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Foreword

This volume of our Journal has two complementary themes : The holistic point of view and the riddle of energy. The thread that links them is the existence of fundamental laws of physics or thermodynamics. Should we respect these laws and organize our lives accordingly? or do we ignore them, justify the life- style that emerges out of this ignorance and behave as if we do not mind the consequences of this wilful ignorance?

Mankind seems to have decided to remain ignorant of the operation of these laws. Yet we seem to be constantly talking of the holistic point of view and the importance of energy in our lives. The implication of these two things no one wants to discuss.

This Journal tries to explore both these things. In the first article the author traces in brief the entire course of evolution, draws certain lessons from it and develops the contents of the holistic point of view. The other articles examine the riddle of energy through the reality of the unavoidable conversion of matter by the use of energy. The authors take full congnizance of all possible consequences of the conversion and is bold enough to set forth what they imply for our lives.

The results of these two explorations are worth reading and digesting.

Prakash Gole
Editor

What can be the Holistic Point of View?

The dictionary (Little Dictionary-Oxford) meaning of holistic is connected with the treatment of a disease. It says, "Treating the whole person rather than the symptoms of a disease."

I am using the whole person as our planet and the disease probably is the modern human being and his/her life style.

I am a human being but am trying not to be a part of that disease, by looking at the person as a whole and trying to interpret my existence according to the order given below.

I shall explore the various sciences in the following order:

Evolution – Geology – Geomorphology – Chemistry – Botany – Zoology – Geography – Palaeontology – Anthropology – History – Sociology – Economics – Politics – Sociology – Engineering – Technology (At the basis of all these are the basic laws of Physics).

The Genesis of Evolution

Now let us start with evolution first. How does it contribute to a holistic point of view? Energy and matter are the main constituents of the universe. Initially they must be in a diffuse, unorganized form. Evolution may be said to have begun when matter and energy began to organize in discernible shapes and forms. It is force of gravity that binds them and does not allow their dissipation into unorganized state. But they always exhibit a tendency to relapse into entropy. Energy dissipates into heat and matter into waste.

Especially when energy is applied to matter to produce work, greater portions of heat and matter are wasted than are embodied in work. **Work, that is coversion of matter with energy, should be carried upto a point where heat and waste creation balences the value of the product. That is energy should be used sparingly and conversions should be minimised. Thus entropy is reduced and mutual linkages built by the evolution are saved.**

Geology and Geomorphology

Now take Geology and Geomorphology. How do these contribute to a holistic point of view? Geology is the structure of the planet. The planet has a boiling hot but liquid core overtopped by a succession of layers formed with the cooling of the planet. But the core is active with the trapped heat and gases trying to escape and keep the overlying plates constantly in motion. On the one hand these forces give rise to natural disturbances like volcanoes, earthquakes, tsunamis and on the other keep the land surface changing over a longer term.

Natural disturbances are thus a part of life on this planet and cannot be ignored.

Climate interacting with base material shapes geomorphology. The process of erosion and deposition are influenced by these two factors. **For a Holistic Point of View it is essential that the erosional and depositional balance be considered. (**Hugget R.J. 2003)

Erosional and depositional processes are important in another connection. They gave rise to flows of different mixes of minerals that combined with sea water collected in depressions of earth's surface as the planet cooled and water vapor turned into precipitation. The shallow seas became a soup of minerals, which when played upon by lightning sparked the emergence of early life. The soup, through a process of fermentation facilitated by heat from the earth's core also provided food for the early anaerobic life. (Ward B., Dubos R. 1972.)

The Holistic Point of View, therefore, recognizes the vital connection between the land and the sea. It means it is necessary that flows from land to sea are kept as natural as possible. (Carson R. 1950)

The march of evolution was excruciatingly slow before primitive life formed in the sea. Conditions in which life could

emerge took billions of years to evolve. **Life, therefore is very precious,** the result of millions of years of development. It is all the more valuable as it flourishes only on earth and on no other planet in the solar system. **The Holistic Point of View demands therefore, that life should not be wantonly destroyed. One should be very circumspect of one's actions!**

Chemistry

Photosynthesis

Chance, scientists say, governs the course of evolution. Its march is punctuated with fortuitous events. One such event is the development of photosynthesis by tiny organisms living in the sea. They mastered the technique of converting sun's diffuse energy into food at ambient temperatures, a feat our technology cannot accomplish even today.

The tiny organisms first developed a wonderful chemical called chlorophyll from carbon, hydrogen, magnesium and nitrogen. The diffuse energy of the sun could be used to separate hydrogen from water and combine it with carbon and other elements to form carbohydrates, a reaction made possible due to the presence of chlorophyll. Oxygen was released in the process which was later absorbed by living organisms who respired carbon dioxide which replaced the portion used in photosynthesis. Food was created without using any concentrated form of energy, i.e. at almost no cost. (Stephen Jay Gould 1965).

Moreover the quantity of food produced was over and above the growth and maintenance needs of the photosynthesizing organism. Later this surplus food made possible the development of non-photosynthesizing organisms but not before another fortuitous event occurred.

Atmospheric Balance

By a series of fortuitous events that spanned millions of years, land was uplifted from oceans at various places. This upheaval substantially slowed down the process of oxygen dissolving in the sea and combining with iron ions to form iron sulphates. The percentage of oxygen on uplifted land went on increasing and life learnt to take advantage of it by crawling onto

land. Anaerobic life forms went into eclipse and slowly disappeared. Aerobic life came to stay on the planet. (Carson R.1955)

The Holistic Point of View has no alternative but to attach the highest value to the whole drama of the creation of chlorophyll, photosynthesis, oxygen and aerobic life. As all these processes form the fundamentals of life on the planet. The most important is the existence of green plants on land and in water. They are the producers of food for all other living organisms. Maintenance of atmospheric balance with its about 20 % oxygen content is another vital need.

A person professing A Holistic Point of View is naturally extremely wary of disturbing green plants and the atmospheric balance.

Ozone Layer

The holistic point of view has to take cognizance of yet another development that took place concurrently. It is the development of the ozone layer. The oxygen that we breathe has two atoms of oxygen joined together. But in earth's higher atmosphere, in the stratosphere about 48 kilometres above us, ultraviolet radiation occasionally forces an extra oxygen atom to join the two. The result is three-atom molecule, a bluish gas called ozone. It is basically unstable for it is constantly losing its third atom but new ones are forever being created by sunlight, so a constant amount persists in an undamaged atmosphere (about 10 parts per million). The ozone layer shields us from almost 95% of UV radiation striking the earth. The flowering of life on earth would be impossible if ozone layer was absent. (Flannery T. 2005).

The Holistic Point of View prescribes that the ozone layer, the protector of all life on earth, must be conserved by banning all activities and substances inimical to it.

Botany and Zoology

Extinctions

The past and present diversity of life has evolved only during the last 700 million years. This is a tiny period in the life of the planet. Even then life has suffered 5 extinctions in the period

between 440 million years ago to 65 million years ago. During each extinction life almost vanished from the earth. Dominant forms of life perished totally. Scientists are not in agreement about the cause of these extinctions. For example, the last extinction (5th) which occurred 65 million years ago, totally wiped out the then dominant form of life, the dinosaurs. It is said to have triggered by a meteorite strike or a forced winter caused by a series of volcanic eruptions, their dust preventing sun's energy reaching the earth or through the greed of giant dinosaurs, who ate almost all plants which formed their food (Leaky R. 1995).

A tiny mammal that survived the extinction was the precursor of all mammalian diversity that we witness today.

Some scientists are predicting a sixth extinction soon, to be triggered by human greed and wantonness! Though technology may be able to deflect a small meteorite and prevent it hitting the earth, destruction due to volcanic eruptions, earthquakes etc. is difficult to avoid. Easily avoidable is the destruction of vegetation.

The Holistic Point of View means a widesperad awareness about nature and life in all its forms. One can even say that the Holistic Point of View prescribes that eco-system needs are more important than consumer needs and accord higher priority to nature conservation than to creation of wealth.

Palaeontology

Dominat life-forms

Life continued to evolve in spite of these great extinctions. After each extinction life took a different line of development, the earlier forms and shapes with their behavioural characteristics, were not repeated. Nature displayed great innovative power, the total number of forms that existed on earth since the emergence of life is therefore, far greater than the biodiversity that exists today. Each time a group of life-forms achieved greater evolutionary success than others and became the dominant form of an era but ultimately destined to perish and leave no descendants. (S. J. Gould ibid)

Dinosaurs was the dominant form of the last era, and at present, it is the human being.

The question is can human beings change their ultimate destiny or perish like dinosaurs and leave no descendants?

Geography

Latitudinal zones and micro-climates

In the course of evolution and over all these millions of years the planet continued to undergo physical changes also. The axis of the earth tilted 23.5 degrees as it faced the sun. The intensity of sun's energy received by different regions of the earth became dissimilar. It was intense at the equator but away from the equator, it became less intense as the rays cover a larger area. Latitudinally, earth was divided into different climatic zones and life adjusted to climatic differences. Seasonal changes became the dominant feature of the earth's climatic regime. Life adapted to these changes.

It is extremely interesting to note differences in vegetation and animal life as one moves north or south away from the equator. Tropical evergreen forests cover the equatorial region with their characteristic fauna. Sub-tropical vegetation dominates the next latitudinal zone. Higher seasonal rainfall and warmer temperatures produce moist deciduous forests, less rainfall produces dry deciduous forests and semi-arid regions have savanna and thorn forests or grasslands.

The next latitudinal zone which borders deserts is the real grassland zone. Even deserts are not without biodiversity. Plants and animals with special adaptations inhabit deserts. Temperate zone is the next latitudinal zone with a year-round rainfall. Here the main factor controlling vegetation is the length of the cold season. Warmer temperatures produce broadleaf deciduous forests while cooler regions are covered by coniferous forests. In still higher latitudes grasses and herbs dominate as higher plants cannot sustain themselves in low temperatures.

As rainfall varies according to all these latitudinal zones, availability of water and quality of soil vary also. Hills and mountains give rise to different watersheds producing a diversity of micro-climates. Over the years micro-climates have produced their own diversity and gave rise to endemism.

The Holistic Point of View is not only deeply aware of the zonal variations but takes intelligent note of micro-climates

and micro-climatic diversity and endenism.

Persons professing Holistic Point of View are well aware that such diversity excludes application of uniform solutions, that each of these sub-zones and micro-climates should be treated on its merits and manifold resource development alone can sustain soil quality and availablity.

Anthropology - History - Sociology

Human Evolution

Human beings evolved in a zone bordering the humid tropics, where climate was neither too hot nor too cold. Human evolution is said to have begun when a primate sub-species established its separate identity by moving to the forest edge and using toes of both hands to grasp objects and use them as tools to strike, to dig and throw. Soon they learnt to live in small groups as a defence against powerful animals who were their enemies. They fashioned tools from stones, bone and wood using them to kill, to tear flesh and pound it. Yet meat formed only 20% of their diet, the rest being, fruit, nut, tubers etc.

This era which roughly covers a period from 7 million BP to about 10,000 BP was punctuated with glacial periods when temperatures became low, freezing water and sending glaciers towards warmer zones. Human groups and animals migrated too as glaciers advanced and retreated. By using fire humans kept themselves warm, baked their food and cleared forests over vast regions converting forest to savanna and grasslands where distinct animal genera evolved. Through group action they could even hunt large animals like buffalo and bison. The sea level used to drop during glacial periods enabling them to wade and navigate in shallow seas to penetrate distant lands. Human beings radiated from Africa, entered southern Europe, occupied much of Asia and probably even reached America.

Over much of this period humans were hunter-gatherers. They acquired higher and higher sophistication in their life style as their brain-size increased. They were principally nomads though towards the end of this period some sedentary communities practicing rudimentary agriculture emerged.

According to researchers who probed this era, hunting-gathering life-style was the happiest period in human evolution.

As land-man ratio was more than one (1 human being to 26 sq. km. area), gathering food was no problem. It was a healthy life-style too as hunger and diseases were rare. As group action demanded cooperation and sharing the produce, unhealthy competition and greed were unusual. Moreover, the sense of individual property, the prime cause of strife and violence in human societies, was not developed. (Simmons I.G. 1989)

Persons who profess a Holistic Point of View do not belittle the importance of this 'Aboriginal' life-style. In fact they believe that it provides an eye-opener to modern societies based on acute competition, greed and avarice and accumulation of wealth and property. They prescribe that while a spirit of cooperation and sharing be encouraged, limits should be placed on individual accumulation of wealth and their transfer to descendants.

Economics

Barter

Barter probably began during the hunting-gathering stage. It may depend on fortuitous discovery of two exchangeable items or may involve deliberate effort to find or locate such items. The former case involves no costs as the discovery of tradeable items depended on chance. In the latter case time and labour have to be spent in locating and later perhaps crafting a tradeable item. This means less time available for hunting, gathering and doing other things for the family or the group. The person who indulges in spending labour-time in finding a good or a commodity and crafting it, has to sacrifice some amount of food, leisure or other necessary family-group activities. An element of cost, therefore, enters in this case.

Persons indulging in barter believe that the transaction compensates them fully and costs involved in labour-time are recovered. They may also believe that the compensation has given them something over and above the sacrifice involved. The sense or element of profit then becomes an ingredient of the transaction. The sense, initially, may be only psychological as long as medium of exchange is not involved. But grading or pricing will be there as one particular item may be exchanged against two of the other type etc. Pricing based on quality or

quantity becomes an essential feature in later stages.

Barter is still practiced in India and probably in other countries also where rural population is substantial. It is an ideal trading system for locally produced good used for local consumption. Many economists consider this to be an ideal form of exchange as it does not involve or create any fictitious wealth. Development of trade based on a medium of exchange really began after agriculture became sophisticated and covered a large area of the then known globe.

But in local transactions, Holistic Point of View reckons, barter is an ideal system of trade. The transaction costs are low; it encourages production of local variants and also encourages local craft. The Holistic Point of View considers that even in a monetary economy, barter has distinct advantages and should be retained. It helps proper distribution of wealth by decentralizing economic activity.

Agriculture

With the adoption of agriculture, the life-style of human beings underwent a fundamental change. The hunting gathering epoch, the happiest period in human evolution, lasting almost 400,000 years, came to an end. This happened barely 10,000 years ago. Why humans abandoned such a healthy, happy life still remains a question. There seems to be no satisfactory answer to it. Agriculture must have become popular as it realized large quantities of production. Between 10,000 and 8000 years BP, i.e. within a relatively short period, agriculture spread throughout the then known world. (Simmons ibid)

Ecologically speaking human beings were able to change life-style of some selected plants. Extensive experiments in selection and breeding must have preceded actual cultivation. A few plants were selected for breeding and care. Plants benefited as they escaped easy predation and obtained a regular feed supply. They reacted favourably by producing an abundant supply of fruit and seed. This became possible for the farmer eliminated competing plants and redirected energy flow (sun's energy) and nutrient supply (from soil) exclusively to his/her favoured plants. (T. Bayliss-Smith 1982)

Ecologically speaking agriculture is also a monoculture as, in a given area, only one or a few plants are allowed to grow. Several

plants growing in an area are able to exploit the soil in an optimum manner, but a single plant may quickly deplete the soil of its nutrients. By utilizing all the sun's energy that strikes a particular area, a single plant is able to provide abundant food. It is beneficial to human beings who selected the plant but beneficial also to the natural predators of the plant. An abundant food supply attracts these predators in numbers and extensive agriculture, a single crop grown over a large area, suffers from pest attacks.

Soil quality depletion and pest attack are dangers from which agriculture needs to be constantly saved.

Ideally agriculture needs to be practised in areas where: a) soils are deep and well-drained, b) where soils, after nutrient depletion by a crop, naturally regain their lost qualities, c) where assured water supply in the form of well-distributed rainfall throughout the year, is available and where, d) sufficiently cooler temperatures minimise pest attacks. Such ideal conditions are available in river valleys and flood plains in temperate zones. Here C3 plants can produce abundantly leading to large surpluses. Soil in these areas get a compulsory rest when it is covered with snow in winter. Soils then can replenish themselves even though they are away from flood plain areas. Flood plains naturally produce the best agricultural soils as annual river floods bring to them silt rich in nutrients. Input costs of agricultural operations can be kept very low in these ideal conditions, making the surplus immensely profitable.

In tropical climates also flood plain areas are ideal for practising agriculture. Ancient civilizations flourished in such areas in Egypt, West Asia (today's Iraq) and India. But though soils are ideal, water supply throughout the year, through well-distributed rainfall, is not assured. Crops then have to be irrigated. No compulsory rest is available to soil which tends to be exploited throughout the year. Soils therefore, need artificial enrichment through fertilizers. Over-irrigation in anticipation of bumper crops is always a possibility. Warm temperatures mean evaporation of moisture from the soil which brings up salts through capillary action turning the soil saline. Over-irrigation and consequent salinity of soil destroyed the ancient civilizations!

In the tropical zone, soils away from flood plains are likely to be shallow, poor in organic content and likely to lose their

microbial activity quickly if exposed to intense sunlight. Exposure also disturbs soil structure through erosion. Moisture-holding capacity of the soil is then quickly lost.

Whether agriculture was adopted due to forced circumstances (increase in human population) or by free choice, is not known. Agriculture, landed property and sedentary life-style that goes with them, seems to have enamoured human beings so much that farming soon became the basic and even the dominant occupation of many human societies. Agricultural practices evolved to adapt to varied conditions of climate, landscape, soil and water supply. Today agriculture is practised from mountain top to valley floors, from deserts to wet areas along the coast, from humid and high rainfall equatorial zones to semi-arid zone where rainfall is low as well as extremely irregular. Increasing agricultural production seems to be the only answer to burgeoning human population. Till the turn of the century agricultural production barely kept pace with increasing population. It is reported that production in recent years is falling behind the growth of population (Hawken P.1993)

The idea of surplus is intimately connected with agriculture. The original surplus is produced by green plants through conversion of sun's energy into food. The quantity of food produced is over and above the growth and maintenance needs of the plant. Yet this surplus quantity is quite small. 90% of the food produced is required by the plants themselves and only 10% is available as surplus. What agriculture achieves is to concentrate sun's energy falling on a particular area, over a particular plant species preferred by human beings. On that piece of land no other plant species is allowed to grow. These other species may be the food of several other non-human beings. Agricultural surplus appears by denying food to non-human species; as such it is really a fictitious surplus.

The real net surplus will appear only if somehow human beings succeed in increasing the intensity of the process of photosynthesis. Today plants are able to convert only 2% of the solar energy that strikes the earth. If this proportion is increased to 3% or 4% and the growth and maintenance requirements of plants remain the same, a real surplus will result. Human beings, then probably, will be justified in increasing their population!

The present agricultural surplus is realized by denying space,

energy and matter to several non-human life forms. Clearing land for agriculture then results in reduction of biodiversity. To make room for agriculture humans have cleared forests, brush, grasslands, drained wetlands and even saline areas like mangroves and irrigated semi-arid areas and deserts. These activities have resulted in destruction of biodiversity on the one hand and on the other led to increase in human population. By clearing and burning vegetation carbon dioxide is released into the atmosphere and infiltration capacity of the soil, its capacity to hold moisture, its organic content and microbial activity have all been reduced. Today we are adding 9 crores of people every year to world's population but also destroying 25 billion tons of soil every year! (Hawken P. ibid)

The surplus produced by agriculture can be called "fictitious" in yet another sense. It is well known that as this surplus became available to non-farmers, human society diversified, flourished, civilization flowered and priests, administrators, intellectuals, warriors, artisans and craftsmen, service people and a host of other professions became possible. Indeed it can very well be said that the development of human ingenuity, the growth of cities and urbanism, the success of military strategists and lastly the growth of trade, commerce and later manufacturing became possible due to agricultural surplus. Agriculture undoubtedly proved the prime mover of human social, economic and political organization. No wonder then agriculture was eulogized, glorified in most human cultures. The farmer was considered to be the epitome of simplicity, virtuosity and magnanimity. The farmer's life-style based on care and cultivation of soil, his links with nature, his down to earth approach, and his hospitality and consideration of strangers was considered far superior to the commercialism, greed, profanity and anonymity of urban life.

History tells us that once this surplus became available, farmers were able to barter it, transport and market it, or store it and obtain the other necessities of life. Powers that be always eyed this surplus as the base of their wealth and strength. In earlier stages of human civilization it was appropriated by consent as by priests and religious leaders and later through administrative powers and political and military force. The quantum of this appropriation seems to have been judged on the

assumption that farmers should remain content with just the necessities of life and should always lead a simple life! Unfortunately vagaries of weather to which farmers are exposed make creation of wealth an extremely difficult task for an average farmer. No state or political power has made any comprehensive and intelligent effort to come to the rescue of farmers. Co-operative planning of crop pattern and marketing of produce at village level may be a sure way of sharing and minimizing risks and assuring a steady income from farming. This is true of India and may be other less developed countries also. But the farmer's acute sense of property, his individualism and lack of proper education mar the operation of cooperative effort. Though developed countries have succeeded in substantially raising the quantum of farm production, it is sustained only by a variety of subsidies. Farmers constitute only a tiny proportion of their population.

In India, fragmentation of land holdings is also a major obstruction in implementing schemes of agricultural development. Therefore, supportive occupations emanating from care and quality development of local natural resources can also be a good complement to farming. These include care and maintenance of stream source regions and upper reaches of streams, agroforestry, grassland development, care and breeding of local cultivars, local breeds of animals, local specialities etc. Proper education and institutional development based on co-operation among farmers are needed to achieve such a breakthrough!

This in brief, is the agricultural scenario. What the holistic point of view has to say about agriculture as an activity, as a profession and as a life-style? Risk is always present in agriculture probably in a greater measure than any other economic activity. This is because of the inseparable relation of agriculture with climate. Weather may play truant even in regions where conditions are ideal for practising agriculture. Being a monoculture, agriculture is always prone to pest attacks. Large scale, single crop agriculture should be taboo. Rainfed agriculture is really a contradiction in terms. Risk factor is too high to make it sustainable. Storage and marketing are also not without risks. **The main consideration should be control and reduction of the risk factor in agriculture.**

Co-operation at village level among farmers in planning of crop pattern, in allocation of water, in transport and marketing and in developing and maintaining a seed bank is the next cost-effective and sustainable solution to reduce risk and ensure a steady and viable income to farmers. Greater awareness through proper education and changes in the legal system to avoid fragmentation of land holdings are prerequisites to bring about effective cooperation. The holistic point of view will give top priority to these measures.

Increasing diversity in agricultural operations should be the next priority from a Holistic Point of View.

Single crop agriculture even in a given area should as far as possible be avoided. Cultivation in a single plot may cover grain, legume, leafy vegetables, tubers etc. to reduce risks of total crop failure and pest attacks. The pattern may differ from region to region and indeed may differ according to micro-climate. This diversity should be supplemented by diversity of supportive activities.

As sedentary pastoralism is a persistent feature of Indian agriculture, breeding and improvement of livestock, development of excellent forage in terms of agro-forestry, grassland and savanna development are necessary supportive activities. All these require adequate availability of land which can only become possible through village-level planning. Other supportive activities will include horticulture, floriculture, sericulture, apiculture, and vermiculture development and maintenance of a seed bank.

These supportive activities will need a well-developed infrastructure of local resources including trained manpower. The trend since Independence is to import agricultural technologies developed abroad. Indeed it is no exaggeration to say that in modern as different from traditional agriculture, we follow practices developed in temperate lands. We tend to forget or ignore the essential characteristics of a tropical environment. These are: 1) high temperatures, 2) a chronic scarcity of water and 3) high rates of erosion and of decomposition. Our agricultural practices therefore, should include control of high temperatures and intense sunlight through development of various vegetational cover types. These will also help in controlling erosion (apart from bunding), retain soil moisture and decelerate

intense decomposition.

Intelligent management of local vegetation, avoiding exotics and focusing training and research on local and regional vegetation are a necessary adjucnt to holistic management of agriculture.

Our agriculture is always haunted by scarcity of water. The Holistic Point of View believes that it can only be averted by a composite treatment of all resources available locally.

This includes an intelligent management of physical features of a landscape like hill, hill- slopes, valley areas and plains as well as patches of local eco-systems, drainage patterns, and distribution of human settlements. **Needs of river and stream ecology will have to be satisfied through intellegent management of landscape.**

These needs include care of the source region, especially of vegetation cover there; management of upper reaches of stream to promote optimum velocity of flow, adequate vegetation buffers on banks to check erosion, add organic matter to the flow and increase infiltration, maintenance of riverine vegetation and in-stream habitats, protection of flood plains and deltas, maintenance of adequate flow in the channel and control of point and non- point pollution flows into rivers.

The Holisitc Point of View requires care and intelligent management of each and every stream, big or small, through local initiative and a decentralised structure.

It does not favour large storages (reservoirs) to mainly supply the needs of large cities and to provide irrigation through surface canals. **It prescribes eco-sensitive management of catchment areas of existing dams, of the dam site and the reservoir and of the command area of dam.**

This will decentralise water distribution, make it more equitable and provide water supply to cities and villages and satisfy the needs of agriculture as well as its supportive activities, needs of all other natural resources and eco- system needs.

This is a tall order. It cannot be realised unless each and every stream is taken care of and habitats and eco-systems associated with it are kept in healthy conditions. **Ecological Society's Nirmal Ganga Abhiyan, a project designed to run for 3 years, will demonstrate what changes occur when streams are well cared.**

The "holistic" measures suggested here are radical in every sense. In the present socio- economic milieu, fostering inequity, they are difficult to introduce. Price support, easy credit, waiver of credit repayment, concessional electricity and water supply, the peculiar operation of government schemes, have created in the villages a class of rich farmers and big landholders who corner subsidies and have a vested interest in maintaining the present inequitous environment in villages. Caste differences in villages only sharpen the inequitous distribution of wealth.

The present super-strucuture of subsidies needs to be dismantled and replaced by one which promotes community efforts and community organisations.

The Grampanchayat needs to be strengthened financially through human resource development. **The adoption of Holistic Point of View needs decentralisation of authority and finance.**

Politics, Engineering and Technology

Industrial Revolution inangurated the Machine Age. Machines are best suited for repetitive work which requires strength and uniformity in product quality. A class of trained operators is required to run the machines. In Europe Industrial Revolution was preceded by a general spread of education. Machines require a huge and uninterrupted flow of energy and materials. In earliest stages Industrial Revolution was given a momentum when abundant supplies of coal and iron were discovered which could be cheaply exploited through political control and cheap labour. Later the discovery of cheap oil consolidated the hold of machines and technology over human societies.

Machines basically convert matter through the use of energy. Research in various sciences has enabled human beings to produce a technology which aims constantly to enhance the scale and intensity of this conversion. Gignatic machines which gulp down enormous energy and can transform or move mountains of materials in a day are now in operation. It is however, barely recognized that these giants are being increasingly controlled by the 2nd Law of Thermodynamics (or entropy). Unknowingly human societies have handed over their destiny to the amoral and immutable operation of the 2nd Law !

According to the 2nd Law when any matter is converted with

the help of energy, more energy goes out as heat and more matter comes out as waste than the volume and weight of the finished product. If heat escapes into and waste deposited into the environment, entropy is increased and eco-systemic damage ensues.

From the economic point of view, heat released and matter coming out as waste are costs which need to be internalised, in determining the price. In earlier stages of Industrial Revolution as energy, raw material and labour were available at almost no cost or at throw- away prices, internalising these costs was the usual business practice. In their hurry to industrialize and create employment, developing nations also offered industries substantial subsidies in acquiring developed land, in procuring raw materials and in terms of tax concessions. This helped industries to offer competitive prices and still pocket substantial profits. The competitive edge continued as costs of entropy created in the environment were not internalized. These "extrenalities" were the cause of pollution in atmosphere, land and water. These were actually social and environmental costs as society and eco- systems had to suffer the effects of pollution.

If the history of industrial progress in the past 200 years is scrutinized, it reveals that industry has prospered, but environment got increasingly damaged. Industrial progress seems to be at the expense of the environment. In recent years in China, pollution became rampant as the rate of growth of GDP per annum soared. The situation is similar in India, today. It appears that the society has to suffer social and environmental costs if people wish to have industrial progress! People must realize that quantitative development alone is not sufficient. Development should be qualitative too. Good is not only contained in goods!

Why are we so conscious of quantitative development and negligent of qualitative one? The answer seems to be something like this: Spread of education among the general public did not precede our decision to industrialize and urbanize. In the early years of Independence, the decision makers thought that industrial progress was the only way to catch up with the west. Their reading of history did not give them the insight that western progress really began when Renaissance brought about a social and intellectual revolution; the society flung down the

yoke of papal authority; it embraced reason and began to probe nature and natural phenomena; it initiated spread of education among the general public; it laid the foundations of basic sciences; it induced a spirit of adventure and exploration; it developed new institutions to organize trade and commerce, to carry out expeditions and to develop research and enquiry in various scientific and cultural fields.

The invention of machines, technology and material and industrial progress was the culmination of all those movements. No such renaissance that envelops almost the whole society has as yet occurred in India. In early years of Independence Mahatma Gandhi had advocated a kind of renaissance which had its roots in our villages. He wanted our grassroots to be enlightened enough to understand the pros and cons of western industrialism. He was conscious of our environment and desired that our progress should be rooted in our soil, nurtured by our climate and based on solid foundations of development of local resources. He was least interested in catching up with the west. He wanted India to find its own way of development based on our culture, our social and religious diversity and varied natural conditions- a model which will lead to upliftment of the people of India in general.

Mahatma Gandhi's vision however, was discarded in favour of a model put together by administrators, engineers and statisticians who came from a class trained by the British to further their interests. Many of them were trained abroad, had lost their roots in India's soil and even tended to despise the teeming millions who were their brethren. They were eager to taste the fruits of Industrial progress and wanted to imitate western lifestyle.

They thought that once they established large scale industries and western style resource management, wealth, technical skills, and scientific and technological awareness would trickle down, forcing people to abandon their lethargy, superstition and nonchalant behaviour and induce a spirit of scientific enquiry, innovative ability and enterprise among the general public.

They did not consider that spread of education among the general public was a necessary pre-condition for such an awakening. Instead of encouragement to basic education, they established institutions of higher learning which basically

benefited their own class. These conditions continue even today! (Bandyopadhyay S. 2004)

Industrialism was superimposed on Indian society. Its success depends on how many of us are prepared to be ingrained with western culture and standards. Modern industrialism is essentially rooted in western culture which includes not only renaissance but exploitative colonialism, racial superiority, resource intensive technology and an economic system geared to increasing creation of wealth (at all costs) but not interested in its just and equitable distribution. Our adoption of industrialism has forced us to proceed along the same path. But morally, intellectually, technically, culturally, politically, economically and militarily we are hardly prepared for it!

Our west-educated, western oriented elite class that influences today's decision-makers, seems to be quite oblivious to the impacts of industrialism and its concomitant systems such as the exploitative technology, the inequitous economic system and the centralizing tendencies which tend to destroy local resources, natural systems and natural processes. They still have immense faith in trickle down theory and give priority to industrial production denying larger investments in health, education, development of local resources and to local initiative. They would still like to invest more in higher education than in basic education! They are not prepared to accept anything that goes against western industrialism.

Will the all- controlling 2nd Law of Thermodynamics hit them like a thunderbolt and bring them to senses? Only if the impacts are revealed forcefully and intelligently. **The law pierces the very heart of industrialism by revealing that industrialism creates wealth that is only fictitious! It is nurtured only by paper money and grows particularly on never ending debts.**

In effect industrialism and all that goes with it have a foundation of sand and rubble only!

As pollution became widespread, public opinion forced states to enact laws controlling it. Manufacturing companies were compelled to install pollution abatement equipment. Externalities no longer could be imposed on the general public or on nature. In the seventies of last century oil producing countries sharply increased prices of oil. Energy could no longer be obtained cheaply. Labour had already become expensive in

western countries. Manufacturing immediately became a loss-making proposition for many companies. It sharply brought out the stark reality: In large scale manufacturing profits are not possible. They can only be obtained if cheap energy, labour and raw material are available and externalities could be safely imposed on nature and the general public. Economic growth can be only achieved by depriving others of just remuneration and by destroying and imperiling health of the general public!

Existence of whole superstructure of modern civilization became questionable!

As the lead article in this Journal shows modern technology if it indulges in indiscriminate conversions of matter by using energy, increases losses manifold and can only be sustained through subsidies and denial of quality life support (health, education, clean air and water, uncontaminated food etc) to the general public. Even small is not beautiful!

In the 70's of the last century, Dr Narinder Singh of Cambridge University had already shown that 70% of the products manufactured by industry contained substances poisonous to human life. Now it is common knowledge that all those who are enjoying modern life- style wholly or partly, daily ingest a variety of toxins in their bodies (Hawken P Ibid).

In the last decades of 20th century, environmental economists Herman Daly, Kenneth Boulding, Dr and Mrs Ehrlich, Ayers and others brought out the essential futility of modern economic growth. They showed that the very assumption, "aggregate wants are infinite and aggregate production could be made infinite by using modern technology", was not only wrong but would bring in ultimate disaster and collapse!

In any economic activity, where energy is used to increase production, energy ratio on investment (EROI) is less than one. In temperate countries, modern agriculture using machinery, chemical fertilizers and insecticides, is almost 1500 times more productive as traditional agriculture. But in energy terms, one (1) input of energy produces 0.005 output, which is negative. (Bayliss - Smith T.P ibid).

Even traditional agriculture where bullock power is used but their dung is further used as fuel, gives a less than one energy ratio of 1 : 0.96. The ratio becomes more than one if cow dung is returned to soil as fertilizer. As modern industry cannot be run

without the application of fossil energy, the energy ratio becomes consistently less than one.

EROI of the use of non- conventional energy is also not positive (more than one) if investment in manufacturing solar panels, their installation, the requirement of dry cell battery and its replacement, the manufacturing cost of wind mills and their transport (in power generation through wind), the power needed to start these mills and bring them to a basic RPM rate are considered. The present techniques of power generation using solar panels and windmills thus give a less than one energy ratio. Similar are cases of power generation using atomic power and even hydro-power. If their social and environmental costs are internalised, these will never produce a more than one energy return on investment!

The conclusions seems to be inevitable: All power generation using modern technology and all manufacturing based on machines and large-scale use of energy are loss making and should be avoided!

These activities are being sustained at present by heavy subsidies from nature and the general public. It means loss of life-support for both!!

If the Laws of Thermodynamics (or Entropy) are well understood, the entire basis of modern life-style falls apart.

Then the question is why does it still persist? There are no doubt, experiments in America and Europe where communities are trying to cut away from the present economic system. Some of them even have their own currencies. Yet the social and economic significance of laws of thermodynamics (or entropy) is hardly known to the general public. Indeed it looks as if the present system has a vested interest in keeping this knowledge away from people. No reference is made to it even in higher education. When the physical and economic significance of conversion of matter from mechanical to electrical and again from electrical to mechanical and the loss of energy involved in each stage, was explained to some teachers from engineering college, they exclaimed, " Please do not tell this to our students!" The losses are of such magnitude that the whole engineering exercise becomes futile. Yet this is exactly what is practised in real life. Heavy losses are incurred all along the line. Ultimately these losses are to be suffered by nature and some sections of

human society!

Modern industrialism is not possible without degradation of nature, a declining human population and a constant rise in the cost of living. Scientists and administrators argue that human population will stabilize around 2050 A.D. What will be the state of natural eco-systems then? What will be the cost of living? Nobody seems to offer any forecast! Thinkers like Stephen Hawking are predicting end of the present human civilization much earlier!!

The Holistic Point of View therefore, advocates a radical change in the face of industrialism. Excessive use of energy must stop. Energy and natural resources must be priced properly.

At present their prices are forced down by various subsidies. This results in unessential conversions, production for production's sake just to keep industrialism alive and manufacturing of unessential commodities (intermediate goods). Resulting pollution and waste degrades nature. **The cost of restoration of nature and revival of natural eco-systems should be internalised.**

This will force up the prices of natural resources including energy. **Human labour should replace machines in many cases and should have a price less than that of raw materials and energy**!

According to some writers (Hawken, Lovins, Armstrong, Bilani etc) such changes are already happening in America, since the nineties of the last century. It is well known that a bulk of US industry has shifted to Mexico, China and some have entered India too. Foreign capital is welcome in many Asian, African and South American countries (the so called less developed nations) and even "dirty" industries and dangerous (toxic) waste deposition are accepted.

According to these authors American economy is tending toward "a green" or "restoration economy" where repair, refabrication, restoration and revival are the key tasks. According to them more than 70,000 businesses of this type have already been established in the US. "First destroy and then restore" seems to be the motto of modern industrialism.

These efforts however, suffered a setback during the "Bush regime" when pollution control laws lost their teeth and

industries were given subsidies and tax concessions, in the name of creating jobs and employment. The price of labour is artificially kept high. "Outsourcing" of labour then became a feature of US and indeed all developed economies!

India seems to be following the same path, making the same mistakes western developed countries committed. Since liberalisation of controls, "First destroy" seems the motto of government's policies. Air, surface and ground water, forest, fragile and ecologically sensitive areas, sea-shore and coastal areas are allowed to be exploited without restraint. Ministry of Environment has lost its importance, environmental impact assessment has become a mere farce and natural resources are allowed to be used without any thought of their conservation.

Bio-manipulation and biotechnology are being encouraged. Government of India policy resolution says that initiatives in the field of biotechnology include techniques for gene mapping, conservation of biodiversity and bio-indicators, research, special programmes for plantation crops, for the benefit of scheduled castes and tribes; cattle herd improvement through embryo transfer technology, in vitro propagation of disease resistant plant varieties for obtaining higher results and development of vaccines. The government says that the country's resources will be used to derive maximum output.

The official approach seems to be basically exploitative in tune with the government's emphasis on engineering and technological solutions to problems. Many people are concluding that this approach is increasing economic inequalities in India ("Disequalisng growth", several articles appearing in newspapers and several letters to editors expressing concern)

To reduce inequalities, the gap between rich and the poor, can there be an alternative path of development? Writers who have expressed concern, have unfortunately not laid out an alternative path. **Such a path should be focused on judicious and sustainable management of our natural resources - atmosphere, water, soil, forest and grasslands and other vegetation, minerals and coastal and marine areas.**

The essential steps to progress along this path include: 1) Restoration and revival of these resources; 2) establishing grass roots institutions to manage these resources at village level; 3) organize basic and higher education in judicious management

and restoration of natural resources and 4) introducing village level planning in management of these resources and marketing their produce. **The goal should be to enhance and use local resources to satisfy local needs on a priority basis.**

The present mindset focusing exclusively on engineering and technology needs change. As technology is power, it inevitably leads to centralizing of authority, of decision-making and of investment. Instead what is required is decentralization and investment in restoration, revival and judicious and sustainable management. **Change in the present educational pattern is also necessary. Introduction of environment in the curriculum in a disjointed manner should be replaced by a holistic treatment connecting various physical and social sciences as is attempted in the present essay.**

A Holistic Point of View, treatment of our problems in a holistic manner, is required to achieve welfare for all - humans and non-humans!

Warning: Conflicts and violence are imminent as we irreversibly degrade our soil and water resources!

Prakash Gole

The Riddle of Energy

Energy and matter are two basic components of the universe. As far as earth is concerned energy travels in a linear fashion while matter circulates and can be recycled. Certain strange things however, happen when these two come together.

The Measure of Energy

The source of all energy for our planet is the sun. How much energy we receive from the sun? Energy is measured in Joules. A Joule is equal to one watt second. In simple terms 1 Joule is equivalent to 0.239 calories and one kilo-joule is equivalent to 239 Kilocalories. In terms of Joule how much energy does our planet receive from the sun?

Energy that hits the top of the earth is 1365 Joules per metre^2 per second. Energy that reaches the surface of the earth is 1000 joules per metre^2 per second. 40 % of this energy is reflected back into space. Energy available for photosynthesis by plants is 3600 Kilo Joules per metre^2 per day. Energy actually used by plants is 12.5 % of incident energy.

Energy from the sun comes to the earth in the form of electromagnetic waves. Though the spectrum is very wide, ozone layer assures that only infrared (IR), visible light and some ultraviolet rays (UV) reach the surface of the earth. Frequency band of IR radiation generally matches natural frequencies of many molecules that belong to the surface of the earth. The heating effect on the earth which produces conducive temperatures and also wind, humidity and rain, is due to resonating vibration of these molecules as radiation strikes them.

Over a local geographical area temperatures are generally uniform (variation less than 10 degree Celsius).

The Pulse of Energy

The sun continuously emits energy. No one can change its proportion or its flow that is received by the earth. Physical conditions on the earth have evolved in such a way as to exclude all the rays from the sun that are inimical to life. Sun's energy, as its reaches the earth, is in a form that supports life. Sun's energy is therefore, the pulsating force of life.

Stationary Plants and Moving Animals

Out of energy coming to us from the sun 70 % is required to keep the biosphere warm, to evaporate water, to make possible rain and wind and in general to make the conditions favourable for the survival for living organisms. Living organisms use energy to keep their bodies fit. For them energy means power or strength to work. But the radiation as received on the earth is of low density and spread over a large area. Only plants have developed a capacity to use this low density energy at ambient temperature. To achieve this, plants have developed a chemical called chlorophyll. With the use of energy and this chemical, plants convert carbon dioxide water and salts into an orderly configuration of biomass molecules in a process called photosynthesis. Oxygen is a bi-product of this process. During the process plants remain at ambient temperature, no heat is generated, no work is done, no heat is released as no lower heat sink is available to absorb it. As heat is not generated to do work, plants are unable to take any movement. They have to depend on wind and rain to spread their seeds. But they can produce surplus food, which no other living organism is able to do.

All living organisms other than plants have to work to get this food. For them energy means power or strength to work. Their bodies generate heat from the food they eat. This heat energy enables them to undertake movements. But this they can only achieve at temperatures higher than the ambient. Moving life, being at higher temperatures, cannot do photosynthesis and depend on plant kingdom for all their energy supply except visible light used for vision and to form vitamin D from UV light. Plants can take help from moving insects and birds for their

reproduction by offering nectar, fruit and seed to them.

Two Laws

There are two basic laws which govern energy. The first law states that energy can neither be created nor can it be destroyed, but it can be used and converted. The 2nd law states that use of energy involves transportation or conversion of free energy that is available for use into bound energy that is no longer available. Free energy available in a piece of coal or a litre of mineral oil is converted into heat as it is used. While performing its work part of energy goes into a form in which it cannot be used. That is, it is released into atmosphere but does not get destroyed. It is released in the form of heat which is unable to carry out work of free energy.

Stored Energy

Work is done only at higher temperatures. The body that does work cannot store energy and has to release it in the form of heat to lower the body temperature essential for its survival. Plants, on the other hand, do not need to perform photosynthesis at higher temperatures. They can thus store energy in their biomass in a chemical form. After the death of plants, this stored energy, under high pressure and high temperatures, is chemically transformed into lignite, coal or oil. For human beings these are major sources of energy to get work done.

Every organism uses energy to keep its body healthy and in a livable, working state. All living organisms respire and release energy in the form of gases mainly carbon dioxide. They perspire to release excessive heat. Plants also respire and release carbon dioxide and water vapour. But they do not perspire and release heat!

Conversion of Energy

The 2nd Law states that conversion of energy cannot be total or 100 percent. Part of energy remains unconverted and has to be released as heat. This can be released only at a place of lower temperature than the temperature of the unconverted heat. There should be a sink where unconverted heat can be released and this should have a lower temperature.

Unconverted energy is a measure of entropy or disorder,

while converted energy lowers entropy or disorder. When heat is released in a sink, overall entropy or disorder is increased. When any work is to be done, we use energy to generate heat to achieve mechanical energy which is a directed form of energy. Conversion to a directed form has low efficiency. The best achievable efficiency of any heat engine is indicated by Carnot Cycle efficiency which is $\frac{T1-T2}{T1}$

where T1= original temperature and T2 is the temperature of unconverted heat.

Increase of Entropy

In any conversion from random to directed energy, efficiency is low, i.e. a lot of unconverted energy, in the form of heat, has to be released, which increases entropy; while conversion from directed to random form, though showing a good efficiency, also increases entropy as random energy comes out as heat. Thus in any direction of conversion, entropy is always increased.

When the chemical energy in plants is stored and collected into coal or oil, under high temperatures and pressure, this chemical reaction does not require application of energy. As such it results in a net decrease of entropy. Such net decrease of entropy is impossible if energy is used. Free energy ingrained in coal or oil, once used, increases entropy!

Potential and Quantum

Energy has two parameters: Potential and Quantum. Energy flows from higher potential to lower potential independent of quantums. Human senses perceive only the potential and not the quantum. This can be illustrated by the following examples:

Heated water in a bucket has large quantum of energy but our senses perceive it when a spoonful is touched. A road roller is a large store of quantum energy but moves slowly; a go- cart much smaller in size and in quantum energy, has a potential to harm and it is perceived by us because it is moving at a great speed.

Potential difference is very important for any energy flow. The Table below shows the three main types of energy that human beings commonly use. The table brings out the consequences of exchangeability between them, i.e. what

happens when heat is converted to mechanical energy and the latter is exchanged for electrical energy. Not only is it the normal route taken while using energy, but reverse route, viz. from electrical to mechanical is also common. (Please refer Table 1.)

Loss of Energy

The table shows that the conversion from heat to mechanical and then to electrical energy involves tremendous energy losses. 100 units of heat converted to mechanical energy obtain only 30 units and 30 units of mechanical energy exchange for only 20 units of electrical. The reverse route is actually a disaster. From electrical to mechanical, the energy loss is almost total, 20 units of electrical obtain only 4 i.e. one fifth unit of mechanical energy. However, heat generated directly from electrical shows a negligible loss. In spite of all this justification we convert everything to electrical because electrical energy is easier to transport.

Subsidies

In modern usage the normal path is from heat to mechanical to electrical. This path appears to involve tremendous energy losses. Losses are not generally felt as they are sustained by subsidies in a variety of forms. Fossils fuels like coal and oil are used to obtain power. Their prices are artificially kept low through subsidies. As such subsidies absorb losses. If subsidies are removed, fossil fuel's use is likely to drop substantially lengthening the period of their availability. If present usage continues the existing stocks are likely to be finished before the end of the present of century.

Alternative Sources

As this stark truth is being increasingly realized, the need is felt to explore alternative sources of energy. Solar energy, wind energy, energy from bio-fuels are being explored. But when we consider the total investment involved in obtaining energy from them, these sources fail in their promise. The investment made in setting up the infrastructure and in the running the gadgets is far greater than the value of energy generated. Effective storage of solar energy is not yet possible. The cost of infrastructure such as installation and making of solar panels, the maintenance and

Table 1

Types of Energy	**Heat**		**Mechanical**				**Electrical**	
Property			Potential		Kinetic			
Potential	Temp	Unit – ^{0}K	height	Unit metre	Velocity	Unit Mtr / sec	Voltage	Unit Volts
Quantum	Mass x Spec. heat x temp	Kcal	mgh	kJoule	1/2 x mv^2	kJ	V x I x Time	kWh
Equivalence	Kcals		Kcals x 4.186 = kJ				kJ / 3600 = kWh	
Natural resource	Plenty – stored in chemical form		Little – stored in potential form				nil	
Storability	Poor		Poor				Little	
Conductability	Poor		Poor				Good	
Conversions	100		30				20	
Conversions	Heat to Mechanical 100 units to 30 units		Mechanical to electrical means 30 units to 20 units					
Reverse conversions	Electrical to heat 20 units to 19 units		Electrical to mechanical means 20 units to 4 units				back	

replacement of dry cell batteries and laying out cables to transport energy, is far in excess of the actual power generated. The energy ratio on investment is therefore, less than one. Low cost conversion of solar energy is not yet possible.

Alternatives are Expensive

The case is similar for wind energy and bio-fuels. The manufacturing and installation of huge wind mills is terribly expensive. In addition, fossil fuel energy is required to push them to a viable RPM rate. In effect, the value of energy produced by the wind mill is much less than the price paid to obtain it. Smaller size windmills having lower investment produce a better energy ratio on investment. They can cater only to a small demand. Growing bio- fuel on a large scale is also an expensive proposition. The gestation period may be long as in Jetropha. If good, crop producing soil is used to grow bio- fuel, the loss in crop is likely to be substantial. If a crop like maize or grasses are used, the volume to obtain enough power is likely to be overwhelming. Livestock may suffer if substantial quantities of maize are diverted to bio- fuel production.

Fictitious Surplus

The non-conventional or alternative sources of energy are also therefore, are not viable. The 2nd law of thermodynamics or entropy gives rise to a threshold effect. Production beyond a threshold becomes un-remunerative. The basic fact is that the surplus produced by using energy at higher temperatures is an unreal or fictitious surplus. It is shown to emerge because prices of labour, raw materials and fossil fuels are kept artificially low. If prices, proper prices, are denied to these factors of production, it results in deprivation and exploitation. If prices are kept low through subsidies, less investment is made in health, education and other life-supporting systems and welfare of the society suffers.

The real surplus is produced by plants who use a chemical reaction to convert sun's energy and keep heat and waste losses minimum, i.e. they do not increase overall entropy. But the surplus is very small, diffuse and a large area is required to support viable, resident populations of other organisms.

Nature Enforces Equity

Nature uses this small surplus in a qualitative way, by increasing diversity of habitats and niches that support a diverse variety of life forms. Their production is kept in check by a simple formula. Species with high metabolism may have large populations but their size is tiny and life cycle is short. Species with low metabolism may grow to a large size and have longer life but have small populations. Human beings are a species with low metabolism. If their life span grows long, their populations needs to be quite small, which should be able to use in an optimum manner a variety of habitats and niches. Development should be qualitative and not quantitative. Human technology should promote a varied habitat structure and not bring in uniformity. Mass production should be replaced by a variety of produce utilizing a variety of climates and micro-climates.

Loss of Diversity

Unfortunately economic development seems to be synonymous with uniformity of habitat and mass production. Less developed nations like India are being advised to attain a level of economic development roughly equivalent to that of developed nations before they can think of nature conservation. In the process habitat and species diversity are being sacrificed in the name of increasing production and creating employment. Search of alternative viable sources of energy is expected to achieve these objectives.

Additional Power for What?

Nobody is asking the pertinent question: why do we need additional power? Are we using the available energy economically and equitably? If additional power is available, what product mix will it help to produce? Will mofussil areas which experience acute power shortage today, get adequate power? Our experience in building dams to create additional irrigation and hydropower, is not very encouraging. The crop pattern visualized in the project stage never materializes. Instead a crop pattern driven by market forces, reflecting the demands of rich consumers, is established once additional irrigation potential becomes available. We need to rationalize the existing

distribution of power, reduce subsidies wherever they benefit only the urban areas and rich consumers, before large scale investments are made in alternative sources of power. The awareness should be widespread that the methods of power generation used today involve tremendous losses which are avoidable.

The key to solve persent problems is decentralisation, minimum transport and local generation to satisfy local wants!

Girish Abhyankar

An Example of a Soft Technology Machine

Girish Tractor
(Operator propelled but no drudgery)

The new vision in ecology of technology provides a lot of scope for creative design and development of technology which generates less entropy, which is designed for human energy and has less of an impact on nature. Let's call it 'soft technology!'

Here is an example of such soft technology machine, Girish Tractor, which is self propelled which means farmer can plough alone with no heavy physical efforts (drudgery) on his part.

Ploughing requires one of the largest hauling forces in agricultural operations, considered much beyond the human capacity. Hence, animal or fuel power is used for the same.

Girish Tractor is designed and developed to find solution to these problems in the following way:

Advantages

"Girish Tractor" proves to be very useful to small land holders or in hilly terrain for the following reasons:

- Low initial cost due to simple and light-weight construction,
- Easy manoeuverability due to small size, reaching corners and boundaries; increased width eliminates possibility of overturning.
- Little maintenance and long-life.

Principle of operation

Girish tractor converts vertical acting operator's self-weight force into a horizontal acting hauling force large enough for ploughing.

Operator stands on the rungs and his own weight forces the wheels to rotational motion. Traction is achieved since the rung at the lowest position bites into the soil. Maximum force, almost equal to weight of the operator, is exerted when the operator stands on the rung in the horizontal plane. When transferred to the ploughing tool through a trailing frame, this force is sufficient for hauling operations like ploughing. Operator's effort is like climbing a ladder, an action most natural, and strains no particular muscle.

Operational stages

1. Trailer wheel is lifted from the ground and locked to a height such that desired ploughing depth is reached. (Ploughing depth depends on the soil condition and self-weight of the operator). Operator stands on the other side and tugs/pulls a rung as shown. The tine plunges into soil as the tractor rolls until the normal hand pull is unable to move the tractor further.
2. One foot is then pushed against the appropriate rung. Further movement of the tractor depends on the foot pressure, soil, and the depth of the tine.
3. If no movement occurs, the operator climbs up the next rung. Tractor rolls onto him and he climbs on the next descending rung. Tractor continues to move backwards from the operator's viewpoint.
4. In case the tractor is stuck due to heavy load, operator leans backward so that much of the body weight is taken away from the axle and helps overcome the heavy load. If this happens more frequently lowering the trailer wheel will reduce the tine depth, decreasing the drag.

With little bit of practice, all the four stages of operation are performed in a smooth natural sequence.

Since the tine is constantly visible to the operator, root-clogs, large stones or clod, hollows and porous soil can be managed

intelligently.

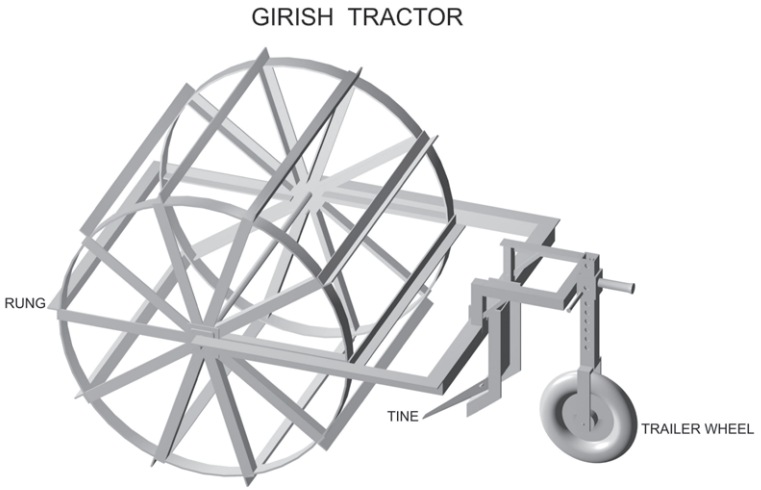
Various other implements like spades and ploughs can also be used.

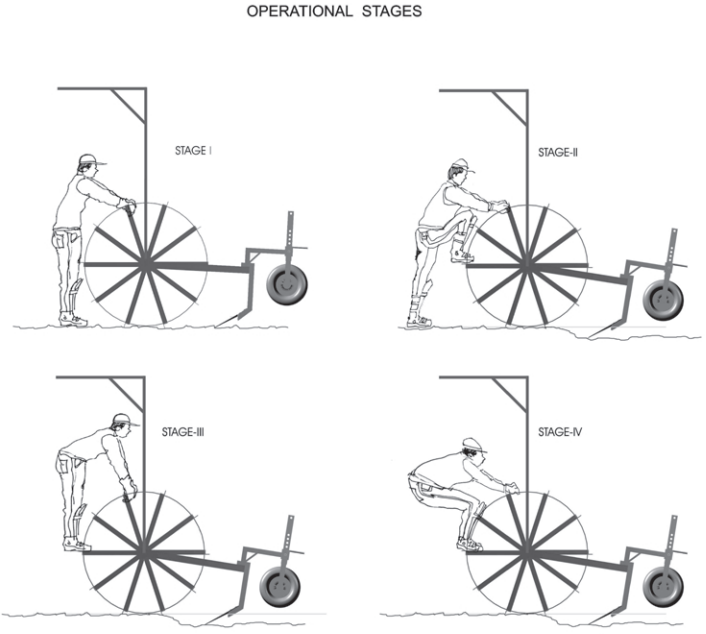
For idle movement or reversing, the tool is lifted above the ground level and trailer wheel lowered for rolling support.

6 meter per minute ploughing is possible for a normal operator weighing 60 kg and expending 60 watts of power.

Safety

Though ergonomically designed, it is recommended that one uses proper shoes, hand gloves and leg pads. Canopy for shelter is also possible.





It is important to note here that there is no mass scale production unit of this tractor. The objective is to provide a demonstration of soft technology which is easily replicable anywhere according to the local needs. Centralized production and distribution involves losses in energy and cost, which is avoided in the spread of soft technology.

There can be many more such examples which cater to self reliant, environment friendly alternative lifestyle. It is for the readers and users to keep the sensitivity alive for healthy, happy and self reliant life style which is less expensive, less exploitative and egalitarian.

Girish Abhyankar and Mrinalini Vanarase

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Ecological Society

In March 2007 Ecological Society completed 25 years of fruitful existence. To promote its triple objective of people-oriented research, holistic education and conservation and restoration of nature, the Society has carried out several projects useful to people and nature alike. These are :

1) An eco-development plan for river-fronts of Pune city.
2) An eco-development plan for the catchment area of Panshet Dam near Pune.
3) Restoration of forest in the catchment area of Panshet dam.
4) An all-India survey to investigate the ecological requirements of Sarus crane, a bird famous since the days of Ramayana.
5) Management plan for the Ujni reservoir — a man-made, tropical wetland east of Pune.
6) Restoration of Wetlands downstream of Panshet. Awarded Excellent Project Prize by Society for Ecological Restoration, U.S.A.
7) Grassland Restoration Project near Phaltan, District Satara.
8) Developing a management plan for Bhimashankar Wildlife Sanctuary, Maharashtra.
9) Conservation of Blacknecked Crane in Ladakh and Arunachal Pradesh.
10) Conservation of Siberian Crane in Bharatpur and Siberia.

Between 1989-2000 the Society conducted weeklong workshops on Environmental Aspects of Water Management for engineers of Irrigation Department, Government of Maharashtra.

Since 1998 the Society is conducting a one-year Certificate Course in Sustainable Management of Natural Resources and Nature Conservation.

The Society publishes an annual scientific journal which is now in its 21st year.

The Society conducts eco-school activities in villages around Pune.

To generate awareness about water conservation among villagers, the Society conducted a competition to improve village streams in which nine villages took part. Prizes were distributed to villages who did an excellent job.

The Holistic Point of View Recognizes the connection between the land and the sea; emphasizes intelligent management of local and regional vegetation and conservation of wild fauna.