/interface*** : There is no tool/interface that has been dveloped to allow the have-nots of developing countries to publish and create content in their local language.

4. ***Local language application*** : There has been no standard software/application interface to allow the have-nots to use communication technology services in their local language. Even operating systems and office suits are not available in local language enablement.

5. ***Basic Standards*** : There has been no basic standard for developing or enabling the communication technology at community level. There has been no effort to educate the have-nots for using new communication advances.

## INITIATIVES REQUIRED

Development becomes reality only when people take active part in the process. In this regard, communication technology is aiming at overcoming backwardness and is preparing necessary grounds for accepting innovations, ideas and technologies. What is needed is to enhance development communication support to rural masses by properly informing and communicating them about the benefits of rural development programs and also the why and how of these programs through communication technology based information services. Some other efforts needed are :

(i) To develop and innovate the new communication technologies for the development of rural masses at all level.

(ii) To offer and use communication technology based services for the up-liftment and social awakening of rural people and to create digital communities.

(iii) To offer the localized interface to the masses so that they can use the desktop, office suits and other necessary applications in their own languages, so that they can use ICT for their daily use and purpose.

(iv) To offer internet/web-based multilingual interface to publish local content including news, general information, commercial information, exchanges, etc.

(v) To offer multilingual intranet technology to allow the local masses to create local information communities. By this, local communities can use communication technology based services in many areas using web, e-mail, on-line facilities.

## SOME INDIAN EXPERIENCES

### LOKMITRA Project at Himachal Pradesh

Lokmitra project was at first started on 9th May, 2001 at Tounidevi Village of Hamirpur district at Himachal Pradesh. This project is the Himachal version of Gyandoot Pilot Project already going on in Dhar district of Madhya Pradesh. Under this NABARD sponsored project, 25 Information Centres were opened in various part of the district.

With the help of these information centres, people of the district, especially those living in remote and interior regions, are now able to send their complaints to various government departments by paying a nominal fee to the

owner of the centre. The person managing the centre sends the complaint to the district headquarters. The complaints get the reply within a week.

Under this project, all the 25 Information Centres were interconnected through computer networks and they are also connected with the office of the Deputy Commissioner, various departments of State government and with important departments of Central government at New Delhi via network. The National Informatics Centre (NIC) of Himachal Pradesh has supplied necessary softwars and hardwares to the owners of the information centre and provided basic training to operate computers and internet services.

At the beginning, two main servers and four terminals have been set up in the office of the Deputy Commissioner, nodal agency in the project. Daily e-mails coming from various information centres are screened at the office of the Deputy Commissioner and then sent to respective offices. The replies received are again sent through internet to the owners of the concerned centres.

Through Lokmitra project market rates of vegetables, fruits and other items are also made available at all information centres. People can also send and receive information regarding their land records, income certificates, caste certificates and other official documents.

The ultimate aim of Lokmitra project was to make Himachal Pradesh, a small state of India a leader in the field of Information & Communication Technology network.

**BHOOMI Project at Karnataka**

Before two decades, the Ramanagaram village was known for the shooting of Bollywood action movie "Sholay" and the British Raj Epic "A Passage to India". Today, it is back in news but the theme has changed from a feudal vendetta and colonial rule to the power of communication technology to transform century's old habits of keeping land records.

Karnataka, which is championing the process to rebut criticism that its software boom is only for the rich, now plans to guide the rest of India in a project called "BHOOMI" which aimed at fighting corruption and boosting transparency.

Amid the mango and coconut groves of Ramanagaram, farmers walk into a state-run "Bhoo Dhakilegala Malige", or land record shop, and buy certified printouts of land records which help them to verify or prove landownership or tenancy. All this is possible only due to Bhoomi, a low cost e-governance initiative taken by Karnataka government in 2001.

Karnataka state has near about 6.7 million farmers and 17 million land records spread over 30,000 villages and the government is spending about 180 million rupees on the land-records project. Under this Bhoomi project, 177 Talukas or Sub-districts are linked through the local area networks over the internet. At block or village level, all the hand written land records are stored on computers and anyone can get the printout by paying just 15 rupees. In every sub-district, two computer friendly account units were established. Presently, near about 10,000 computer account units are covering all the 30,000 villages of the State.

The Bhoomi project is getting a very good support from software giants Microsoft Corp., computer maker Compaq Corp. and Aditi Technologies Ltd. These software and hardware companies are helping the project to develop a fingerprint-based access to software application in which land records generated by the village accountants are entered. A small fingerprint recognition point is attached to each terminal. This system is needed to prevent password-based hacking.

In these computer based account units, the land owners and farmers can trace much information and processing of their lands keeping away red tape and corruption.

**Warana Wired Village Project, Maharashtra**

Communication Technology revolution has silently swept through 70 villages in Warana, Kolhapur district, Maharashtra.

Before this communication technology project came to Warana, sugarcane farming and milk procurement were hard work. Now the networking has solved a major problem faced by sugarcane farmers. Once the crop is ready for harvesting, each day's delay in harvesting reduces the sugar content of the cane and as a corollary the price it fetches at the sugar co-operative factory. The one harvester that the co-operative owns would often be monopolized by the rich farmers. Through the network, harvesting dates at each farm and village can be predetermined and the farmers can complain on-line to the co-operative chief if the harvesters do not arrive on time. Each farmer is provided a code number that helps him to decide when to take his crop to the factory. His bills are also cleared online as well.

Co-operative dairies are now selling their products online and milk collection centres have been upgraded to cyber cafes. The Warana group has also opened an office in Eurpeo to market its milk product.

The network also provides farmers pricelists of farm products in the region. So, now it is easy for them to monitor the rates of agricultural products across the state. They can also access daily weather forecasts, information on cropping patterns, soil conservation and government schemes.

An information package called Disha has also been developed to provide vocational guidance to village children and youth, provide information on career options and educational institutions they can enroll in.

The basic objective of the Warana Wired Village Project is to use communication technology as a tool for development and to bring government planning's, programs, policies to the doorstep of the rural masses.

**GYANDOOT Project at Dhar, Madhya Pradesh**

Gyandoot was the first intranet network that brings the administration close to village India. The network is actually a low cost, self-sustainable and community owned rural intranet system that caters to the speicific needs of the village communities in the district. Near about 50 centres are established which are managed by the rural youth who run the centres as entrepreneurs and charge for the services that include agricultural information, market information, health, education, women issues and applications for services delivered by the

district administration related to land ownership, affirmative action and poverty alleviation. A mechanism to evaluate the system and demand accountability from district adminstration as well as the kiosk managers is built into the system through an interface for complaints redressal.

The Gyandoot project has main servers backed by battery power and UPS. The UPS are able to provide four to five hours backup power during the frequent power outages. The NT servers are connected to five modems, which in turn are connected to five dedicated BSNL lines. Three ISPs provide internet/intranet infrastructure. Kiosks are connected to the intranet through dial-up lines.

The application software was created in a surprisingly short period of time using an array of web and database languages. The user interface is menu based with information presented in local Hindi language. Web based e-mail has been provided in the local language as well. The content on the internet is extensive and is available in local Hindi language. Information related to agricultural produce and government services are being extensively used. This has resulted in the reduction of middlemen who previously bought agricultural produce from farmers at suppressed prices as well those who facilitated access to government offices to expedite applications for land registration or caste certificates and other services provided under the numerous programs for poverty alleviation. The interface between the local government and the rural people has empowered thereby empowering the villagers who were previously intimidated by the government machinery and civil servants.

The Gyandoot project was entirely financed by the village panchayats, the community and by private entrepreneurs with no contribution from the government. The cost of establishing one information kiosk is near about US $ 1500. Each kiosk caters 30-35 villages in the vicinity. These kiosks are located in government buildings or at prominent locations in the markets or along the main roads. Kiosk managers who are young, educated and motivated are ecouraged to maximize the use of the services to make a profit on their investment. Some of them are combining other services to become more profitable. The kiosk mangers meet once in a month at the district headquarters to exchnage their experiences.

The Gyandoot project is important for two main reasons : first, it has demonstrated that an economic logic can function at rural computer centres, and second, it has developed a menu of e-commerce and e-governmence services that is of real benefit for rural citizen-consumers. The information kiosks (*soochnalayas*) have begun to eliminate middlemen and are introducing a positive restrain on corruption at the local, village level. The networking is also prodding slothful *taluka* administrations to become more accountable. Gyandoot won the Stockholm Challenges Award for public service and democracy. It was chosen for the award from 109 projects across the world which shows that it is a unique intranet project in itself.

**T A R A H A A T**

The project "TARAHAAT" means a all purpose haat (a village bazaar/market) comprising a commerially viable model bringing relevant information, products and services via

the internet to the unserved rural markets of India from which an estimated 50% of the National Income is derived.

The concept of TARAHAAT was developed and promoted by the Development Alternatives Group. The group has a staff of more than 500, including 200 professionals having higher qualifications and work experiences in the field of Engineering, Sociology, Marketing, Computer, Communication, Psychology and Management. These professionals design, implement and operate various phases of the project and look after its associated services.

TARAHAAT combines a mother portal, TARAhaat.com, supported by franchised networks of village cybercafes and delivery systems providing a full range of services to its rural customers/clients. The subsidiary units are–

(i) TARAdhaba ; Providing the village people connectivity and access to new world.

(ii) TARAbazaar : Providing access to products and services needed by the rural households, farmers and small scale industrialists.

(iii) TARAvan : A mobile van service delivering the goods ordered by the rural people.

(iv) TARAdak : Connecting the rural families to the daughter married far off and to the son posted on the front.

(v) TARAguru : A decentralized university providing mentoring and consultancy services to village-based mini-enterprises.

(vi) TARAreporter : Collects relevant information for the portal.

(vii) TARAvendor : Runs a store dealing and making available the products available at Tarabazaar.

(viii) TARAcard : A service which enables the villagers to order goods and services on credit.

In the absence of efficient infrastructure for transport and communication, information is hard to come by and market options are not clearly and widely known. Even if something is available, somewhere, information on where, when and for how much, is not, it is impossible to have an access to that information. There is no instrument/tool more effective than the new communication technologies, especially internet based services, for bringing both jobs and information to the rural economy, bringing the buyer and seller together and creating an efficient market place in developing societies like India. This is all what TARAHAAT project is doing quite well.

**JAN MITRA Project at Rajasthan**

Jan Mitra is a United Nations Development Project (UNDP) and state government of Rajasthan supported pilot project. The main objective of Jan Mitra project is to provide a single window facility to rural people to access government work, simplify various government procedures through computerization and to make use information and communication technology (ICT) to establish direct communication between the administration and the rural people.

Today, the people in villages across Jhalwar, a remote and backward border district, are using communication technology to exercise their right to information and access government services.

The Rajasthan government is using Jan Mitra to ensure transparent, accountable and responsive governance and to make the right to information an effective tool in the hands of the rural masses. Most villagers reckon that, for the first time in their lives, the information kiosks have brought them closer to their government and vice versa.

Jan Mitra or 'people's friend' has truely been a friend in need. Registration of births, deaths and land records, grievance redressal, submission of online applications for a clutch of government schemes and services, even getting of examination results, all are just a click of mouse away. And while each service comes with a price-tag, the villagers pay up happily, actually counting their savings in terms of time and effort spared.

Presently, near about 50 information kiosks are running under this project. Unemployed rural youth have been selected and trained to manage these "village information shops", providing them gainful employment. Nearly 40 departmental offices have been linked with the Jan Mitra server and near about 20 offices linked to the local area network (LAN).

The government has developed its own information management system to exercise vigilance over the disposal of problems through Jan Mitra. It provides detailed information on action taken for the disposal of public grievances.

No doubt, Jan Mitra has heralded the arrival of the knowledge economy in an area with high property levels, abysmal infrastructure and chronic shortages of drinking water and power supply.

## CONCLUSION

It is a big challenge for any government of developing countries like India to be successful in diverting the flow of new communication technology based services towards a massive population with such limited funds and social and cultural barriers. But even than, we are successful to an extent in bringing the communication based technology at the doorstep of every common man.

This paper has briefly analyzed the initiative taking place at grass-root level ro provide new communication technology in rural India. a broad range of services are provided to a cross-section of rural masses through a number of low cost, self sustainable, community owned programs and projects like GYANDOOT, JAN MITRA, LOKMITRA, BHOOMI, TARAHAAT, Warana Wired Village, etc. The only aim is to offer the rural poor a bridge to the Communication Age.

By going through this paper one can easily find that in the last five years there has been a significant surge in terms of access to new communication technologies. The whole ICT sector is emerging as a strategically important sector driving social and economic change in India. Both central and state governments, public and private sectors are taking many initiatives to remove the communication gap between the haves and have-nots. We are bringing the global world on the doorsteps of rural people residing in remotest villages and are providing them new avenues to do better. The only aim behind this communication revolution is to provide access to new communication teachologies to every

citizen regardless of gender, language, handicap, geographical location, class, caste or creed, and no doubt, we, the people of India, are progressing.

**WEBSITES/HOMEPAGES CONSULTED**

1. http://www.digitalpartner.org/tara

2. http.//www.gyandoot.nic.in/gyandoot/intranet.html

3. http://www.inomy.com

4. http://www.iowafarmer.com

5. http://www.indiachi.com

6. http://www.it-taskforce.nic.in

7. http://www.netsansar.org

8. http://www.powerfarm.com

9. http://www.rajasthan.gov.in

10. http://www.tarahaat.com

11. http://www.revdept.kar.nic.in

## DO YOU KNOW?

Q1. Name a bird that cannot glide?

Q2. Approximately how many feathers a swan has?

# ALTERNATIVE MEDICINE : COMPLEMENTARY TO MODERN MEDICINE

Sisir K. Majumdar *

**Alternative Medicine has become popular all over the world in recent times. The reason is simple. Notwithstanding massive technological advancement and its application in mordern diagnosis and treatment, we are still lagging behind in the exploration of the root-causes of many diseases. Hence, there is no specific curative remedy for them in modern medicine. Naturally, people are tempted for alternatives. This short write-up tries to glimpse into the genesis of Alternative Medicine.**

## INTRODUCTION

The aim of all systems of health science is one and same-alleviation of human pain and cure of human illness. Methods of achieving it may be different. Alternative medicine is thus complementary and not contradictory to modern medicine. Throughout history, Health Sciences evolved as a splendid blend of science, art, philosophy and mythology. Still today, much of healing art is a myth, wrapped in mystery inside an enigma. The practicing healer is very much a child of his time. Throughout human history, his methods have been rooted in the thinking and feeling of the human beings of his day, as well as their knowledge. Healing art has given much to all branches of knowledge in the past just as it has received much from them, and these mutual exchanges have been reflected not only in the theories and origin of ailments but also in its alleviation.

* HASI NIKETAN, 200 Summer House Drive, Wilmington, Dart ford, Kent DA, 27 PB, England.
Email–majumdar@tiscali.co.uk

## A PEEP INTO THE PAST

Science, as it has developed since the days of Galileo (1564–1642), has drawn even more heavily on the faculty of vision. There are in human beings, however, other senses and feelings beside those derived from vision, and clinical medicine. Being concerned with the whole man, we must take note of the world of emotion in the patient, his loves and hates, his religion and its content, the theory of disease underlying it, which makes it so absurd in our eyes. Primitive specialism, in which the practitioner knows only one kind of disease and its cure, is still present within us.

A significant feature of all primitive examination is the stress laid on prognostic signs. Such so-called omens may be found in the flight of birds, in features of the patient's body, or in the characteristics of an animal's entrails. There are, of course, great variations in such prognostic procedures, but throughout the world these primitive techniques are basically

and surprisingly similar. It was from this pursuit of prognostic signs that, medicine made its greatest and most significant advance. Medicine is both an art and a science and needs to both "evidence-based" and "experience-based". Albert Einstein (1879–1955), Nobel Laureate in Physics, 1921, rightly said :

"Not everything that can be counted always counts, and not everything that counts can be counted."

**THE ORIGIN**

Alternative medicine is a fairly recent construct ; it means method of treatment alternative to conventional modern medicine.

It was evident to a few discerning minds in the West in the 19th and 20th centuries that palliative nature of allopathy, its inability to cure several diseases, its polypharmacy, its superspecialisation, its use of potent drugs and its interventional procedures do more harm than good. Homoepathy founded, developed and propagated by Samuel Hahnemann (1755–1843) in his work ["Organon den rationellen Heilkunde" (Handbook of Rational Healing] was the earliest important alternative system of medicine in the West. Its "Law of Similars" helped the body to heal itself.

Since the birth of humankind, treatment of diseases by whatever means available at the time or place, was the norm. Various systems of treatment developed in various societies and in various cultural norms and forms. Allopathy (Greek : 'allos'–other) is the treatment of disease by conventional means, i.e. drugs having effects opposite to the symptoms. Homoeopathy (Greek : 'homoios'–like + 'patheia'–suffering), innovated by the German physician and chemist–Samuel Hahnemann is a system of complementary medicine in which disease is treated by minute doses of natural substances that in large quantities would produce symptoms of the disease. Unani (Greco-Arabian) medicine is an admixture of Arabic medicine or Tibbi with Ionian-Greek medicine [Ionia (in present Western Turkey)–birthplace of Galen (130-200 A.D.) of Pergamun]. Ayurved–"the science of life" is the ancient Indian system of medicine. The essence of Ayurveda is really fascinating.

Every system of complementary medicine has made useful contribution to the evolution of health sciences over the centuries. The trend will surely continue unabated in the twenty-first century.

Greek medicine (later Graeco-Roman medicine) was an admixture of Greek and ancient Indian Ayurvedic medicine. The Indians had access to Ionia (Asia Minor, now in Western Turkey) through the famous silk-route, which extended from China to Europe. Arabs had contact with Ionian Greeks. Thus Arabs imbibed ancient Indian medicine through the Ionian Greeks indirectly and directly through the Indian Ayurvedic Vaidyas (doctors) practicing in Baghdad ("Garden of God") during the brilliant reign of Caliph Haroon-al-Rashid (763–809 A. D.) of the Abbasid dynasty, who was the hero of "The Arabian Nights" (Alf Lay Lah Wa Lay Lah). Several Ayurvedic treatises were translated into Arabic, including "Shshruta Samhita" (Kitab-shawasoon-al-Hind). Unani medicine heavily borrowed from Indian medicine.

## HOMOEPATHY *vs.* ALLOPATHY : THE PHILOSOPHY

The words–"allopathy" and "homoeopathy" are both from the Greek and mean–'allos'–other–opposite suffering and "homoeo"–same–similar suffering respectively. Like cures like (The Law of Similars) ; Totality of Symptoms–Minimum Dose–Single Remedy–Direction of Cure : these are the cardinal principles of Homoeopathy.

In the 4th century B. C. the Greek physician, Hippocrates (460–370 B. C.), found that there were two distinct approaches to illness–one by way of 'opposites' and the other by 'similars'. Orthodox medicine–or allopathy–heals by 'opposites', and homoeopathy heals by similars. Samuel Hahnemann brilliantly drew together the principles of homoeopathy. He is considered to be the "Father of Homoepathy". Homoeopathy treats the patient as a whole.

## THE CONCEPT OF AYURVEDA

Indian Ayurvedic system of medicine existed even before the birth of modern medicine–the Greek medicine of Hippocrates. It served people–all people with the medical expertise available at that time. We must live up to that ideal even more today.

Ayurveda encompasses not only science but philosophy, religion and the specific techniques for living well–religion in the sense that one becomes a witness of oneself, philosophy meaning love of truth, and truth as being pure existence. Generally speaking, the source of all life, Ayurveda is a science of truth as it is expressed in life.

The vibration of pure universal consciousness produces the soundless sound OM ; from this sound, five basic elements are produced, *i.e.*, Ether, Air, Fire, Water and Earth. Furthermore, these five basic elements are manifested into three biological organisms, known as Vata, Pitta and Kapha. In every organism these three govern all physio-pathological changes.

At the time of fertilization, Vata, Pitta and Kapha determine, by their innumerable permutations and combinations, the constitution of an individual, which is called prakruti. Prakruti means the first creation. Every soul in the human being is the first creation of the cosmos, and is never repeated. That is why every human being is a separate entity, a unique phenomenon. The healing science of Ayurveda is based on the total understanding of the individual constitution, then one can understand what is a good diet and style of life for oneself.

So, one man's food can become another man's poison. Hence, to live a healthy, happy and balanced life, the knowledge of one's constitution is very essential.

After knowing the constitution, one has to learn that every individual is composed of a body, a mind and a spirit, hence these bodies of knowledge are created.

Ayurveda deals mainly with physical body, Yoga deals mainly with spirit and Tantra is mainly concerned with the mind–through different techniques. But the philosophy of all the three is identical ; their manifestation differs becauses of their differing emphasis.

Ayurveda is most concerned with the physical basis of life, concentrating on its harmony to

induce harmony of mind and spirit. Yoga controls body mind to enable them to harmonise with spirit, and Tantra seeks to use the mind to balance the demands of body and spirit.

The balance between these three was called Health–or Svastha–(Sva–self–Stha–established).

Hence Svastha–"established in the self" the 'self' here is the ego, but the poorer of individual identity, which separates every being from every other being. The ego is that which gives me my identity, which makes me know that I am I, not you, he, she, we or they.

Modern physicians are more interested in the nomenclature, definition, or named diagnosis and its infective case, rather than look into them individually. Also, they tend to specialise compartmentally, *e.g.*, into liver specialist, lung specialist or heart specialist–*etc., etc*. Also, they never encourage looking after the self because they can offer a bullet-pill treatment–or take the organ out, or even replace the organ if need be. Hence, most of the approach is suppression or repression. In other words, we destroy our body in order to save it.

The other coin of disease promotion in our society is "excess", and we use this coin liberally, never worrying about the consequences until the consequence hits. The discomfort is ignored, to become a disease–and this is further ignored till it settles down to be named or verifiable disease. Once the name is decided, we attach the name and never help the individual who is afflicted with the name ; and we treat the name with accumulated data on percentage basis. The result is that we try to buy, beg, borrow or steal health with all kinds of suppressive or abortive methods. Health is nature's gift, but we fight the nature of self and are always in a build of copying, mimicking, imaging and unreal, and forget the real, original, intuitive self.

In Ayurveda, the first thing to learn is to know the origin of the universe and its relation to self. Ancient sages ("rishis"), when they examined their own experience and consulted their intuition, they realised that human consciousness, will and identity must be fragments of nature's own consciousness, will and identity. Hence their conclusion through observation brought the insight of pure existence, which wanted to manifest through desire, which split into consciousness and will–which, when merged together produce the intellect, which has the capacity to discriminate and become the Informer called Ahamkara. The individual self or the numerous bundles or intellect with individuality, are all searching for means of expression–and they express themselves in waves of kinetic energy called "rajas", and subjective consciousness named Sattva, Rajas is activity, Tamas inertia, and Sattva balancer of both. These three qualities control the five great elements ; out of which the body is created, which are further controlled by three doshas, *e.g*. Air, Fire and Water, which regulate the functions of metabolism.

## ACUPUNCTURE THERAPY AND MOXI BUSTION

"*Acupuncture*" is derived from the Latin words–"*acu*" : with a needle, "*punctura*" : prick–it is a centuries-old Chinese method of treating diseases and of relieving pain by use of needles inserted into specific parts of the body. At present, it is popular all over the world.

The art and science of *acupuncture* is legendary, perhaps even antedating the introduction of Chinese herbal medicine. The aim of this therapy was to restore the balance between the "*yin*" and the "*yang*". Needles are inserted in the skin at varying depths through any of the 365 points along the twelve main meridians that carry the life force of "*qi*" (single most vital essence supplying energy to the body along fifty-nine meridians). Each of these points is related to a specific organ. The Chinese use acupuncture techniques to treat a vast array of illnesses and to relieve a number of symptoms, particularly pain. Its empiric use has now been shown to release endorphins (a group of neuro peptides) natural substances formed within the body known to cause relief of pain.

*Acupuncture* began to be used in Japan and Korea by the 10th century and spread to Europe by the 17th century. It came to India in early 1950's. Today it is an important mode of alternative medicine in many countries outside China, especially for problems unrelieved by Western medicine.

Moxibustion is a form of treatment in which a powdered plant substance is fashioned into a small mound on the skin and burnt, producing a blister. The same meridian and points that govern the placement of *acupuncture* needles are also used in moxibustion.

## THE YUNANI SYSTEM

The word–"YUNUN" means "Greek" in Arabic. After the fall of Roman empire around 400 A. D., the Nestorians (Syrian Christian sect) alleged to be "heretics" were expelled from the Roman region around 341 A. D. They moved east to Gondisapur (South western Persia–present Iran) and then to other parts of West Asia. They brought with them all available manuscripts of Graeco–Roman Medicine. The Arabs including Muslims, Jews and Christians, preserved them, enriched them with their experience and knowledge and then presented the whole "cocktail" to the West during the Moorish reign (711–1492 A. D.) of Spain. In India, the admixture of Graeco–Roman and Arabian medicine is known as "YUNANI" medicine. On Indian soil, it imbibed and incorporated the excellence of Ayurvedic system of medicine and then, this combined product is known as "Unani Tibbi".

Muslim invasion started in India when Ayurvedic medicine was at its peak around 10th century A. D. The invaders came in hordes from Afghanistan and Persia and brought with them their own culture, life-style and their system of healing art (Yunani medicine).

Contrary to the concept of "Panchavut" of the Ayurvedic medicine, the Yunani system divided the main elements of the human body in seven categories : 1. Aarkan, 2. Mijaj, 3. akhlat, 4. Aja, 5. Aarva, 6. Kuva and 7. Aafal, collectively known as "*Um ure Tabia*".

Hakims or Yunani physicians used to believe that good health depends on healthy food, drink, muscle-movements, rest, sleep, early walking, defecation and restrained sex. It flourished during the Muslim rule in India. But it is interesting to note that even in those days, both hakims and vaidyas (Ayurvedic physicians) used to treat patients together. Both systems were popular and there was respectful co-existence and no rivalry or confrontation. Even now, it is popular among Muslims.

### OTHER SYSTEMS

Complementary medicine also includes Aromatherapy, Herbalism, Hypnosis, Massage, Osteopathy, Reflexology, Yoga, Meditation, Shiatsu, Naturopathy, Taichi, Ch'uan, Chiropractice, Bioenergetics and so on. The list is long.

### THE EPILOGUE

The relationship between modern medicine and alternative forms of medicine should not be one of conflict and confrontation but of cooperation and complementation. It is best expressed by Farokh Erach Udwadia in the preface of his scholarly book–"Man and Medicine : A History" (Oxford University Press, Kolkata/New Delhi/Oxford 2000) :

"The first and all-important lesson is that there are limits to medicine and that frustrations expressed towards medicine today are because expectations of people from medicine have always been far more than what medicine can meet. The other important lesson of history is that truth is relative and never absolute. Many concepts and beliefs considered to be sanctified truths in the past were held to be utterly false at another time in future. We should, therefore, be humble enough to realize that many aspects of contemporary medicine about which so many are so proud, may a hundred years from now prove to be false and perhaps even harmful and dangerous. At the same time history also teaches that discarded concepts of the past have been resuscitated and found useful in the future. Alternative forms of medicine, therefore, need our tolerance and even respect, not the disdain shown by practitioners of Western medicine."

### DO YOU KNOW?

Q3. Air pollution in different parts of Kolkata has been measured by various agencies during normal days as well as during 'Bandhs' when city streets have no vehicular traffic. The idea is to estimate the contribution to vehicular traffic on air pollution. How much is that?

Q4. There are two elements which are injurious to human health but when combined those become absolutely necessary ingredient of human food. What are those elements?