

CANCER AND ENVIRONMENT

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Introduction

The phenomenon of cancer: A brief introduction

It is all in your 'mutated' genes, man!

Search for the culprit continues ...!

Environment: our concern is justified

Matters of serious concern? ... How far?

Conceptual conundrum, indeed!

Do we require a new outlook?

New insight

Evolution and cancer: A radical departure from the existing views

Are we prepared to accept the paradigm shift?

To summarise

“Cancer is now in the service of a simplistic view of the world that can turn paranoid...” : Susan Sontag

INTRODUCTION

Whenever the question of relationship of cancer with the environment is raised, the discussion boils down to the problem of environmental pollution. Anti-pollution drives are aplenty, discussions in knowledgeable quarters over the measures to improve our environment are routine, and the public are being made aware of the dangers of pollution and the perceived benefits of a pure environment. Pollution however, is not a modern phenomenon. Since the birth of civilisation people have always used their sovereign power in order to live a healthier life. Today there is a tendency to accuse the general masses for the rising environmental pollution. People are blamed also for their 'faulty lifestyle', which is a form of environmental pollution, for the rising trends in the incidence of cancer. Whether and how far the lifestyles are responsible to bring about cancer will surely be made an interesting study, but for overall environmental pollution, we feel it is utterly outrageous to blame the general masses as such. We feel that the corporate bodies on the contrary are responsible for the environmental pollution. In the name of globalisation they have hijacked our sovereign power and are using it against us. If now it is said that the incidence of cancer is rising largely due to environmental pollution, then those corporate bodies and their irresponsible activities must be accused for that. However, a critical analysis of cancer vis-à-vis environment raises questions whether such linear equation is acceptable at all. Cancer as a distinct phenomenon may be discussed from various angles, such as political, economical, cultural or social. But we must not forget that after all, it is primarily and precisely a biological phenomenon. It seems now that precious little of this basic aspect have so far been propagated to the

general masses of the people, as a result of which the environment, environmental risks and environmental control have all created a kind of conceptual conundrum.

THE PHENOMENON OF CANCER: A BRIEF INTRODUCTION

The term 'cancer' refers to more than 100 forms of the disease. Still, the basic processes that produce these diverse diseases appear to be quite similar. There are 30-50 trillion cells in a normal, healthy human body, and unlike the human communities they live in a complex condominium, in the sense that they are uniquely interdependent, regulating one another's development and activities. It means that although we merely pay a lip service to the concept of democracy in practice, as biological beings we harbour within ourselves a truly democratic society of cells indeed. This collaboration of cells within our body ensures that each tissue maintains a size and architecture appropriate to the body's needs. The cancer cells however, are destined to violate this unique scheme and tranquillity of the democratic 'celldom'(1). They have their own agenda, both short term and long term. They form a different society of cells, democratic again, within their own sphere, looking after one another. The problem is that these cells take their origin from the normal cells, live and progress with their normal counterparts, largely inseparable and indistinguishable from them, and without the slightest knowledge of the host they live in. The only exclusively distinguishable feature is their unique behavioural properties. When the normal cells become cancerous they become deaf to the friendly suggestions of the other cells and follow their own internal agenda. The agenda comprise of relentless reproduction, migration from their original sites and invasion of the other sites. These insidious properties of the cancer cells make them more and more aggressive over the time, and ultimately they become lethal by disrupting the tissues and organs needed for the survival of the host. However, the cancer cells have another property, unique of its own; i.e. they may remain dormant within a tissue, maintaining equilibrium with the other cells, for years or even decades together. But the question is how, and why does a cell become behaviourally so malignant?

IT IS ALL IN YOUR 'MUTATED' GENES, MAN!

Or, that is what we are given to understand. We have come to understand that the most significant aspects of human life and disease, from alcoholism to criminality, from coronary to cancer, are all genetically determined. Genes express themselves as proteins. Since the proteins catalyse all the biochemical reactions in our body, it is implied that they ultimately control and determine all the characteristics of the organism. Genes or the proteins have thus become sacrosanct. Genes are there in the nucleus of a cell, and they are of various classes. It is popularly said that certain specific classes of the genes get 'mutated', and malignant transformation of a cell comes about through the accumulation of such 'mutations' within it. Of the specific classes of genes, two are said to be most important in relation to cancer. These are 'oncogenes' that encourage growth, and 'tumour suppressor genes' that inhibit it. They are polar opposites of each other. These two classes of genes are normal genes, and they must remain intact in order to have a normal life. When the oncogenes are mutated they yield too much of proteins or their active forms that stimulate cellular growth. On the other hand, when the tumour suppressor genes are mutated they fail to counterbalance the oncogenes, and thus growth remains uninhibited. So, cancer is supposed to occur when both these classes of genes are mutated. Of course, this is a simplified story, for there are other classes of genes that also play very important roles in the genesis of cancer. This is why

cancer is said to be a 'polygenic' disease. However, for the present moment, this is the standard or conventional view on cancer.

Thus, it can be argued that cancer occurs by switching on a genetic mechanism. But how, and why does a genetic mechanism get switched on? We shall appreciate this if only we accept that a human being is nothing but a bag of genes. If we are to survive as members of a species we must enjoy a stable genome, for a stable genome is a primary requisite for survival of the species. In other words, if the genes of a member of a species are imperfect, the very genome becomes unstable, and thus the very 'survival of the species becomes jeopardised'(2). If it is jeopardised the integrity of the common gene pool of the human society comes to be at stake. In order to maintain the integrity therefore, those individuals carrying defective genes have to be eliminated. One of the methods of such elimination is the 'mutation' of the genes. In modern medicine, 'mutation' means the loss of memory of a gene. Due to this the gene forgets to perform its normal function and acts abnormally. Such mutation can occur in two ways: We can inherit the mutated genes from our forefathers, and we can also acquire them in course of our life. In other words, for harbouring mutated genes in our body we can make our forefather(s) responsible, although it is impossible to say whether they are maternal, or paternal ones! Or, we shall have to make ourselves responsible because it is we who have acquired the mutated genes. Such mutations occur by 'chance', due to radiation or ultraviolet rays, for instance. They can also occur due to a chance mistake during cell division. Such a chance can only function in a genome that is unstable. Thus, in whatever way we see it is we who are responsible in the last analysis. And, in whatever manner the mutations occur, in a way they serve a definite advantage to the human society. This is akin to the classical Darwinian concept of evolution, - the concept of 'natural selection' and 'survival of the fittest'. Therefore, one gets cancer basically because of his imperfect genes. So there is nothing in the world, no societies of communities except the 'selfish genes'(3). As a mimicry we can say now that there is nothing called a human society, it is the habitat of selfish individuals only. Even these individuals serve only as a vehicle for the genes. Since the vehicle is of less importance because it will not last long, but the gene will; all that is good in human beings, love and compassion etc is also less important. The vehicles may even be abandoned if they are found to be damaged or imperfect. Competition is the one and the only that have a lasting importance.

This genetic explanation of cancer comes out straight from the idea that today's biology is armed with genetics, the code of life, - 'the language in which God created life'(4). Let us recall the double helix famed James Watson, who said, 'we used to think that our fate was in our stars. Now we know, in large part, that our fate is in our genes'(5). Gene centric ideas are therefore, basically deterministic. In fact, the revolution that came from Watson and Crick's double helix has largely been a technological one. We have come to understand the nature of the genetic code, the mechanism of protein synthesis and the manner of gene replication. But when it is said that the code of life is written in DNA, it seems to be an exceedingly narrow view of life. Such a view asserts that if we have mutated genes we will be off the race. Two kinds of determinism emanates from this outlook. The first kind asserts that we are all mere puppets at the hands of our DNA. We can call it as 'puppet determinism'(6). But this kind of determinism is not expected to find much popularity in today's world. All the more, the assumptions of 'puppet determinism' have already been contradicted by such discoveries in gene research, which showed that under certain conditions the genes could be silenced, or inactivated or even eliminated from the genome. We have of late, come across such terms like 'fluid

genome' that tell us that genes can also undergo changes due to environmental perturbations. So, the pure gene-centric ideas have already been 'nullified'(7). But such nullification gave rise to another deterministic idea within us, namely 'promethean determinism'(8). It claims that we can tamper with our genes and genetic make up, and thus we can act as the guardians of our genes. Since we have unravelled the mystery of creation, we can even create life. Gene centric hypotheses are basically a matter of world outlook. For example, the double helix famed James Watson thinks that 'the world would be a better place if there were fewer stupid people'(9). And in order to eliminate stupidity in future generations, he prescribes genetic engineering that will influence intelligence. He warns the parents that they would be foolish if they refuse to understand that genetically enhanced children will eventually dominate the world. One would appreciate the anxiety of a father for the learning disability of his son, but one should not forget at the same time that such prescriptions carry sinister echoes of a not so old chapter in the history of science, i.e. eugenics. This also reminds us that such shameful ideas and claims were first propagated in 1865 by Francis Galton, Charles Darwin's cousin, and such prescriptions were the most favoured ones of Adolf Hitler, in order to make a pure 'Aryan' race.

However, it seems now that history has failed to enlighten us. We now propagate the idea that as the most developed creature on earth, human beings are invincible. We have already landed on the moon, and manufactured bombs that are 'brighter than thousand suns'. We have made revolution in the animal world creating a Dolly, and have brought about revolution in agriculture with engineered seeds and soybeans. Since we can create a genetically engineered man on earth, we can also defeat cancer and can even eliminate it from the face of earth, lock stock and barrel. For this purpose we think the first thing we shall have to do is to identify the 'imperfect genes'. So, now we have been rewarded by the birth of a generation of scientists who run after 'imperfect genes' or the genes that are supposed to get 'mutated' or are already mutated. They are better called 'gene hunters'. They have hunted for genes for cancer, genes for Diabetes, genes for coronary and so on.

However, serious researchers now know that although this kind of simple linear thinking brings money, huge publicity about cancer genes 'yielded precious little'(10). Scientists were expected to find at least in certain forms of cancer some combination of 'oncogenes' and 'tumour suppressor genes' that are always mutated. They failed. Instead the number of putative cancer genes has leaped into the dozens. Even 'mutation' as the central tenet of the deterministic ideas is not a linear story either. Experiments have shown that different cells in the same cancer often contain different mutations. So, there is no clear pattern that perfectly matches the supposed genetic cause of cancer. When the proponents of the gene-centric ideas say that the imperfect genes are to get mutated in order to bring about cancer, they tend to make us forget that such mutation or loss of memory of the genes are however, taking place in our body everyday, as a part of evolutionary process. Our genes have made us survive all the adversities in life for thousands of generations over tens of thousands of years. They mutated several times over to keep us alive. Billions of such somatic mutations occur, almost all of which are harmless and insignificant. But some of them are of course, cancer related. So, millions of cancer cells are being produced in our body daily due to mutation, and fortunately they die due to trauma within the vascular channels of our body. Still, they talk about mutation, although they are not even certain whether the mutations are the result of cancer, or it is the other way round.

So, whatever the promethean gene-centrists are boasting of their achievements are all very true. 'We are staring at those achievements in utter dismay, not because these are wonder of the wonders, but simply because how modern biology can boast for these extreme malformations, conveniently forgetting and even ignoring potentially dangerous consequences'(11). According to many molecular biologists(12) therefore, this determinism in any form is a myth, since all these tampering might be possible only at the expense of being 'dehumanised'(13). We will no longer remain human at the present sense of the term! Not only it is a myth, it is dangerous too, for this notion in the long run, will direct a bio-medicalised man to realise that what he had wished for was not exactly what he had wanted; but that will be a painful and late realisation indeed.

SEARCH FOR THE CULPRIT CONTINUES ...!

Although cancer has been fashionably called a 'polygenic disease', it was pointed out subsequently that mere 'polygenic inheritance' is not a sufficient explanation of cancer, because by the term polygenic, cancer does not acquire any uniqueness. There are other diseases as well, which are examples of polygenic inheritance, ranging from 'congenital malformations' to 'porphyria' to 'peptic ulcer'. Each of them has its unique characteristics and unique life history. It was thought therefore that in cancer, apart from the genetic changes there must be 'factors' outside the genes and even outside the body that are also needed. Thus cancer came to be called as a 'multifactorial polygenic disease'. So the culprits are the 'factors' outside the genes, which play their respective roles in turn, or in combination, in the genesis of cancer. These factors or 'agents' are called 'carcinogens' since they are responsible for the making of a cancer. It is now being argued that there are numerous examples of such carcinogens in our environment, for instance the chemicals which can cause mutations in the genes. This is the 'environmental explanation of cancer'(14), also known as the social theory of cancer. So, this view propagates that gene mutations are elementary indeed, but they cannot occur without the role of the external factors. It sounds rational indeed, for we know that the elementary cause of development of a matter is internal, not external; but the elementary or internal property cannot be activated without the help of the external forces. This view at least does not relegate the responsibility of the disease on to our forefathers. However, the genes are ours, and the environment we talk about is also ours own. So the environmental explanation tends to suggest that it is we who are indeed responsible.

What do the carcinogens do? In the making of a cancer the carcinogens are required from the very first step, i.e. for switching on the genetic mechanism. But this is only the initial step. When a cancer-related mutation occurs, those cells that get damaged are just 'initiated' cells, as they are called. In order to behave cancerously these 'initiated' cells have to be 'promoted'. As we know, a continuous transmission of messages always takes place back and forth among the cells in their democratic society. So, a damaged cell has to be 'promoted' by some agents that interfere with this message transmission. These agents are again, carcinogens. Even now these cells are not cancerous. In order to get cancerous they have to be 'progressed', for which again, they need some carcinogens that will bring more injuries to the cells' DNA. Therefore, cancer is a multi-step process, requiring perhaps 5 or 6 (or more) insults to a cell as well as a series of carcinogens before cancer develops. When a cell is sufficiently damaged it takes up the cancerous properties. It is now a truly cancer cell and, left alone, it may remain dormant for indefinite period, or it may grow and multiply until it kills its host. There are very few things on earth that have the ability to do the three jobs in a row: to initiate cancer, to

promote it and to make it progress. Things that have such ability are called 'complete carcinogens'. Radiation for instance, is a complete carcinogen, including cosmic radiation from outer space, which we cannot avoid; but most carcinogens are not. Most carcinogens can do any of those three jobs as mentioned above. In sum therefore, if we are to avoid cancer, we are to find out the exact cause of it, and to avoid contact with it, meaning a carcinogen.

A relevant question is, how is it that the same environmental carcinogens do not affect everybody in the same way? It is said that certain individuals or human populations have historically obtained a genetic profile that has a survival advantage. So, they escape environmental onslaught. The social theory of cancer tends to suggest that despite such advantages, all individuals are now susceptible to cancer. This is because the genetic advantage today flips to a flaw due to rapid changes in the environment and lifestyles. The design limitation of our body is such that it can adapt in response to a slowly changing environment, but it finds itself unfit and therefore fails, if the changes are too much and too rapid. Today we are surpassing the inherent design limitations of our bodies. This is the essence of 'nature-nurture hypothesis'. It indicates that achieving tremendous success in the social and economic development has its biological consequence also. We now live in a 24-h society that destroys the natural 24-h cycle of light and darkness, freshwater supplies and food-producing ecosystems. Therefore, instead of finding excuses in the genes, we must look at the faults in the environment around and in ourselves also. In fact the social theory of cancer emphasises that 'the body is always personal and also political; always local and also global; always distinct and also shared; always sexed and coloured and also gendered and raced; always genetic and also environmental'(15). Thus it appears that it is justified to get concerned with our environment.

ENVIRONMENT: OUR CONCERN IS JUSTIFIED

The environment we talk about is the very environment of our own civilisation of which we are an integral part. If we take environment as a concept then it varies depending on its social, economic and natural characteristics. In general however, it means a sum of the physical, chemical, biological, cultural and social aspects of the environs, at any given moment. All these aspects are likely to have a direct or indirect, immediate or delayed, short-term or long-term effect on all the living beings and their activities. Within this environment, along with our own civilisation, we can imagine that there are other kinds of civilisation as well, of the other living creatures. So, civilisation is species specific, so to say. Billions of such civilisations have evolved since the origin of life on earth. Out of these, only one has established a kind of civilisation that we are talking about. This is because this species has achieved the kind of intelligence needed to establish such a civilisation. This had happened in Africa, in a small breeding group of which we are all survivors. That intelligence has further developed, shaped and reshaped. We have entered new environments, shaped them, reshaped them and exploited them for our benefit. Concern has been raised that in the name of exploiting the environment we are now depleting it to the point of extinct. Concern has been raised that this is due to our extreme jealousy and anarchy, which are the direct fallout of our dominant economics and politics of today. Therefore, we are no more the same species as we happened to be thousands of years ago, for we must have committed many biological errors during this long period of our civilisation. We must have undergone plenty of mutations particularly during the most modern era. Thus, as a mutated species today we take pride in assault on the environment that sustains life, in

cold and sadistic manner. We organise calculated cruelty on the other species, in the name of progress. It raises question that if we are so callous as to destroy our own environment, then the claim that the more intelligent would survive is whether true at all!

It is said that 'five key factors'(16) have been identified for contributing enormously to the development of an ideal environment for the evolution of the current disease profile, particularly cardiovascular diseases and cancer. These are changes in human demographics, urbanization, technology and industry, economic development, and war. It is also said that these are the characteristics of the present era, the so-called 'fourth era of public health'(17). As compared to the previous eras, i.e. the era of 'sanitation', the 'biological' era and the era of 'lifestyle', the present era has also been characterised by the re-emergence of the older diseases in newer garbs as well as the rising incidence of chronic illnesses of which cancer is vastly important. Such a concept of public health has of course, emanated from the west. The west fails to recognise the existence of a superior civilisation at any given point of history. Suffice it to say that the health of the public in general always formed an important issue in the socio-political domain in our country in the ancient times. Why have we accepted such a western concept of public health is however, a different issue. For the present moment it is true that we have become obsessed with economic development to the point of neglect of its consequences. It is also true that there is tremendous discordance between our evolution-based biological needs and our lifestyle. It is being said now that this discordance plays a deciding role in the present disease profile. Therefore, the very concept of improved human health and living should be questioned. It should be questioned why we are now 'living better, but feeling worse'. This is an irony, but this is true. It is clear therefore, that the environmental pollution, causing damage and destruction to biodiversity are matters of serious concern.

MATTERS OF SERIOUS CONCERN? ... HOW FAR?

No doubt, they are matters of serious concern, but the question is, how much, if at all, does the environment contribute to the causation of cancer. Today faulty habits and diet, chemicals and even urbanisation have all been implicated as pollutants of the environment. Let us examine them in relation to cancer, in brief.

Smoking

Smoking has been attributed to the rising death rates from cancer and cardiological diseases. Naturally so, the mass campaign against smoking has gathered a hysteric proportion. Many studies have claimed that 'causative link' between smoking and cancer has been discovered. For instance, it has been shown that a very important gene named 'p53' gets mutated in smokers, due to a chemical known as 'Benzopyrine'. It is argued that the 'p53' gene is very important in that it controls the 'tumour suppressor gene'. Since the former gets mutated the latter is forced to remain silent, thereby causing the domination of the 'oncogene'. This causes lung cancer. We understand that rationality in natural sciences is supposed to be the search for causative links. However, when we observe complex living systems as biology, in a complex environment, we are very often provided with nothing more than 'associations' and 'temporal correlations', instead of causative links. It is true that mutated 'p53' genes are seen in lung cancer; but in order to undergo mutation this gene does not require Benzopyrine; it can be induced by other events, including physiological conditions as well!(18)(19) Moreover, these mutated genes are seen in the late stages of the disease, not in the earlier ones.(20) Therefore, although p53 genes are associated events in lung cancer, this is not a causal

association. Many such mutations and other cellular perturbation may be associated with many cancers; but they cannot be described as causal association. The concept of causation is entirely different.

If mere association of something is so important in lung cancer then it can very well be said that 'stress' is a more important association than smoking. Stressed-out people take up smoking to try to relieve the stress, and that's why there is more cancer in smokers, not because of smoking. And also, it can be proposed on the contrary, that it is cancer itself, which is responsible for heavy smoking. It is possible that a hidden cancer or a pre-cancer or a latent cancer may induce a person to smoke. And when cancer is diagnosed, smoking is implicated. This is in fact a fallacy called 'post hoc ergo propter hoc'. So, smoking is not a cause, but a 'proxy variable'(21). All we can say is that smoking and cancer are of course, associated. But then cancer is also associated with rising prices of food or fuel, for instance. In this regard, it is to be noted that Prof. Eysenck, a noted psychologist of UK took a very radical stand, when he declared in December 1980 that 'There are too many inconsistencies, downright errors, and unsupported conclusions in the research to make it possible to accept the suggestions as proven that cigarette smoking in a meaningful sense causes lung cancer or cardiovascular disease'(22). It seems that contemporary health scares have confused association with causation, and sequence with consequence.

But how can we disregard statistics? Statistics do not lie, it is said. Of course, they lie and they are known to be worse than the damned lies. It seems today that computer-generated statistics can satisfy anybody in whatever way one tends to get satisfied. However, such arguments apart, it is to be noted that statistics are varied, and they are known to prove the contrasts. Question is how should statistics be interpreted. To take but one example, there was an authenticated statistics back in 1962, that on an average, of 740 smokers, one gets lung cancer(23). The problem is if it was so, then it was the responsibility of the causalists to prove, why and how the remaining 739 persons could escape. It means that it was 739 times more difficult to prove why it did not than to prove how it did. This was an awful task, anyway. No one has ever ventured to do so! That heavy smoking is injurious to health is common knowledge, for it can give rise to many uncomfortable situations. But to claim that smoking causes cancer seems biologically unsound. It spreads cancer phobia. Not a single cause including smoking, cited in modern cancer research as responsible for the occurrence of a particular cancer, has ever proved to be the sine qua non of that cancer(24). Still, if one insists that A is the cause of B, then it must be explained why B can be caused without A, and also B is not caused despite A. Therefore, when we say that Fat causes coronary, Love causes cancer of the cervix, Long prepuce causes penile cancer, or Smoking causes lung cancer, we must be prepared to answer the relevant but bitter questions as well.

It has been argued that 'the absence of absolute proof does not predicate the absence of common sense'(25). Therefore, since common sense dictates that certain habits could initiate cancer, it is better to avoid those habits, no matter how much it remains unproven. True, but common sense dictates so many other things as well. For instance, common sense dictates that if we behave in the manner we are being asked to, we must lose the joie de vivre, spontaneity, and many a small, convivial bliss of life; and instead we shall be given some hard statistics. If we stare at statistics, here again common sense also dictates that we should not ignore the statistically demonstrated fact that 'those who smoke have a lower incidence of brain and bowel cancer as compared to those who despise Lady Nicotine'(26). In the medieval period it was preached that

illness was the result of a sin, and that the sin must be expiated by the mortification of the flesh. Common sense dictates that we must try to forget such idea. However, the guardians of public health fail to forget that.

Today, public health policies are based on the results of epidemiological analyses, which implicate age-old human habits for this and that disease. Sometimes these analyses tend to offer suggestions that run counter to elementary medicine. It has been claimed for example, that restriction of salt in diet in people who are hypertensive could reduce the incidence of stroke by 26% and of ischaemic heart disease by 15%(27). Elementary medical knowledge says that there are at least six independent physiological mechanisms that contribute to the control of blood pressure(28). Therefore, salt restriction studied in isolation seems to be quite irrational. Most of the times these analyses contradict common sense also, while at the other times if they fail to implicate something they even tend to invent new conceptions, like 'passive smoking'. For instance, one such analysis has shown that 'passive smokers' run 35% increased risk of having lung cancer'(29). What type of lung cancer, one may ask, because all types of lung cancer are not associated with smoking. It is interesting to note that the type of cancer that is shown to be caused in this study is historically not associated with smoking.(30) But the lifestyle protagonists did not stop. They continued with their new and dubious concept like passive smoking (or 'ETS': Environmental Tobacco Smoke) with explanations that remained even more dubious(31). It is now being questioned by the responsible epidemiologists themselves as to whether any kind of honest health policy should be based on such studies on eating, drinking, smoking and other lifestyles at all(32)(33)(34).

Diet

The irrational euphoria of the cancer establishment against smoking aroused the suspicion of many critics that such campaigns were an alibi only. They warned that campaign against food and drinks were in the pipeline. They said that 'the object of the exercise is to impose the will of those who believe they know best on a supine population which is supposed not to know enough to come in out of the rain'(35). It came out to be literally true today. We are now being told that our unscientific diet habit may also be responsible for the initiation of cancer. It is however, true that a myriad of naturally occurring chemicals in our daily food and consumptions have been shown to cause cancer in laboratory animals; but then this is also equally true that these natural chemicals provide us with some degree of immunity, instead of cancer. If we say that some components of our diet can increase the activity of enzymes that convert chemicals into carcinogens, we must also say that in a balanced diet there are other dietary components that can inactivate those enzymes. We must remember here that the concept of balanced diet is not an invention of the modern western science; it was ingrained in our culture for hundreds of years. On the contrary, we must point out that dietary perversions are the contribution of western culture. After having practised such perverted diet habits for a couple of decades the western world is now posing as our masters by advising us what should we eat, how much and when. They tend to make us forget that diet as such is not a homogenous phenomenon; diet habits depend and change according to racial tradition, culture, geographical location and seasonal variation. But the linear equations discovered by the cancer establishment, based in the USA, and their relentless propaganda result in a health scare in the public mind. They suffer from worry and cynicism.

It will be relevant to quote the famous social scientist Marvin Harris, who said, 'To explain food habits, priority must be given to material conditions, to messages in the stomach and intestines of hungry human beings, rather than to cute thoughts in the heads of well-fed idealists'(36). These 'well-fed idealists' now claiming as 'experts' are now showering opinions upon us on how dietary components allegedly contribute to the cause, prevention, and even cure of cancer. Not only cancer, many other conditions and diseases have been supposed to be nutrition-related problems in one way or the other; for instance 'Alzheimer's disease', 'Immune disorders', 'Juvenile delinquency', 'Homicidal behaviour', 'Baldness' and 'Irritable Bowel Syndrome' etc. Every year we are blessed with simple 'explanations' of purported dietary causes of such problems, blaming an excess or lack of specific food constituents or ingredients and portraying dietary supplements or dietary diversification. Such explanations are more often contradictory, for instance while certain dietary restrictions are supposed to prevent heart disease, those are in turn supposed to increase the propensity towards cancer! But the popular press is not bothered about that; they in their turn make those suggestions even simpler and linear in order to feed the public. The public at the receiving end remains utterly confused. Historically, human societies have tried to explain illnesses according to folk logic, rather than on the basis of scientific proof. It seems now that we also tend to propagate folk logic, rather than propagate the knowledge of biological processes. Knowledge of biological process of cancer will be dealt with later on, but in our country, it seems painful to talk about faulty diet habit as a cause of rising cancer incidence for another unique reason. What dietary supplement or dietary diversification should we talk about when we know that food itself is available to our population as precious little? And again, under-nourishment itself is not an established cause of cancer. It has been most efficiently shown that 80% of our population lives on a daily wage of not more than Rs 20. In the period from the early 1990s to 2003, annual per capita food grains absorption in India came down to 155 kg. Levels so low were last seen at the beginning of World War II and during the food crisis of the mid-1960s. During this period 20% of our population, mainly urban of course, had been improving and diversifying its diet. In the rural areas on the other hand, there had been an unprecedented decline in purchasing power. All these were direct fallouts of neo-liberal economic reforms. The sum effect was a massive decline in the absorption of food grains.(37) With this sad and devastating experience during the most recent period of our history, and in the face of sharply rising unemployment both at the rural and urban levels, to speak of dietary diversification for the general masses is illogical to the point of being foolish.

However, even if we knew how to identify precisely which factors or agents or dietary factors may act as carcinogen in whom at which time and in what way, then, in principle, the relevant advice would have been useful. There is no way to identify it. On the contrary, there is another fundamental challenge to such idea: it is the existence of 'biochemical individuality'(38). It has been pointed out that there are massive physiological differences between people, so that what is beneficial for one person might be deadly for another. No diet can ever be homogeneously safe. Human variation and diversity are inherent and inevitable, and so are the subsequent risks that follow from that fact. It is impossible therefore, to untangle such a mess.

Chemicals

It is still messier if we are asked to cleanse the environment of its carcinogenic chemicals. The National Toxicology Programme in the USA had published an elaborate 'Cancer causation list', an elaborate list of chemical substances, which could also be termed as a 'what not'. It appeared that no matter as such, under the sun is devoid of

carcinogenic property. The basic claim was that the cancer initiation properties of those chemicals were proven in the laboratories, in the rodents. So, they must be accepted as a scientific proof. Of course, they are scientific proof, but in terms of rodents. It becomes a 'context fallacy' if the same proof is juxtaposed in human beings. The idea that 'a mouse is a little man' is simple, but false. It is said that the rodents inherited the same set of genes as we did from our common ancestor some million years ago. What is never said is that many of those genes underwent many changes over the time, and also the rodents have an entirely different history. Time and time again it has been found that genes associated with diseases of mice have no such association with diseases in humans. It has also been noted for some time that many chemicals, while being associated with the induction of cancers in animal bioassays, can, at the same time, in the same animal, protect against other cancers(39). Even more striking is the observation that the same chemical, say 'Phenobarbital', a valuable human 'anti-epileptic drug', can promote liver cancers in rodents in specific conditions(40).

This is not to say that there are no carcinogenic chemicals in the environment; there are, in plenty. The point is how to deal with them, why and to what end? Let us examine the case of Ethylene Oxide, or say Cadmium, for instance. According to the Cancer Causation List, these are 'known carcinogens'. Ethylene Oxide is known for its various uses including sterilisation of medical instruments. Cadmium is used for the manufacture of batteries. Every user knows that these are toxic chemicals, and there are methods of using them. There are relevant laws also. However, there is no proof that these chemicals have increased the rate of cancer in human society. So what is the significance of propagating them as known carcinogens? The only significance seems to be that such information is added to our knowledge bank. That is of course, important; but what if we come to know tomorrow that the uses of these chemicals have been restricted or even banned for fear of cancer? Such a doubt is not unfounded, for there is a trend to deal with the data on some chemicals selectively. It is not that those chemicals cause dangerous cancers in humans more than the others. So this is an appalling situation, for it exposes the basic purpose of stimulating cancer phobia. Blatantly political intonation is exposed in this way. It has been said therefore, that 'emperor wears no clothes in the field of chemical carcinogenesis'(41)(42). Leaving aside such socio-political aspects, even if we stick to the scientific aspect we can see that there is another distressing trend. This is to equate a 'carcinogen' with a 'mutagen'. An agent that can cause cellular mutation may be called a mutagen. But all mutations do not necessarily result in cancer. Therefore, using an old adage it can be said that all carcinogens are mutagens, but not vice versa. Thus, the calculus grows so complex that it can be virtually impossible to predict what will happen in a particular individual exposed to low levels of a possibly toxic chemical. Not only that, while forming a public policy on the basis of expert reports, public perception tends to be neglected. It seems now that public perception regarding environmental purification is equally important. In 1990, an interesting study was conducted. A list of 28 different risks was evaluated by 75 risk experts and ranked in order of seriousness. A public poll of the same risks was conducted. It was found that there was a 'tremendous divergence between the opinions of experts and those of the public and the order of ranking of seriousness also was virtually reversed'(43). So, the situation seems to become more complex. This is not to say that chemicals should not be regarded as pollutants; they must be. But then there are gene and environment interaction, interactions between various genes and chemicals, interactions between the enzymes in a cellular environment, and so on and so forth. We must bear in mind that the environment is much broader than just chemicals.

Urbanisation

The so-called experts however, tend to forget that. The need of environmental purification seems to have gathered extra momentum when cancer has been characterised largely as a disease of industrialisation or in other words, urbanisation. Urbanisation has its evil effects of course, not only in terms of diseases but in other aspects also. But as we understand, every person aims to balance the rewards of taking risks against perceived hazards. It seems it is a matter of perception. This can probably explain why laws on wearing safety belts have not reduced deaths from road crashes. Such deaths now happen to those outside rather than inside the vehicle probably because the drivers feeling safe with the safety belts now drive recklessly faster. Therefore, what are the perceived hazards of development and how much of these are acceptable to a population is a million dollar question. For example, should we encourage rural electrification, or should we not? In recent years, childhood leukaemia has been associated with residential electromagnetic fields. Many papers are being published in this regard. The issue however, is not of recent origin. During 1928-1932, in the USA deaths from childhood leukaemia had an increasing trend in the areas where more than 75% of residences were served by electricity, whereas those areas with electrification levels below 75% showed a decreasing trend. During 1949-1951, when rural electrification was almost complete, all areas showed a peak incidence of death from leukaemia. So it is now claimed that there is historical evidence that residential electrification caused the emergence of the childhood leukaemia peak(44). Does it mean that the policy of electrification in respect of leukaemia was a wrong one? It seems fallacious.

The 'Occupational Safety and Health Administration' in the USA had projected in 1978 that a huge number of people would die each year from asbestos-related cancer. The number would be about one-sixth of all cancer fatalities. Based on that projection, the U.S. government had propagated that the number of cancers presumably caused by industrial exposure was as high as 40 percent. A ban on asbestos was contemplated. However, the 'Environmental Protection Agency' (EPA) subsequently failed to make a case for even 13 to 15 asbestos-related cancer deaths a year, even among heavily exposed workers(45). How could it happen? Meanwhile it has been proved that asbestos cannot cause any specific gene mutation. The answer therefore lies in environmental ideology, not in science. The same environmental ideology draws our attention towards global warming, nuclear radiation, fossil fuels and so on. All these are implicated for the rising incidence of cancer. Should we put a halt on urbanisation? Will that protect us against cancer? But before we deal with that, let us see if cancer incidence is really rising or not.

Are we supposed to take it for granted that incidence of cancer is rising due to environmental hazards, without question? It is true that more people are now being diagnosed with cancer. At the same time however, this is also true that more people are now living longer than before, as a result of which the number of old men in the society is more today than ever before. If the former is related partly to health awareness and partly to technological improvement, then the latter must be accepted as a biological phenomenon. Moreover, the density of population is many times increased today as well as the population itself. Therefore, it is easy to construct a linear equation now, i.e. more people are seen with cancer today. Modern 'screening tests' are certainly supposed to show a statistically increased incidence of cancer(46). When healthy people are screened, the tests find not only deadly cancers, but also a certain percentage of

tumours that would never cause problems if left alone. After all, cancer is basically a 'senescent' process. So, what appears as increased incidence of cancers of the breast and prostate, for instance are in fact artefacts of increased screening. However, screening tests alone cannot address the issue, for childhood cancers have also been shown to have increased by about 20 percent since 1975 up to 2003(47). Why does a child suffer from cancer? What might be the cause? No one seems to know. It is difficult to implicate the environment as such for this problem, anyway.

If we now leave the question of childhood cancers, can we get rid of the other cancers if we possibly cleanse our environment effectively? The 'International Agency for Research in Cancer' (IARC) told us that 80-90 per cent of human cancer is determined environmentally and thus theoretically avoidable(48). Such a 'theory' however, is very weak, for how does an environmental ingredient bring about cancer is still open to question. And in practice it is clear to us that avoidance of environmental factors is untenable. Even if we try to 'avoid' a specific factor, that does not help us in totality. What is intriguing here is the question whether these agencies are talking about infection, or cancer? The very nature of their propaganda suggests that the environmental factors pose as infective agents and therefore, if they are avoided the specific infection they cause can also be avoided! Modern medicine boasts of its history of war against many infections. The Americans tend to fight cancer in the same manner, and they ask the others to follow suit. But the biology of cancer is entirely different from that of infection. So, it seems also that there is a conceptual conundrum within us, thanks to our idea that whatever emanates from the west is the best. How is it that after a severe anti-smoking campaign the incidence of lung cancer has been shown to decrease in the USA, while other types of cancer in young adults have increased? How is it that the incidences of different kinds of cancer are seen to rise and fall at variable periods of time, in the different regions of the world? How is it again, that the incidence of a particular kind of cancer at a particular region neither falls too much, nor does it increase too much? How is it that even in the most polluted regions the rate of cancer does not increase? All these must be discussed, but before that let us ponder over a simple issue: if it is said that cancer incidence is rising then the frequent claims of the US based cancer establishment that we are winning the war against cancer must be false. Is the cancer establishment aware of what it is talking about? What is more interesting, and confusing also is to note that the 'EPA' of the USA has recently declared that what looked like an increase in childhood cancer was 'just a statistical fluke'(49).

CONCEPTUAL CONUNDRUM, INDEED!

For a pretty long time, we were given to understand that a holy war was going on, - war against cancer, the cause of which is our genetics, our bad genes. So we had started hunting on the bad genes. We know that in any war there are two kinds of hope: either 'no hope', or a 'new hope'. Having exhausted our fuel in gene hunting and having found no hope in this, we have been asked to find new hope in carcinogen hunting. So we are now made to look at the environment because it can change our genetics. Whereas gene hunting was the glorious task of the elite scientists, i.e. the war generals, the task of carcinogen hunting has been relegated to the public at the leadership of the environmental agencies and the self-styled environmentalists. The truth rather is that genes are our own as the environment also is; so it is like saying that we are to search out the enemy within ourselves! Interestingly, there is no answer if one asks if such ideas of environmental pollutants causing cancer in the human beings are applicable to cancers in the other animals or in the plant kingdom also. The underlying premise now is

that the health of an individual and of a population is determined primarily by social and environmental rather than intrinsic biological factors. So, the war continues, against the environmental carcinogens, which are but ubiquitous.

But how and why did such a plan of grand war made? We have seen 'microbe hunters' in the '50s, when there was a polio epidemic in the western world. The scientists/virologists fought effectively against polio, and made the world prepared for the next epidemic that never came. The virus was able to find out a safer abode in the eastern world. Many such diseases, particularly infectious diseases have disappeared from some parts of the world, mostly due to improved nutrition and sanitation and some vaccination. Nevertheless, they make their appearance from time to time with renewed vigour and characteristics, sometimes here and sometimes there. So the lesson we have learnt is that we have our immune systems, which are to be maintained in a good shape with the help of proteins, vitamins and filtered water. If we can do that we can possibly carry on more or less peacefully. We may need some aspirin also, but not so much as we take antibiotics. So, that is precisely about the infections. But what can we do about cancers? Can we drive them out from the face of earth once and for all, with the help of our immune system? We understand we have precious little to do there, for immune system has nothing to do with cancer. Immune system as such is said to maintain a complex relationship with cancer. It may even protect the cancer cells from destruction!(50)

But that sounds frustrating, for if it is so then our 'microbe hunters' are destined to loose their jobs! Meanwhile however, the microbe hunters have come to be known as Virologists. So, instead of Polio, when cancer engulfed the western mind, the Virologists tried to fix viruses with cancer. First, some virus was implicated in breast cancer; but no causal relation was established. Then Herpes virus was implicated in 'cervical cancer'; but again no causal relation was proven. And now Human Papilloma Virus (HPV) has been shown to be associated, again with cervical cancer. What is an association? What does an association mean? 50% of women in the USA have these HPV, and men have them too, but the incidence of cervical cancer has remained independent of it. Is cancer a contagious or infectious disease? – No, but still the virologists tried to prove an association of viruses with cancer, particularly cancer of the cervix. Is cervical cancer a great issue in the western world in terms of mortality or morbidity? Not either, but the hunters must have something to do, - something to prove. While doing so much research in the laboratories we have learnt a lot about the viruses, a little about cancer also; but could we prove a virus-cancer association? Yes of course, although it is not a causal association. But then, this 'association game' has to continue. Who does not know that various aspects of so-called lifestyle are associated with various diseases and conditions? The same is true with cancer also. The association game has three possible outcomes: positive association, negative association, or no association. Positive associations are equated with 'risks'. Considering more than 100 kinds of cancer that exist, how many items of lifestyle can be entered into the risk game is an enigma. 'The number of possible combinations is staggering and opens new vistas for the generations of epidemiologists to come'(51). Should we embark on that task?

It appears that the manner we are progressing is making us more and more confused. Most confusing is the 'risk-benefit' ratio. Some of us are concerned about pesticide residues in bananas, others find a link between mobile phones and cancer, while still others tend to reject anything 'nuclear', confusing nuclear power with nuclear bombs. Of these, nuclear radiation is undoubtedly risky, particularly because its 'safe dose' still

remains unknown. But then, how much risks are associated with fossil fuels? Which risks are greater? And what are the benefits? It seems difficult to say. Which one is comparatively easier to control: the compact nuclear waste, or the close to 30 billion tons of CO₂ released into the atmosphere each year by the burning of fossil fuels? This also is difficult to judge. It is feared that millions could fall victim to CO₂, due to global warming. As an answer to such a threat, people talk about reforestation that will absorb quite a lot of carbon dioxide. New research however, shows that trees will absorb more sunlight and heat than the ground they cover and that will only add to global warming. Again, if global warming increases, it is said that the incidence of cancer will increase, particularly skin cancer. But so far, skin cancer has been known to be associated not with heat as such, but with UV rays. The Global Warming is supposed to change weather, causing generation of more clouds. That on the contrary, is supposed to impede UV rays. So, the increased incidence of skin cancer may prove to be a myth.

Studies on risk factors are therefore, extremely difficult, if not impossible. Even if the study finds that some chemicals have increased the rate of one or more cancers in a particular population area, it remains unclear what do they mean. Do they mean that the population in other areas, or the population in general run the same risk? What may happen to the people in a particular area who are exposed to a low level of those chemicals for a long time? Are the risks real, or imaginary? Risks to health in general is of course, real; but we are discussing cancer, to be specific. Many scientists are even of the opinion that the risk of cancer from environmental chemicals is very low, and it is almost impossible to ascribe cancer in any individual to an environmental exposure(52). Toxicologists perpetuated the idea that if 100 molecules are going to kill one, then one molecule is going to kill 1 percent of somebody(53). Any body can understand that this is a blatantly false paradigm, a linear one. Also unclear is whether toxic chemicals should be banned. Such decisions are largely political, and have greater perspectives also. For example, banning smoking would shatter the economy of certain tobacco producing countries. We also learn that scientists are not happy that their scientific findings are distorted and misreported to the public(54).

Similarly, our reverence for statistics is also in question. Statistics is said to have indicated that the lifestyle changes, such as losing weight, improving diet and exercising more can prevent diabetes or cardiac diseases(55). Scientific rationale dictates however, that although these measures are useful in our overall well-being, they cannot prevent the occurrence of chronic diseases such as those. The internal milieu of physiological functions cannot be influenced by changes in the exterior, no matter how beautiful and plausible the statistics are. Statistics cannot change the laws of biology(56). So, the prevention claims are not only false, but they are popular illusions in terms of chronic diseases. Statistics can also be used to increase cancer phobia. In order to highlight the dreadfulness of cancer, the 'person-years of life lost' are calculated. In 1984, the number of deaths due to cancer in the United States, for instance reached an all-time high of 453,450. The person-years of life lost due to cancer were calculated to be 6,881,281. It was up from 5,303,668 in 1970(57). Overall, it was calculated that each person who died from cancer in 1984 died 15.2 years earlier than his/her life expectancy. The message seems to be clear, and loud: we must reduce the loss of years. A simple scrutiny however, shows that the greatest loss was for those who died of childhood cancers and the least loss was for those who died of prostate cancer. Neither childhood cancer, nor the prostate cancer is however known to be straightway related to environmental factors. Clearly, in both these circumstances, if something has to be implicated, it is the intrinsic

factor rather than lifestyle or environment. Therefore, can such loss of years be reduced? The answer of course, is self-evident.

It seems now that we live under a lot of absolute nonsense about many environmental issues. We wish to regulate our life style and also, our environment; but how environmentally induced cancers arise still remains a puzzle. We are becoming obsessed with carcinogens, but we tend to forget that we are always exposed to many carcinogens, the most ubiquitous of the lot being oxygen. It is said that the most significant carcinogen may be the 'reactive species derived from metabolism of oxygen and nitrogen'(58)(59). So, many of us will die of cancer anyway, mainly because just breathing oxygen daily is equivalent also to quite a hefty radiation dose. So, regulatory decisions would not only require reliable scientific data, but those data are to be interpreted in proper perspectives also. It is not just 'catch and kill' game. The problem with our outlook seems to be that we vouch for all the good things in nature. There are a lot of things those are good in nature, - like motherhood; but it can be an absolute menace in certain circumstances as well. It is true that all environments unsullied by man's industry and exigency are pristinely health-giving. But how can we afford to forget that in the smoggiest metropolises since at least the 17th century, civilisations have also prospered, and people have progressively lived longer and healthier. Therefore, we have equal conceptual confusion regarding nature and environment. Not only that, we are confused about the nature of our own progress also. For example, should we eulogise 'organ ablation', or should we not? Surgical techniques for the resection of the organs have improved to a great extent today. Such resections are the most useful and rational treatments in many surgical conditions. However, it is already fairly documented(60)(61)(62) that those methods of treatment for conditions other than cancer promotes cancerous growth after a variable period of time. It is another way to say that ablation is also a carcinogen! So, what can we do about that?

We are aware that environmental explanation of cancer sounds somewhat radical. It lacks sophistication of classical gene research, and its appeal is also simple, for every child knows that prevention is better than cure. However, in trying to do so, its protagonists have unearthed every bit of earth under the sun, including the sun, which can contribute to the development of cancer. In effect, this so-called social theory of cancer has generated a perennial fear psychosis in the society, instead of awareness with little certainty whatsoever. It seems now that we have effectively learnt how to fear sunshine, sex, food and other pleasures of life. Although the business of making anxiety is not new(63), but today it sometimes acquires interesting dimension when, for instance it is propagated that oral sex causes throat cancer, due to a virus, believed to be transmitted during oral sex. With such illusion, phobia, anxiety and conceptual confusion about cancer, environment and the nature of our progress we are now holding our own surroundings and our own life styles as the cause and thus the culprit. We are trying to prove ourselves cunning to be the judge, jury and the executioner. It is not difficult to appreciate by means of our wealth of experience that if we try to be clever with our environment with our half-baked intellectualism, we shall be paid back in unacceptable terms. It is to be noted that cholesterol-free kindly-fat-for-the-heart has paradoxically resulted in a sharp rise or epidemic not only of coronary artery disease but also of diabetes mellitus and other disorders of 'insulin resistance'(64). Our ancestors would have called it 'penny wise, pound foolish'!

It is distressing to note that all such propaganda activities are being orchestrated under the very nose of our social elites, skilled and qualified professionals(65). These elites

tend to forget very often that they move 'from one euphoria to another'(66) according to the dictates of the western society. These well-meaning intellectuals, on the ideological level might be of different colours, but they offer the same scientific arguments now and then, which lack rationality. We often hear from knowledgeable quarters that if we could eliminate cancer, largely caused by smoking as it is alleged, we would live much longer. How much? It will not be more than 15 days(67)! And if cardiovascular diseases, again allegedly caused by smoking, together with all forms of cancers and traffic accidents are extinguished, we would live 15 to 20 months longer(68)! Still, we never question the unrealistic propositions. The question therefore, is why do we behave so irrationally?

The answer must be sought in the nature of modern science itself, the way it is being practiced and propagated, and of course in our very outlook. It seems now that some kind of determinism in some way or the other would satisfy our ego. We tend to imagine that this kind of determinism does not lead to fatalism as the 'puppet determinism' does. However, when some social scientists put the blame of human ailments almost entirely on the environment, they possibly tend to forget that the human organism has the biological necessity as well as ability to be resilient. This resilience describes that medicine and society are intimately interrelated, in meaningful, mutual and more than one way, which may not be linear. Carcinogens are indeed increasing in number and intensity year by year. Yet, one must remember that from year to year, our life expectancy also improves.

DO WE REQUIRE A NEW OUTLOOK?

So, how should we look at cancer? We have seen that since 1971, despite tall promises and claims every ten to fifteen years that the war against cancer will be won, neither the overall death rate from cancer nor its overall incidence worldwide has appreciably declined so far. It has been predicted on the contrary, that the annual global cancer deaths could rise to 15 million by 2020(69). This has increased our anxiety. Meanwhile however, as members of this powerful clan of medical intelligentsia we have been over jealous to implicate 'a limited number of simpler constituents'(70) like a couple of genes and thousands of environmental pollutants as our enemies. We thought that molecular biology would rescue us. No doubt, we have witnessed impressive triumphs of molecular biology. But can this molecular knowledge help us understand the complex phenomena existing in cancer, so that we can save the normal cells from environmental onslaught? In other words, if we had a complete description of all of the molecular reactions occurring within a living normal cell and its cancerous counterpart, would we understand that cell? The cell being the basic unit of life, is it the 'all-encompassing phenomenon'(71)(72)(73)(74) of life? If we could know that we could also find out how to rescue our cells from the enemies. Now we know that it is not, for the structure and function of 'human genome could not explain the systemic complexity'(75) involved in the initiation, progression and metastases of cancer.

Cancer is not a linear phenomenon, and as an 'emergent process'(76) its behaviour remains unpredictable, and sometimes surprising also. The whole process of initiation and progression of cancer is a highly complex one, exhibiting periods of inactivity, sudden change(77), disappearance of apparent patterns of development and emergence of unexpected new patterns. We thought, we could solve the issues, because we can now 'model the growth and development of human tumours using mathematics and biological data'(78)(79). But those models often became 'simplifications that ignored vast amounts of knowledge'(80) already acquired. Such knowledge helps us understand that

the search for links between lifestyle or the environment and cancer is 'an unending source of fear, but yields little certainty'(81). Such knowledge also points out that the human organism, robust as it is, will not become so pervious to so many changes in the external world, and if it does, it is contrary to the fundamental laws of human biology. The fact that we still refuse to understand this complex phenomena of life and disease, only proves our 'emotional immaturity'(82). We refuse because this complex phenomenon appeared to us as chaotic. But such chaotic behaviour does not indicate a lack of order; rather, the order is difficult or impossible to describe in simple terms and requires complex narrative description. For this, it appears now that biology, and cancer biology in particular needs a new language.

But how can we understand the new language if we do not forsake our conventional outlook? Our conventional outlook rests on two pillars: One is the notion war and the other is the notion of causality. In cancerology, thanks to the National Cancer Institute, USA and the American Cancer Society the war metaphor has indeed 'corrupted biomedical communication'(83). Use of the words like 'killer cells', 'renegade cells', 'savage cells', 'gaining ground' and 'environmental aggression' are but a few examples. This is not to say that the use of any metaphor is unacceptable, although Susan Sontag was of such opinion(84), for medicine is largely about 'interpretation'(85). Suffering man tries to accept the illness according to his belief, outlook, cultural history and historical experience. Symbols of disease and those of healing are therefore, common and at times necessary too. But such metaphors and symbols at the same time reflect the outlook and idea of a given society. War outlook snugly fits with modern American psyche, the psyche of a 'death denying society', which we are trying to imbibe today. War needs hatred towards enemy. It creates a sense of terror and anxiety in the public psyche as if everybody's life is most vulnerable. It creates a sense of emergency as if a slight delay will result in devastation. War needs simple answers, not the complicated ones. The answer should be clear and straightforward. If they are shallow, so be those.

It is to be noted however, that the idea of using military terminology in conjunction with cancer is not new. As early as 1934, the British Medical Journal wrote about the 'War Against Cancer'(86). It was only reinforced in 1971, when Richard Nixon converted a biological weapons research facility at Fort Detrick, in Maryland, into a cancer research laboratory and signed the National Cancer Act into law. That brought us to this war, we fight valiant battle, we lose, we destroy enemies, we beat retreat, we become fallen heroes, we wait for opportune moment, we resort to more aggressive weapons, and in this way the play goes on. We are asked to prevent cancer at any cost, to diagnose cancer as early as possible, and to run from pillar to post in order to get the best possible treatment. If we question, we may be labelled as a 'coward or uneducated'(87). So, we have declared war against cancer, war against Diabetes, war against osteoporosis and so on. But we must say, this is a false analogy. Cancer is otherwise inevitable component of the aging process and all of us at some time in our lives co-exist with latent cancer scattered around the body. War metaphors on the other hand, denoting attack and defence are misleading, 'detrimental to the progress of science'(88), and are likely to 'drastically limit the perception of the problem'(89). Even in microbiology where we deal with the bacteria and viruses, 'it is not just an attack and defence business'(90). Indeed, it is now rightly argued that our militaristic use of antimicrobial agents has only made the pathogens stronger, for we have neglected the other more important factors, like host behaviour and the social and physical environment. Thus, the use of military metaphors in relation to cancer reflects the unproductive and potentially dangerous constraints on one's thinking.

The notion of causality in cancer similarly took its origin from the concept of war. War must have a target, a precise cause of cancer, the enemy so to say that must be extinguished. A 'cocoon of causalism'(91) that we have spun around ourselves for a pretty long time made it easier for us to accept the causal phenomenon in cancer. Since causal explanations have promoted important discoveries, such as antibiotics, we believe that a similar cause-effect relationship might solve the cancer riddle someday. We failed to remember that even in infections the cause-effect relationship is incomplete and non-linear, and that there must be something 'more to an infection than microbes'(92). We see ourselves that many individuals are unharmed by pathogens. Nevertheless, the notion of causality in health and disease has led us make policies that are convenient to us. The classical earmark of causality however, is an 'invariant relation of events in which the cause must precede its effect and the effect must follow its cause, in time'(93). It is implied here that there is no scope of any 'temporal gap' between the cause and its effect. Since this condition cannot be achieved in the search for an exact cause of cancer, the so-called cause that we supposedly discover should be regarded as an interpretation only. 'There is no after-one-another, but only an into-one-another, a process in which the single moments that succeed each other do not condition each other as causes and effects'(94). But these teachings failed to make us a bit wiser. Still we fail to appreciate that structural or functional alterations do not necessarily cause dis-'ease'; and lack of those do not necessarily mean health or 'ease' either. Our judgement is based rather on 'pragmatism', most of the time.

This is not to say that pragmatism is useless. On the contrary, this has played a glorious role in many spheres of human activity in which the purposes are unambiguously altruistic'(95), medicine being one of those. Modern medicine is now enviably powerful also. So it is customary to praise such a pragmatist modern medicine for whatever it has achieved so far. However, a critical understanding reveals that its power and success have resulted in a kind of narcissistic obsession that was not expected of it. So, winners should not necessarily be regarded as automatically privileged; on the contrary they are to be brought to the foreground, not because they are 'best' or 'right' but because they are powerful(96). Therefore, we should not take whatsoever is being claimed by it for granted, only because it is successful and powerful. Question may be raised whether the medical professionals and the scientists who are propagating the ideas of determinism are all conspiratorial? Of course, they are not conspiratorial. It is their conditioning in the prevailing medical thought system. We are conditioned to such a system that we become part of a worldview that refuses to study cancer in its proper perspectives. As a result, in spite of our periodical rhetoric and promises at regular intervals, in the public eyes it is our 'sickness maintenance'(97) activity that is going on.

Such activities have of late made it clear that the health of the people and all the elements of health and disease are mere commodities at the hands of the interested persons and communities. All this could happen because we have fallen prey to the world outlook that favours traditional logic in biology and medical science. Traditional logic is linear. For instance, when it says that 'P' is true, it tends to say that 'no P' is necessarily untrue. It excludes any third alternative. It suggests that it is either 'P' or 'no P'; there is no middle case: 'The Law of Excluded Middle'. Dynamic logic on the other hand, asserts that both 'P' and 'no P' can simultaneously be true. Similarly, Being and Nothingness coexist as dual aspects of nature. It asserts that although males and females are fundamentally different, there is some degree of masculinity and femaleness

in all humans. So, nothing in the nature is absolutely true; nor is there anything that is absolutely false. Such an outlook reminds us of Heraclitus and the Buddha.

Conventional outlook teaches us to differentiate the 'evil' from the 'pure', because they are said to be qualitatively opposite to each other. We believe in competition that results in either a Win or a Defeat. We believe that doing good makes the world a better place, and by avoiding things 'evil' and unpleasant we can raise our quality of life. These are false. Nature does not operate in this way. In Nature, there is nothing 'evil' or 'bad'; there is no such thing as 'small' or 'big'. Our ancient forefathers believed in the concepts of 'cosmos' and 'chaos', rather than good or evil. One can argue that terminology does not matter much, for cosmos and chaos are similar to 'good' and 'evil'; but it is not. The reason is that chaos is not condemned as something 'wrong' or 'evil'. It is true that everybody likes to see cosmos only to exist, and it is understandable. It might be harder to see why chaos must also exist. But chaos is as important to the world as cosmos, for the world will cease to exist without one or the other. One is there because of the other. New insight in biology is indeed based on such dynamic logic. Thus, we must try to understand the relation of cancer with the environment, with the help of the new insight in biology. If we talk about biology and if we claim that we live in a higher consciousness, it is implied that we have obtained the higher knowledge. Higher knowledge does not see life in the light of contradictions only; it can see the harmonies at the higher levels.

Such a view refuses to see life as a mere commodity in the free market economy, sustained on 'fast food', fuelled by 'struggle for existence' and encouraged by the concept of 'survival of the fittest' in a perennial battlefield. It refuses to accept the theme that life's ultimate fight is against death. Such a theme is propagated by a 'Biblically-dominated culture'(98). Eastern culture on the other hand, talked about the 'trinity' of nature: Development, Nourishment and Annihilation: the 'DNA', so to say. In this outlook, it is impossible to solve society's problem if we do not see beyond the contradictions of life. 'Life is not the most important thing in life'(99). Of course, one needs good health, but what is meant by good health? It means 'being able to fall sick and recover'(100), for sickness is an inevitable part of health. Reality in this view is ultimately a unified whole that necessarily expresses itself in dualistic terms. The polar opposites exist in our experience and perception only, but essentially they are complementary and co-substantial. So, they are rather polar apposite. This outlook is known as 'Dualistic Monism'. Cancer as a unique form of life, rests and evolves within the given form of life, and ends with it. Therefore, if we insist that we must find out the culprit that brings about cancer, it is not difficult to find it, for it is the reality alone.

But why should we accept such an outlook? Let us see why we had accepted the traditional outlook at the first instance. Since centuries, medicine has been clubbed with physics, chemistry and biology. Newtonian deterministic predictability had its profound influence on modern medicine. Some wonderful advancement in medical science resulting from the earth shaken discoveries in the 20th century have strengthened the belief that human existence per se can be reduced to a formula. We started dreaming that one or more such formulae would help us conquer the diseases by means of newer technology. In essence, the idea of a linear paradigm in life and disease has led us to look for a 'specific cause', - a specific gene, or a specific carcinogen. Physics however, meanwhile has witnessed a 'paradigm shift'(101). Modern physics, at the beginning of the twentieth century, described quantum mechanics because the Newtonian determinism did not work well everywhere. Paradigm shift is not unknown in medicine either. The miasma theory of infection has been replaced by the germ theory, now part

of the current 'biological theory of disease'(102). Many other ideas have been interpreted and then discarded. Nevertheless, it seems to be a matter of concern that this time medicine refused to follow this less travelled route of new physics. With our stubbornness and halfway cleverness we stuck to our pet ideology; and our cause-hunt continued, like asking a blind man to go into a dark room to find a black hat, which is not there.

It is only now that modern, evolutionary biology started explaining that development begins in the womb and ends in the tomb. Whatever happens in the body during life of an individual, from womb to tomb, are all a part of developmental repertoire, resident in the genotype of every cell and manifesting as varied phenotype. Therefore, everything is 'coursal'(103), not a causal phenomenon, and all that we talk about is basically a question of probability. All that we see is a kind of stability of those probabilities in the society, in the human herd so to say. Studies have pointed out towards a stability of probabilities like one in 1000 newborns having a cleft palate, one in 10 having a stroke, one in 5 having cancer, one in 33,000 having 'Acute Lymphocytic Leukaemia', 2.6 in 100 being low in IQ precisely because 2.6 in 100 having too high an IQ - world over, generation after generation. It is clear that the occurrence of some diseases or condition in the animal kingdom is certain, but who will be affected and when remain uncertain. This reminds us of Heisenberg's uncertainty equation, in terms of biology. Inside the human system, $p \times q$ is not $q \times p$, because it is a dynamic system driven continuously by food and oxygen. With an inbuilt environment, this system exists within an environment and participates in shaping and creating that environment, for better or for worse. It may sound cruel, because uncertainty and probabilities in distress do not console; but it is irrefutable, because 'we essentially live with uncertainty'(104). Again, this is not nihilism per se, this is 'an attempt to justify that we are rational indeed'(105).

NEW INSIGHT

Rationality demands that when we see cancer as a unique form of life, we must answer how did Life as we know of it, take its origin on Earth? There are at least three hypotheses that tried to account for it. The first is that life was actually created; so it is an unique act of 'creation'. This however, could not be explained experimentally. The second hypothesis that life had arrived from the outer space since it was prevalent there. This hypothesis is known as 'Panspermia'(106). This could not be explained experimentally either. The third hypothesis emphasises that life was generated from non-living matter. This was however, tested experimentally, denoting that life has evolved spontaneously, near the surface of the earth, probably in the oceans, from a 'primitive soup'. It has been suggested that the early, special conditions on earth included an atmosphere of hydrogen, ammonia, methane gases and water. This concept is known as 'Abiogenesis'. Many scientists now believe that 'the first cells did originate by some kind of spontaneous assembly of their components'(107). There are examples of spontaneous generation in our body also. We get a new stomach lining every five days, a new liver every two months, a newer skin every six weeks. Ninety-eight percent of the atoms of our body are replaced every year. These are all signs of life. This phenomenon has been called, 'autopoiesis'(108). (Auto = Self; Poiesis = as in 'poetry': life's continuous production of itself) Without autopoietic behaviour, organic beings are not alive. Cells are autopoietic, the organisms made of cells are also autopoietic, and the biospheres made of organisms are 'all autopoietic and can metabolise also'(109).

Spontaneous evolution however, is a complex process, 'a much more sophisticated, engineered process'(110) than the so-called chance mutation. Life's smallest atom is the cell, and 'Complexity' is indispensable in it, for without this life ceases to exist. Complexity is indispensable in the environment also. The question now is why it is so complex? The answer is that although the cellular structures are characterized by two contradictory properties, the contradictions are only apparent. They are architecturally stable, but at the same time they are flexible and prepared for change. But what is the nature of such complexity, in life and in the environment? Is it ordered, or it is disordered? The two fundamentally different mechanisms that exist can be described as cosmos and chaos, - self-assembly and self-organisation. 'Whereas self-assembly involves the physical association of molecules into an equilibrium structure, self-organisation involves the physical interaction of molecules in a steady-state structure'(111). So, what we see as order or self assembly, rests on the edge of disorder or chaos, or self organisation. Therefore, although biological system is a highly ordered, apparently stable structure, it has developed from disorder. So cosmos developed from chaos.

Nature and the environment around us also, by their quality are ordered. We are just the right distance from the sun. Our blood plasma, which circulates around every cell, is high in Sodium, and our cells actively pump Sodium out of them to create an internal environment low in Sodium. Thus we carry our own ocean, our evolutionary environment around with us! Anything other than this state, i.e. a lesser or greater distance from the sun, or a lesser concentration of sodium in our plasma would result in a different chemical reaction, a chaos, and thereby a different life altogether. So, what has happened was the only possibility; the question of the possibility of any alternative here does not arise at all. There was no other choice, and 'since there is only one thing happening we are all seamlessly welded into it'(112). This can only be understood if we appreciate that it is a whole in itself; there is no break in nature's repertoire. That 'whole' has a pattern, which also evolves.

Therefore, everywhere it is the 'oneness' that works and evolves. The minutest structure of life evolves, in time. All the mega-details of future remains ingrained in the minutest structure around which, there remains enough free space in order to accommodate the details, in time. Today, we have the 'homeobox concept'(113) in embryology with us. It tells that all fully formed mammalian embryos are of the same size, - it is 2.5 cm. A whale starts as a 2.5 cm individual, as does an elephant or a man. In the bacterial kingdom similarly, we see a nanobacterium with a diameter of 50-500 nanometers sculpting a shell 2 micrometers in diameter, showing a huge well in its centre(114). From a microinsect to a mammoth man therefore, there is a single developmental plan, summed up as 'homeobox'. This might seem to be an enigma, but it may be easier to realise if we look at our own cell. If the DNA of a single cell, which is tightly wound in the cell nucleus, is uncoiled and the pieces laid end to end, the length of the invisible genetic thread would be five feet. So, if the DNA of almost 50 trillion cells of our body is stretch out, it will be 50 billion miles, or enough to reach to the moon and back 100,000 times. A cell also enjoys a supporting complex around it. The ability of the cells to multiply is the most outstanding feature of the supporting complex(115). As the cell multiplies a chromosomal choreography is played on thready spindles, hence the name 'mitosis'. (mitos = thread) We may wonder therefore, what is the speed of the choreography that is played on the thready spindles? Our gastro-intestinal track exfoliates a cell number equal to the entire cell population of the human body in just 22 days. It means that it manufactures 2.25 billion miles of genetic thread in a day. This can only be possible if

the cell's choreography works at the speed of light. A cell therefore, can be considered as a configured waveland. This waveland has its own pattern that evolves only in time.

This brings us to the question of 'arrow of time'. 'Complexity theory', proposed by the Nobel prize winning chemist Ilya Prigogine draws our attention to the concept of 'arrow of time'(116). Such a concept arose out of the observation that natural systems tend to generate disorder or 'entropy', over time. When we talk about 'arrow of time' in biological discipline, we mean biological time. Organism has its own time reference, known as biological time. Biological time has a property that lacks in physical time. Although both time scales are correlated, they differ in their clock rate. Physical time is linear, and one-dimensional. Biological time is non-linear, and two-dimensional, the second dimension being the health, which controls the clock rate(117). A forty year old worn out male may look like an old timer, while a seventy years old grandfather jogs like a youngster. The essential ingredient of biological time defines health and disease. The arrow of time is the fundamental property of nature and of all biological systems. This arrow of time, it is said, is irreversible. One's cancer or coronary or diabetes mellitus therefore, manifests itself in time only. This helps us to understand why even after so many years and decades of research on the mechanism by which chemicals or oncogenic virus causes cancer, we are unable to stop the genesis of cancer. It may be asked now that even if a cancer free world remains a dream, can we delay its occurrence? In other words, if cancer is basically a senescent process, can this process be decelerated? But before we discuss this issue, let us see if we can accelerate the process.

All those agents, which have the ability to damage the cells, have also the ability to accelerate the genesis of cancer. But, it is now being held that all these can happen if, and only if cancer is a part of the individual's cellular programme. Otherwise, all such accelerated senescence of an individual will cause the earlier occurrence of the other diseases, but not cancer. What is meant by 'cellular programme', one may certainly ask, because it has been believed so long that any cellular programme is scripted in the nucleus of the cell? However, such an idea of a script of life in the nucleus is no longer tenable. It will be clear to us if we go back for a moment to the very concept of embryogenesis. As we know, at fertilization, the sperm, torpedoes into the ovum. Then it gets decapitated at the border of the ovum and gives its nuclear head to the mature ovum. Its cytoplasmic body and tail are lost to the peri-ovular void. Thus, a 'diploid' nucleus is formed by the fusion of the 'haploid' female pro-nucleus of the ovum and the 'haploid' male pro-nucleus of the sperm. We now have the 'zygocyte' (= zygote) where the cytoplasm is therefore, is entirely contributed by the ovum. The entire embryogenic blueprint lies in the ovular/zygotic cytoplasm. So, what stands to be most important is the ovular cytoplasm, which is unsubstitutable and knowledgeable. It has been postulated that the wide range of biological material necessary for the early stages of development is 'already present in the cytoplasm of the ovum before it is fertilized'(118). Thus, what is dominant is not the nucleus, but the cytoplasm. The diploid nucleus is therefore, 'reprogrammed'. This reprogrammed nucleus plays only the second fiddle. It is another issue as to why and how during the later course of life cytoplasm should abjure its dominance over the nucleus.

So, cytoplasm being such an important issue, it is not difficult to understand that disease can arise by means other than the impact of something from the environment on the nucleus only. For example, we blame the 'pills' for the present sexual promiscuity and all its attended evils, including cancer. We tend to forget however, that the very 'population pressure'(119)(120) that we face today may make us promiscuous; we do not need pills

for that. But we stick to the pills because of our linear outlook. Moreover, why should we imagine that we are all enveloped by a blanket of environment that is out to cause all sorts of diseases within us, including cancer? Carcinogens are there in the environment, but the environment is not carcinogen! However, of the various means that might be associated with cancer, carcinogen is important. They are known to 'accelerate a process'(121) that is already ingrained in the cell. If there is any 'modus operandi'(122) of a carcinogen, it is this. In that sense therefore, carcinogens may be regarded as cancer 'preponers'(123). One cannot deny the fact that 'strontium90' released as a result of atomic explosion can lodge in human tissues. It can prepone the occurrence of cancer that otherwise possibly would not occur in an individual's lifetime. The cellular basis of preponement of cancer in various ways has been described long back.(124).

It appears therefore, that if cancer can be preponed, there should be possibilities that it can be postponed also. If something can advance an event, it is possible that the avoidance of it can very well delay the event. The whole logic of environmental purification may emanate from this viewpoint. And also, if we can postpone the occurrence of cancer for an indefinite period, it means that we could prevent cancer. Theoretically at least, it sounds possible. At the same time however, this seems to be linear logic. This logic has directed the modern medicine to operate on the basis of 'Baconian inductionism'(125) in order to cope with the environmentally related health problems. It means that it tends to work in the fashion of a detective in a Victorian crime thriller. It tends to believe that the evil factor or force that is to be identified and then eliminated has nothing to do with the rest of the society. We have seen that this logic is a false one at the elementary level. Not only that, such a logic has already given birth to irrational obsessions also. Such obsessions of the new environmental orthodoxy in the west had devastating impact on the less developed countries. It has been fairly documented how the indiscriminate use of DDT in order to wipe out malaria gave rise to a plague of caterpillars followed by a 'Bubonic plague'(126). On the other hand, the campaign against the use of DDT because of its carcinogenic properties, led to its withdrawal under the guidance of the US Environmental Protection Agency (EPA). This resulted again in the rise of the disease throughout the world(127). The lesson if any, is that if we still go on swinging our mind according to the dictates of inert western outlook of 'catch and kill', we are destined to witness more and more disasters. Why should we forget the teaching that 'friendship between microbes and man is a rule, foeship is an exception'?

With the same linear logic, modern medicine now talks about prevention of cancer, or its postponement at least. First we have come to such conclusion that cancer is 'caused', and then we have proceeded to spin an endless array of theories on how it is caused. And lastly, since we are satisfied with our theories we have set about to find out the causes in order to eliminate or to resist them. So, we have started interfering with the life of the common men with lists of Do's and Don'ts. We tend to educate our womenfolk that if they do not marry they will have breast cancer and if they marry they will have cervical cancer! Such a confused state of mind is the perfect breeding ground for actions that are uncalled for. In support of our actions we take refuge to the dictates of 'EPA'. It is the same EPA that brought about fallacious charge that chlorination of water causes cancer. As a result Peru abandoned chlorination and 800,000 of its population became ill, 6000 of whom died. Not for nothing therefore, some regard EPA as the most notorious abuser of science and measurement. But the question is what are those carcinogenic factors that are entirely or even grossly avoidable? How can we so religiously say that by avoiding certain habits we can really avoid certain forms of

cancer? Modern medical history has it that removal of breasts in order to avoid breast cancer can of course prevent breast cancer, but not the other forms of cancer. But the logic behind removing our organs one after another from unknown fear of cancer based on mere genetic study seems to be nothing less than a stupid proposition. One has to understand therefore, that the whole prevention game in cancer is scientifically untenable. If now, we think about postponement of cancer then we must also remember that in order to make it possible one has to forsake not only the so-called damaging lifestyle as a part of the environment, but his entire life and the environment itself! But before one protects oneself from the evil effects of environment, let us see how we should evaluate our environment. What should we mean by environment?

Tens of atoms form a molecule, thousands of molecules make a polymer, millions of such polymers make a cell, billions of cells make a tissue and trillions of cells form a human body. This human body along with plants and animals, and hundreds of billions of microscopic creatures around and within them forms the environment. In this environment, the total biomass of the microscopic creatures is many times greater than that of the plants and animals together. Together an interwoven network is formed. This network is a complex ecological web. This web provides sustenance to all the living creatures, and without which all will cease to exist. 'In a wider, panoramic view, the human body and its behaviour becomes a tiny decoration in the tapestry of life interwoven with the incredible variety of plasmids, viruses, bacteria, plants, and animals in a 4-billion-year evolutionary development'(128). It appears thus that if we study biology and medical science from this angle, the boundaries between medical and biological disciplines get vanished. This ecological web is a system, and as system it controls all of its systems on land, in the water and in the air in such a way as to preserve life. Thus, the web itself acts as a living organism. As a living organism it has the capacity to regulate the temperature and the composition of its surface and to keep itself comfortable for its children, the other living organisms. As a system, it is able to regulate itself always, and also the capacity to evolve. As the whole system evolves, new properties emerge, the ability to self-regulate its climate and chemistry. So in that respect, this system should be regarded as a 'super-organism'(129).

As a tiny part of the web, - the self-regulating and living super-organism, we are now trying to find fault in our environment, - the other parts of the same web, immediate and remote. Apart from that, we have our own, inbuilt environment, i.e. intracellular and extra-cellular environment. So, the equation is a complex one. We can of course, tamper with one or more of these elements, but that will result in something we might not have desired. As all the elements of our external environment are potentially important to the well being of each other, so are the intracellular and extra-cellular elements. If we tamper or destroy one for the other's benefit, we in fact destroy a part of ourselves. We must remember therefore, that the comfort we are seeking for, 'enters as a guest, turns into our host, and finally ends up being our master'(130). We knew such a lesson from antiquity, but now we relearn the lesson with scientific rationale.

Does that mean that we must remain idle in the face of the so-called environmental pollution? Of course, the pollutants are so-called, if only we appreciate the view of oneness. The view of oneness teaches to regard all life, - all the elements of life as our kith and kin. We shall use them, but without damming any flow. We must enjoy all our needs, but at the same time we must redesign our lives so that our inevitable output, the waste may be reprocessed. In other words, we must adhere to the cyclicity of nature so that the unwanted elements no longer remain pollutants; they become useful again in

a renewed form. Of course, these are tall orders, for it is much easier to destroy or evade these elements of modern life. Instead of just dumping them into the water, we can protect our land, our air and water also. Why should we suffer from perennial fear psychosis? Why should we forget to enjoy the pleasures of life? Why on earth should we try to remake ourselves into inert pieces of 'pure' architectural beauty, while we are indeed dynamic living beings, with all our virtues and vices blended together into one soul. By doing all these, how far and what form of cancer may be postponed is a matter of extreme uncertainty, but a simpler and enjoyable life might be a possibility. Therefore, as human being we have many possibilities of comfort and dismay as we live; but we have to measure them rationally.

Decades of futile optimism have passed by before we could possibly understand now that the hackneyed gene-centric ideas of cancer should be forsaken. It is a matter of curiosity why the medical profession forgot to guess a simple thing that if genes could play an important part, then the risk of cancer should have been substantially greater in identical twins than in non-identical twins; but this was not the case(131). At the present moment however, the medical profession has been seduced by social theory of cancer. After another span of futile decades possibly, it will come to realise once again that 'the promise of the prevention of thousands of deaths a year has not been fulfilled'(132). All this could happen because we have never viewed cancer from its evolutionary perspective. Indeed, cancer is best understood from the ecological and evolutionary point of view. Everything on earth coevolves, i.e. the human body, the environment around it, the cancer within the body, and the environment around and within the cancer cells. In other words, 'life is an evolving process'(133), and diseases also are.

But how does evolution play its role within the cancer? It becomes clear once we study the nature of anticancer treatment, particularly chemotherapy and radiotherapy. A growing cancer as a special 'organ'(134), is seen to maintain a very diverse and complex relationship with the normal cells around. In such a special organ, the malignant cells are evolutionarily bestowed with the property to survive many onslaughts. When chemotherapy or radiotherapy is applied to a population of tumour cells, many cells are killed while some survive which get resistant after a variable period of time. These resistant cells get mutated again. They again divide to replicate, giving rise to the daughter cells sharing the same mutations. So, the therapy ultimately becomes futile. This seems to be the most important problem in cancer therapy. This is why it is said that 'evolution is also driving therapeutic resistance'(135). The same problem is faced with in our agriculture also. When we spray a field with pesticide, we select for resistant pests(136). It follows therefore, that 'the dynamics of evolution are fully in play within the environment of a cancer, just as they are in forests and meadows, oceans and streams'(137). Indeed, cancer is now viewed as a special organ with a unique evolutionary ground for its development.

EVOLUTION AND CANCER: A RADICAL DEPARTURE FROM THE EXISTING VIEWS

Viewing cancer as a special organ, earth as an ecological web and both as co-evolving phenomena is of course, a radical departure from the existing Darwinian or even Neo-Darwinian evolutionary thinking. They are therefore, paradigm shifts in biology. What is the nature of such a shift?

We know that the chloroplasts and mitochondria are the energy-generating organelles in plant and animal cell respectively. It has been observed that these organelles were originally independent bacteria but they are now inherited in the cells of higher species. Such observations were the basis of proposition that new species arise when existing species unite, fusing their genomes. The process of such fusion has been called 'symbiogenesis'(138), and the new theory has come to be known as 'endosymbiotic theory'. This theory has shattered the linear, zoological, capitalistic, competitive, cost-benefit and dogmatic interpretation of the existing evolutionary biology. This theory stresses that the so-called fierce competition does not exist in the environmental market; what exists on the contrary is a symbiotic, and thus cooperative relationship between all organisms. There is a flow of evolution, and 'selection' may act not just on individuals or their genes, but on entire species or groups of species(139). Life is always mutable, for without mutation it cannot exist in a changing environment. Therefore, variations in the structural integrity of the organisms have to occur. But the means for such occurrence are provided by the constant interactions and interpenetration of various organic forces, at all levels of existence. These forces are historically contingent. The complex interactions between these various contingent forces have patterns, but their outcome remains unpredictable. Therefore, although the external environmental forces are always important, they 'do not act as mere putty to be sculpted over the organisms'(140). Contingency becomes a force in both the natural and social universe. So, nothing on earth, including cancer can be explained adequately by mutation theory only.

Thus, the new theory draws our attention to complexity, which means a network of multiple cross-interacting elements. It asserts that the relationship between genotype and phenotype is not deterministic. What functions is 'quasi-determinism of the network, a coexistence of deterministic and non-deterministic events'(141). There is no linear equation; there is no proportional relationship between input and the outcome. For the emergence of life or cancer, the existing outlook propagated such concepts like 'sudden triggering of events' by the carcinogens, 'random mutation' caused by the carcinogens and 'favourable circumstances' for carcinogenesis. If we regard the living system as a self-organising phenomenon, we shall realise that the postulation of such sudden events and circumstances is unnecessary. In fact, the language of life is chemistry, and 'chemicals do not combine randomly, but in ordered, patterned ways'(142).

This is why the living organisms can be described in terms of their chemical elements. However, a complete description would require something more, i.e. how the relations between various elements get organised. Such a description is still under discussion and intense debate, but this is the very idea of 'organismic biology', which emerged during the first half of the last century. This idea again, gave birth to a new way of thinking, known as 'systems thinking'. According to this view, 'the essential properties of an organism are the properties of the whole, which none of the parts have'(143). When the system is dissected, its properties get destroyed. Of course, many questions will arise, the answers of which are not still clear. One such question that is relevant is, given that we live in complex and patterned ecological web that evolves, wherefrom the information of such 'patterns within patterns' come? With this question in mind, let us try to see what happens in cancer, and how.

New researches have shown that mutation of a gene is not essential for the development and progression of cancer. In order to loose function for instance, the tumour suppressor gene need not undergo mutation; its expression need be suppressed or silenced only, so that it does not make the proteins necessary for healthy cell

functions. Which force can silence or suppress the normal, genetic expression? One tends to guess therefore, that above and beyond the DNA sequence there is another layer of 'information' in the chromosomes or elsewhere inside the cell. Fingers are being pointed towards the significance of such a 'higher level, organisational fields in the onset and progression of cancer'(144). Those fields are now called 'epigenetic'(145). It is now being said that a significant portion of tumour suppressor genes in cancer cells are silenced in 'epigenesis'(146). Numerous studies have indicated that there is an epigenetic machinery, an 'interactive epigenetic network' by means of which 'everything fits into an interlocking, self-regulating system'(147). Thus, it appears now that the rules governing physiological regulation are located not in the genome, but in the 'epigenetic networks'(148). These networks themselves organise genomic responses(149). A surgeon removes a cancerous growth from a stomach, only to find that it reappears there only, after a variable period of time. For a surgeon it is frustrating since he had delivered his most sincere effort to remove the cancer, for a pathologist it is embarrassing since he had described the field of operation as microscopically free of cancer, and for the patient it is the most agonising phenomenon. For a systems biologist however, it is not surprising. For him the field of surgery was of course, microscopically normal; but there are epigenetic alterations, initiating the occurrence of a new cancer or recurrence of the older one. In other words, there is an 'epigenetic landscape'(150) in the field of operation.

What is the essential significance of this epigenetic phenomenon? We understand that each species has a typical behavioural repertoire, known as 'ethogram'(151) that is innate. It may be manifested at birth or later. Therefore, there is 'a priori' knowledge in each species that is not gained by experience. It seems to be imprinted. Immunology for instance, presumes that the organism carries within it 'synthetic a priori'(152) knowledge of antigens, so that it will produce antibodies against them, when necessary. It is another question, if we could learn this a priori knowledge in cancer, for our patients' benefit. This should be left to the posterity. For now at least, it has been proposed that such a knowledge or information can be seen in the epigenetic phenomenon. This phenomenon indicates that there is a 'need for a continued turnover of the individuals that constitute a species'(153). Thus, it suggests that as an inevitable attribute of the animal world cancer almost certainly fulfils some 'evolutionary tasks'(154). Therefore, environment as such does not have any antagonistic contradiction with man. And man on the other hand, is not destined to regard his environment as something dubious in relation to cancer. Irrespective of high cellular plasticity enjoyed by some species, all species suffer from cancer, irrespective of the environment they live in or live with.

This phenomenon indicates that such a trait of having cancer has some evolutionary advantages. It is like 'apoptosis', a phenomenon in which the damaged cells commit suicide in order to maintain the stability of a cell population. Similarly, cancer might also be viewed as a suicidal act of the individual, a process of senescence that brings some benefits to the population. The difference is that here the host remains unconscious of the suicidal act occurring within him. Therefore, cancer development is an evolutionary process within the organism, but it is also related to the general process of evolution through the generations. This is why, despite important advances in therapy, all statistics show that the cancer incidence continues without a sea change anywhere(155). The relative constancy of the incidence of cancer and its death rates make it clear that we should give the concept of genetic and environmental causes of cancer a decent burial. Cancer is in fact, an evolution that no body wants. If we still seek solution to cancer we shall have to start reproducing ourselves in a different way. In fact, our genes have not

developed to give us long and happy lives. The entire human genome, it is believed, is probably developed to give us a 'limited lifespan'(156), for there are 'Time bombs' planted here and there, to be exploded in time and space. One must remember that 'every time a cell divides, it's going to be at risk of developing into cancer'(157). Many of our genes are constructed in such a way that under the influence of 'epigenetic pathways' they protect against cancer in the early periods of our lives, but that they are programmed for causing destruction, as we get older.

ARE WE PREPARED TO ACCEPT THE PARADIGM SHIFT?

Clearly, this is a paradigm shift in our understanding of cancer. But is such a shift necessary? Are we prepared to accept it? Is society prepared to accept it? It is known to everybody that when society is not prepared to accept a new phenomenon, it goes on castigating it. It is to be understood however that whenever a paradigm shift occurs in any branch of science it is not just to contradict the earlier paradigm by someone's fancy. History is always reinterpreted by the newer generations, but such interpretations do not render the earlier ones entirely false. The earlier explanations in physics or biology are of course important in certain context; but the point rather is that they do not hold good in most of the situations. A shift becomes a historical necessity for this reason only. But it is not easy.

History shows that in order to seek the truth, to understand the law of nature, if any, the classical physics took the leading role. The Newtonian conception of the universe as a great cosmic clock, where all events result from absolutely determinable interactions of inert particles was shattered by the uncertainties of relativity and quantum physics. It was not easy. Einstein's Special Theory of Relativity formed the new paradigm. It could resolve many anomalies and riddles of the old physics. However, this paradigm did not hold at the level of galaxies and electrons(158). So, another shift had to occur. Quantum mechanics has been the most successful theories that science has produced to date. It has helped to unravel the structure of the atom, explain the nature of the chemical bond, and predict the existence of anti-matter. But it has at the same time produced shock waves within science. We were accustomed to see the nature as consisting of particles and waves, but quantum mechanics found the world to be made up of 'indeterminate things' with the potentiality to behave like waves in some circumstances and particles in others. It has characterised nature by a wave/particle duality. It says that something need not be either a wave or a particle - it can be both, as a wavicle! While wave has a momentum, particle has a position. It was postulated therefore, and also formalised in 'Heisenberg's uncertainty principle' that we can never know the position and the momentum of an entity simultaneously.

Quantum mechanics sees subatomic particles not as a thing or an object, but as 'tendencies to exist or happen, expressed in terms of probabilities'(159). Two different routes and philosophical methods, those of Schrodinger and Heisenberg, arrived at the same discovery at the end(160). The physicists have now begun to see that all the seemingly different parts of the universe are manifestations of the One whole, united reality: the 'unbroken wholeness'(161). This is also the basis of 'Advaita', - non-duality. It appears that the physicists are beginning to turn around. It also appears that modern physics has reduced the classical notions to shambles. Thus it is said that the more one studies the conclusions of modern physics, the more one sees the intrinsic closeness of modern physics and 'enlightened mysticism'(162), that all conscious beings are aspects of the same universal entity. It is true that such a world outlook has not been popular till

today, for many wonder this can be mobilized against progress and reason, putting 'science on the defensive'(163). Many have criticised such ideas for the fear that they try to elevate the natural world above human attempts to analyse and modify it. Many of them are even marxists. But before we deal with the marxist outlook, let us see what happens when biology turns around.

The assumption of linear biologic reality and simple cause and effect relationships in the conventional cancer research seems to have 'outlived its usefulness'(164). Such an approach has been shown to be 'erroneous'(165) also. Clearly, a new approach to understand the complex phenomenon of cancer has become the demand of the day. New approach seems to be emerging now; but it is interesting to note that biology now finds its language of expression in modern physics. What is more interesting is that both physics and biology are expressing themselves in the language that was heard thousands of years ago! It seems therefore, that the ancient observations are now being expressed in terms of modern mathematics, physics and biology.

It is to be mentioned however, that the crucial early role for epigenetic alterations in cancer is not a very recent idea to the scientists. It was studied long back(166). Even the concept of 'symbiosis' was first put forward by Merezhkovsky way back in 1905 and again by Wallin in 1920. But all these studies were summarily dismissed by mainstream biology at the time. After having traversed a long and tortuous road to genetics, many scientists are now renewing the studies on epigenetics(167). Drawing from those ideas and relying on microbiological observations, Lynn Margulis prepared her theoretical paper in 1966. It was again rejected by about fifteen scientific journals, before being finally accepted by The Journal of Theoretical Biology and is considered today a landmark in modern endosymbiotic theory. However, biologists by large were still not ready to entertain her theory. It gained support only in the 1980s, when it was demonstrated that the genetic material of mitochondria and chloroplast were different from those of the nuclear DNA. Thus, the implications of non-genetic influences in health and disease are being discussed today(168). The concept of 'entropy' has also simultaneously found its due place in the genesis of cancer. Today, the concepts of 'attractors' are being introduced, which provide a mathematical and molecular basis for an 'epigenetic landscape'. Distortions of epigenetic landscape are being described. Cells are no longer regarded as spherical; it is being said that they tend to be spherical. So, as a cellular phenomenon, cancer is getting more and more complex. The boundaries between biology, medicine, mathematics and physics are getting more and more blurred. For the pragmatists therefore, the 'complexity theory' looks complex indeed.

But let us recall a story that was told of Albert Einstein's lecture to a lay audience about his recent 'Theory of Relativity'. After his lecture, a reporter in the lecture hall came up to him and said, 'Professor Einstein, now that you physicists understand the workings of the universe, don't you think it is complicated?' Einstein thought for a moment and replied, 'Young man, when you know nothing of the universe, it is, indeed, complicated. However, when you begin to understand, it is MERELY COMPLEX!' The same could be said today of our understanding of the carcinogenic process.

Naturally therefore, concerns have been raised from many quarters that science as we believe it is in all areas, from physics to biology, has reached an end(169). They say that no great revelation or achievement as compared to the earlier ones is expected anymore. The 'complexity phenomenon' has made the situation worse for us, for it seems now that we may not ever be able to solve the entire problem. Some marxists

also seem to be anxious about the same, for they maintain that the new notions in physics and biology are propagated with a view 'to malign Dialectical materialism', in essence(170). Marxists remind us how Lenin had criticized the 'idealist' philosophy' so as to defend the materialist position that matter was knowable and that it existed independently of human consciousness(171). They say that the new views are nothing but mystical trends and romanticism.

Marxists base their thinking on dialectical materialism. The founding document on this issue is Engels' 'Dialectics of Nature'. Its central thesis evolved from a set of principles laid down by Marx and Engels. According to this thesis the laws of nature are dialectical and therefore take the fundamental form of thesis, antithesis and synthesis. The dogmatists in the name of Marxism, tend to apply the formulaic set of these rules to all forms of thought(172). When such ideas are similarly applied as a set of rules in relation to nature, then in the end, nature becomes what marxists hope it should be. This is the inevitable result of marxism being taken as a dogma. In fact, this was the approach of the most dedicated exponents in biology and agriculture in the Stalinist era. In this era Lysenko represented his ideas and policies in the biological sciences and on crop cultivation. Under his all-embracing leadership such notions were stressed that the acquired characteristics of the living beings could be inherited. It was claimed that man's intervention could force any form of animal or plant to change more quickly and in a direction desirable to man. This assumption stressed environmental influences and the malleability of nature, which naturally appealed to the authorities(173). All of Soviet biology and also medicine ostensibly followed this notion, and tried to reorganise all of science in the 40's and 50's in the Soviet Union. Science was of course, reorganised, but it was a sterile science. It was a collective tunnel vision indeed.

All this is history. But those were the very decades in which the dramatic developments in nucleotide chemistry led to the discovery of the structure of DNA. It is ironic that much of those discoveries were inspired by the research and influence of the British scientist and marxist J. D. Bernal. Much of those discoveries were completely at odds with the assumptions of the authorities of the Soviet biology. Still, in the then Soviet Union, Stalin backed Lysenko, showered honours on him, and the dissidents were condemned and sent to work camps in the Gulag Archipelago(174). It was the same dogmatic attitude that regarded the dissenters as enemy of progress. As a result, history was witness to the colossal waste of scientific talent.

But how could all this happen at all? The answer possibly is that there was a gross distortion of dialectical materialism. One remembers the warning that materialism without dialectics tends towards mechanism and reductionism. Similarly, dialectics without materialism tends towards idealism and vitalism. Dialectical materialism in its true sense and meaning, seeks to transcend these antinomies. One is supposed to remember also that marxism does not offer us a finished dogma; it does not teach us a doctrine, but a method. Pasteur held that life came only from life and Virchow held that cells came only from cells. These propositions were assumed to be valid for all times and circumstances, because they were taken as dogma. When Bernal and Haldane challenged this dogma, they consciously used one of the principles of dialectical materialism. While working on the origin of life, they pointed out that a law that applies for the period after the origin of life need not be valid for the period before the origin of life. Thus, it should be clear that dialectical materialism is rather a useful insurance against dogmatism. Adherents of dialectical materialism are supposed to keep an open mind on emergent questions and issues. All such questions cannot be addressed with a given formulaic set of simple

rules. Such assumption goes against the very tenets of dialectical materialism. Both Marx and Engels have studied science in order to understand what in fact does exist, not what might be conceived to exist. Their very method of questioning and answering was dialectical. At least this is clear today that none of them thought that natural processes could be reduced to something evolving through internal contradictions only. An object is of course, an entity in itself and undergoes certain internal processes. But science has gone beyond that, - the entire part-whole process is now being looked at through the use of systems theory.

It is true that it often appears that the new explanations in physics and biology, and the advent of the words like 'cosmos', 'pre-programme' or 'complexity' lie outside the domain of science, and are akin to some kind of spiritualism. But it is not necessarily so. It does suggest, however, that the new insight in the evolutionary theory may be incomplete in proper or conventional scientific language. Of course, there are certain aspects in this new paradigm that are difficult to explain, and the arguments offered are not conclusive. The evidence of 'stasis' and 'punctuated equilibrium'(175) found in the evolutionary history of animals also has no adequate or complete explanation at the moment. So, what can we do? Feynman tells us that when a paradigm runs out of gas and a new one is not yet discovered, we have to start guessing. We understand that such a guess must be an intelligent one. However, the proposition that the epigenetic changes in gene expression during development plays a 'determining factor'(176), is no more a guesswork now. In aggregate they do make a strong case for questioning the prevalent paradigm(177,178,179,180,181). Researchers have clearly pointed out that mutations and cancer are not the cause and effect; it could be just the other way round. So, it is 'information' that flows in a network, from parts to parts, incessantly. Information is neither matter nor energy, it occupies no space and covers no distances; it is beyond, and free from the limitations of both space and time.

Does it sound mystique? But modern physics does not deal with, nor does it indicate mysticism when it divides up reality into literally hundreds of discrete subatomic particles, each with its own distinct signature. It says that the subatomic particles are 'connected in an immediate and intimate way'(182). When it says that they are related, they mean that they are related organically, not mystically. 'It would be a sort of organic whole whose parts are changing constantly'(183). When somebody talks about cosmos, he does not necessarily talk mysticism. Cosmos is indeed an organic unity with diversity, not a mystical union. Therefore, neither a man, nor a mouse, not even a cell or a molecule is an island entire of itself, but an integral part of the main, with a distinct signature of its own. This means that we live our lives in a non-local universe. 'Locality' therefore, is a myth, an illusion only.

We have just mentioned about a distinct signature in everything, because every bit of everything on earth is unique in itself. Each snowflake, made of hundreds of millions of water molecules is unique in itself. At the same time however, everything on earth, every cell of a body and every body are shaped by all the rest. This applies to every individual. 'Each fashions its uniqueness by taking recourse to the 'TITE' principle (Through Total Inclusion = A cell achieves Total Exclusion)'(184) of biology. And biological principles are not mysticism. Surely, the new outlook reminds us of the 'Buddhist view of reality'. But the Buddha was not propagating mysticism either; his doctrine is best conceptualised in organic terms rather than mystical terms. And so is Schrodinger's wave mechanics, which can easily be seen with the spectacles of mysticism. When modern physics describes 'a web of relationships between elements whose meanings arise wholly from

their relationships to the whole'(185), it stands miles away from mysticism. The Buddha was telling us the same 2500 years ago: that all things in the universe are related one to the other: the whole can be seen in a part; the ultimate truth of the universe is embodied in a single flower. His doctrine was radical indeed, for he was rather rejecting idealist propositions, standing miles away from mysticism. Modern physics has also been interpreted to have described the equivalent ideas of 'Tantrism', (186) but 'Tantrism' also has nothing to do with mysticism. Literally, the word Tantra means 'to weave'. It holds that reality is like an interwoven fabric. Therefore, if modern ideas point towards 'superdeterminism'(187), they must not be interpreted in terms of spiritualism. It is said that there are philosophers who believe that 'the great problems of philosophy are real, but they are beyond our cognitive ability. We can pose them, but we cannot solve them - any more than a rat can solve a differential equation'(188). This is possibly because 'the innate structure of our mind imposes limits on our understanding'(189).

TO SUMMARISE

Therefore, it is clear that any prescription of environmental purification with a view to prevent the occurrence of cancer is quaintly naïve. Such suggestions are basically intended to introduce simplified, mechanised designs of life. Such a view emanates from the idea of reducing the diversity of nature by eliminating it. Claims that by discovering the laws of nature we can substitute nature's principles by our own have made us profoundly confused. We have introduced more and more powerful antibiotics in the name of exterminating infections; but those have proved to be more and more toxic and dangerous to ourselves. Not only that, we have grown more and more resistant strains of organisms also. We have earlier mentioned that medical interventions have their parallel in agriculture. Thus, we have made our plants more and more susceptible to attacks from pests and fungal diseases. As we have eliminated earthworms with chemical fertilizers, we have made our soil dead. In cancer, medical activism has now being combined with social activism. While medical activism is signified with the 'Cacotelic' (Cacotelic, from Greek, means tending to end badly) nature of more and more aggressive therapy, the social activism is signified with prevention ideology, making people more and more fearful, anxious and bewildered.

It is time therefore, to reiterate that such practices should only be termed as 'Nazi science'(190). Today, we have set ourselves as elites of our society, and having done so and posing as experts acting on behalf of society, we propagate our borrowed ideas and opinions about flawless lifestyles. The essence of all these activities has been described as 'health fascism'(191). The term fascism represents an ugly expression of life in our times. It is an emotionally charged concept in the political and religious arenas. As such it is not easy to find the application of this term in health arena. As opposed to common imagination however, fascism is a much more subtle and seductive phenomenon. It was subtle and seductive in Nazi Germany as well when it came in the name of educating the public. However, the influence it exerts on the people does not necessarily educate the public; on the contrary, most of the time it makes them utterly confused. As the do-gooders of society we are no less confused. Such confusion gives rise to the belief that the health of individuals and of society at large will be assured by the control of social factors plus the use of some medicines. This very belief has now acquired a distinct design. Needless to say that such a design does not help the common man in any meaningful way. On the contrary, such a design seems to be immensely rewarding to the interested quarters, - the corporate bodies and their numerous cringing obsequious, named and unnamed.

We think, it is time to replace the modern concept of intrusive activism, over-intervention in manufactured problems and over-manipulation of man and nature. It can only be replaced by the wisdom of the common citizen and medical professionals. For that we require a more modern, radical and rational worldview, for such worldview only has enormous creative power(192). Of course, it is a radical gesture, but what is meant to be radical? According to conventions a 'radical' is someone who is out in left, or right field. But the root of the word radical is, in fact, 'radix', the Latin word for 'root'(193). Therefore, radical is the exact term to be used for this gesture. So, the new outlook in biology, medicine and cancer should be taken as a radical outlook. Radical it is, but sober at the same time. We consider the technologies like genetic engineering and global communication network as our most modern achievements. But this could be a sobering lesson to us if we realise that such technologies have been used by planetary web of bacteria for billions of years to regulate life on earth. It is sobriety that is required of us in order to understand that it is a hysterical and hysterically funny assumption that science is war.

“Never doubt that a small group of thoughtful and committed citizens can change the world. Indeed, it’s the only thing that ever has.” (Margaret Mead)

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