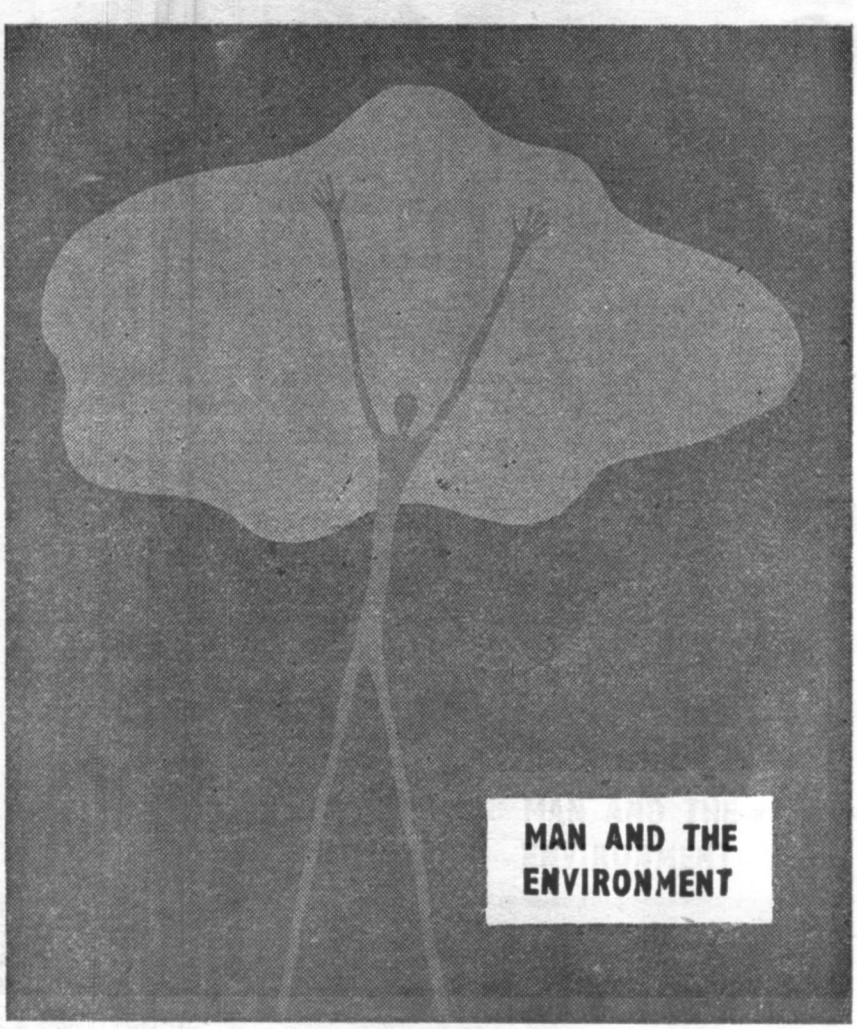


ENVIRONMENT

Environment—Surrounding; surrounding objects, region or circumstances —*The Concise Oxford Dictionary.*

The environment in relation to an individual means the sum total of that individual's reality, for today the physical as well as the cultural, is regarded the environment. It is also defined in terms of the participator or component of that environment. So we speak of the environment of mind as easily as of the environment of a forest. The environment is thus seen as a complex, dynamic process which gains subjective reality only on the defining of its parameters.

As biological entities we can define our natural environment as the 'biosphere' or that region of the planet that can support life, or on a more local scale our environment can be defined as our Island.

The study of the interactions between the participator and the environment is termed Ecology. Arising from the Greek root *Okios* a 'house' and *logy* 'the study of', it attempts to take into consideration as many of the interactions between the participator and the environment.

The environment can be benign or hostile in relation to the participant. Thus it is possible to use the human values of "good" and "bad" when assessing the net effect of an environment on its participants.

This view is open to question as being vulnerable to subjectivity but is only so when considered from an individual assessment. However, there are objective methods that are relatively independent of individual values and such perspectives are useful when defining as "good" or "bad" environment for a group.

In order to achieve this the human must be considered from two fundamental, but related, perspectives. (1) human beings are biological entities responding to the same physical/chemical laws that all biological organisms respond to and (2) human beings are also socio-cultural entities.

A concrete illustration of this point, where the natural processes and ecosystem were upset by human interference is clearly seen in this example as recounted in the *Natural History* Magazine. In a village in Borneo health workers sprayed the walls of the villagers' huts with DDT in order to control the mosquitoes that spread the malaria parasite. However, the lizards that patrol the walls of the huts inevitably absorbed large quantities of DDT, both from contact with the sprayed walls and from eating poisoned prey and they died. This had the unfortunate effect of killing the cats that ate the moribund and the now poisonous lizards, leaving the straw-loving caterpillars (hithe to kept in check by the lizards) that inhabited the thatched roof free to gorge without limit. The end result was a plague of rats and destruction of the roofs of the villagers huts.

Still another example can be drawn from the case of Brazil where it has now been realised that it is not all that easy to reverse the natural order whereby converting its two million square miles of Amazonian forests into what planners dreamt could become thriving cattle ranches and farms. (See Box on page 5). While Brazil's colonisation programme of settling one million families alongside the trans-Amazon highway has been abandoned (not more than 6000 families were officially settled) the authorities have at last grown alive to the potential dangers of this policy. Nearly half of this dense forest cover of 2 million square miles has now been declared ecological and forest reserves and natural parks. The signals of the damage done so far appear alarming indeed, with fears that "injection of carbon dioxide

into the planet's atmosphere would increase by at least 8 percent as a result".

Now an objective grading of the environment (good or bad) can be approached. For the biological being, the environment that produces more of the necessities of biological life (measurable by criteria such as physical well-being, nutrition, etc.) would be better than that which produced less. For the socio-cultural being the environment that produces a more benign social atmosphere (measureable by criteria such as crime, suicide, contentment etc.) would be better than one that produced a more hostile social atmosphere. Although any absolute grading that meets with unanimous concern may not exist we can determine an environment that would create an atmosphere relatively free of negative criteria, corresponding to some social norm.

In recent years this grading of the human environment has been attempted by many workers. To achieve some degree of objectivity they have been presented as indices. The PQLI. and NEW are some examples. All these attempts incorporate a fundamental ecological principle: the inter-relatedness of process (see Box below).

Carbon dioxide returns to the atmosphere or is absorbed by water bodies like the ocean; much of the water is again evaporated and comes back as rain, while the energy is let into space. Energy lost in this manner is always replenished by that never ending source—the sun. Most of the others are used again or recycled at some stage or other. There is therefore a close inter-relationship between those that have life, like plants and animals, with those that do not, like carbon dioxide, water, oxygen etc., and that all these form part of a system or process. Such a system is called an Ecosystem or an Ecological System. An important process going on in any ecosystem is the flow of energy.

Another question which occurs in this connection is "what is a natural ecosystem?" or perhaps "what is an unnatural ecosystem"? Is the Beira Lake in Colombo or the city of Colombo itself a natural ecosystem, or has it somehow been rendered unnatural, or at least improved? Is the Ruhunu National Park, managed for recreational and aesthetic objectives, a natural ecosystem? Does the very act of management render an ecosystem unnatural. Thus, natural resources available to man, are intimately connected with ecological considerations.

Natural Resources

A natural resource ecosystem has been described as an integrated ecological system, one element of which is a product of direct or indirect use to man. The produce may be biological as in the case of forests, grasslands, agricultural products, fish and wild life; physical, as in the case of water, air and soil or both. In all cases, the distinguishing fact, of a natural resource ecosystem, is that man has a direct involvement in the complex set of ecological interactions.

'Man has a direct involvement' and that is a point that should be emphasised; that no ecosystem, natural or unnatural, can escape from this involvement.

A natural resource might be defined as anything found by man in his natural environment that he may in some way utilize for his own benefit. Natural resources thus include minerals, fossil fuels, and radio-active energy sources, water and soil, as well as the native vegetation and indigenous wild life. It also includes the land and landscape, the atmosphere, the ocean and solar energy. They might be classified as non-renewable or fund resources and renewable or flow resources. Renewable resources include water, soil and vegetation and non-renewable as fossil fuels, minerals and radio-active energy sources. Natural sources might also be classified into marketable products—coal, timber, fish etc. or amenities such as harbours, waterfalls or scientific and aesthetic values which are not marketable in the accepted sense.

The resources listed above might be considered "natural" if they are provided by nature in the place where they are or may be used or put into useful form. In these terms we might classify a Dry Zone forest of the palu (*Manilkara bexandra*), wira (*drypetes sepiaria*), burutha (*Chloroxylon swietenia*) and Kaluwara (*Diospyros ebenum*) trees as a "natural" ecosystem and a teak plantation on cleared Dry Zone forests as an "unnatural" one. In practice, the distinction becomes academic, it is difficult to identify the point at which this condition of being "natural" ceases to exist, and many would think of a teak plantation as a way of managing what is basically a natural ecosystem.

The concept of what constitutes a natural resource or a natural resource ecosystem varies according to man's capacities, interests and objectives. The concept is a dynamic one that changes with the needs of man, the state of his technology, and the choices he is prepared to make in order to achieve his aims. Two hundred years ago, coffee plants which grew wild in the Kandyan Hills, were not used for the preparation of a beverage from its beans, but only its tender leaves made into curries, and its delicate jasmine-like flowers for ornamenting temples and shrines. Similarly, the apatite ores found at Eppawala, which are a good source of natural phosphate fertilizer were unknown till about 10 years ago and hence were insignificant natural resources. If there were any Sri Lankans, still living in the twenty-fifth century they will possibly consider the mud dug from the Beira Lake as a valuable

The Physical Quality of Life Index (PQLI)

The PQLI takes into account human factors such as health and educational factors in a society as well as the factors referred to in the GNP. However even this index suffers from a lack of accounting for the values and relations within a society.—The realization of rights to freedom, justice, truth, culture, participation and sharing.

Nett Economic Worth (NEW)

Where the 'bads' such as pollution costs, environment maintenance as well as the 'goods' such as manufactured products etc. are computed. In such an index maintenance work too is included. The GNP for most nations including the US has been rising but the NEW has levelled off. Indicating that the real economic situation has not been improved by an ever larger production of goods — Nordleaus & Jukim, 1972.

natural fertilizer resource, or the rubble that was once the Colombo Fort a useful natural resource of building material.

Pollution in terms of the environment is to add to any system substance or processes that change the nature of the system. Pollution is caused when a change in physical, chemical or biological conditions in the environment harmfully affects the quality of human life, including effects on other animals and plants, industries, and cultural and aesthetic assets. Most pollution may be characterized as a production excess resulting from manufacturing or growing more than is to be consumed or as a result of discarding products after use. Though pollution is generally attributed to material substances (gases and particulate matter from smokestacks, chemicals in water or solid wastes, paper, glass used machinery and motor vehicles) pollution may also be non-material such as an excess of noise and lights. Pollution in all its forms is a more serious problem in the heavily industrialized areas of the world than it is in predominantly agricultural regions. In most cases the effects of pollution are detrimental to the system. The fact that all processes are interrelated to some degree in the environment makes the assessment of the impact of pollution most important. Pollution then, is equated with the 'bads' in environmental assessment.

The production of pollutants are not confined to man's systems only. Pollutants are often produced in natural ecosystems but these are 'treated' by nature. In other words nature recycles and renders less harmful these pollutants in her natural process. Man has consistently used nature to treat his pollution too. A favourite dictum among industrialists was "The solution to pollution is dilution". However, the sheer volume of man's poisons and the fact of Biological Magnification has shown this dictum to be grossly naive. (See Box on page 6.)

Industrial Pollution

Environment pollution has become a major issue, on a global scale, only in recent years. The types of pollution are many and the action of pollutants on the environment vary from the obvious to the subtle. The fact to be faced is that this phenomenon is a by-product of the development and maintenance of the modern industrial civilization and it poses a serious threat to human existence on our planet.

Industrial pollution is one of the most visible, and once established, one of the hardest to control. This is due to the economic stance (maximization of profits) that industry is based on. The pollutants that are emitted from a factory are considered "waste" and is ejected from the process as fast as it is produced, for an accumulation of waste impedes growth and production. The waste is got rid of in the most economically expedient manner. Often, the finished product is costed so that to "treat' or install machinery to 'treat' the waste will increase or even over price the product. Secondly, the costs of 'treating' the pollutants are increasing with the cost of energy; thus there will be a point in some industries' lives where pollution control has to be abandoned or the levels of pollutants increased to

SPARE THAT TREE

An almost complete reversal of Brazil's policy of "opening up" the country's share of the 2m-square mile Amazon forest is being urged by a government-appointed committee. The committee's report recommends that no more forest land should be leased to companies, and that about 600,000 square miles should be designated as national parks and ecological reserves and 300,000 square miles as national forests.

Although powerful interests will oppose this drastic change of policy, it is likely to have strong support from President Figueiredo. He lost no time in setting up the forest policy committee when he took office in March, and since then he has created three new national parks in the Amazon region. Previous Brazilian governments' ambitious attempts to open up the forest led to spectacular failures, primarily because the belief that the soil was prodigiously fertile has proved to be false.

The Amazon tributaries have been found to be almost as pure as distilled water, showing that the soil of the region contains hardly any nutrients for plants. The exuberant vegetation is produced by a closed system of recycling, the nutrients from decaying vegetation being reabsorbed into the tree roots without creating a deep fertile topsoil. Up to half the rainfall is provided by evaporation from the tropical forest itself.

So neither cattle ranches nor small farms have prospered. Between 1966 and 1976 the official Amazon development agency, Sudam, approved the setting up (mainly by businessmen from Sao Paulo) of 354 ranches with an average size of 50,000 acres. Fortunes were made from the lavish tax rebates granted to the cattle companies. But many of them have found that the African grasses they planted on the cleared forest land grew less well after the first few years, and that they faced huge outlays on fertiliser and on remedies for soil leaching and poisonous weeds.

Sudam itself has become alarmed at the harmful impact of the process it initiated. It has approved only four new cattle projects since 1976. In 1976, too, the government abandoned the colonisation programme that was to have settled 1 m families alongside the 3,000-mile Trans Amazon highway, built in 1970. Only about 6,000 families had moved into the region as official settlers. However, hundreds of thousands of unofficial ones have swarmed in along the new road, squatting on virgin forest land held by absentee landowners. Only a few of the consequent conflicts were reported in the press, but hundreds of squatters have been killed while resisting eviction and many thousands had to leave.

It is estimated that about a tenth of Brazil's Amazon forest has already been cut down, and that destruction is still occurring at a rate of about 400 square miles a year. The unprecedented six-week drought in Manaus this year was probably the first sign of climatic change caused by the clearing of forest near that town. The destruction of the greater part of the world's biggest remaining area of tropical forest would not only transform the local climate but also affect that of the whole planet, by leading to a massive injection of carbon doixide into the atmosphere. It has been calculated that, after allowing for half of this carbon dioxide to be absorbed by the oceans, the world total would increase by at least 8%. This would be additional to the rise of about 16% caused during the past century by the destruction of forests and the burning of coal and oil.

A Special Correspondent,
The Economist, December 8, 1979.

BIOLOGICAL MAGNIFICATION

Biological magnification refers to a concentration of substances along food chains. It is also referred to as Pesticide Accumulation. When one animal eats another it absorbs and retains a percentage of the substance being concentrated in its own body. Thus the more food it eats the more of the substance it concentrates in its body. In the case of poison, the concentration at the time of application may be small; but by the time it has reached an animal along the food chain the concentration may be dangerous. Some chemicals like DDT may be absorbed by the skin in addition to infection by food.

The table below indicates measurements made on the concentrations of certain pesticides and radioactive materials along the food chain. However, the effects are subtle and often sub-lethal; thus people are not immediately aware of the effects.

DDT		Radioactive Phosphorous (32p)		Radioactive Strontium (80 Sr)	
Water ...	1	Water ...	1	Water ...	1
Plankton ...	800	Insects ...	3	Sediments ...	200
Minnows ...	11,600	Swallows ...	75,000	Water plants	300
Big fish ...	34,600	Duck Eggs	200,000	Minnows ...	1,000
Fish-eating birds ...	92,000			Large fish ...	3,000
				Mammals ...	3,900

Concentration factors (Ratio amount in organisms to amount in environment

maintain the profits. The action of the pollutants on the environment however will remain the same and will worsen with continued additions

Industrial pollution can be defined in two broad categories, primary and secondary. In primary industrial pollution the pollutants affect the human directly. This is seen in the case of lead poisoning; it is effected by injection. If eaten in food about 10 percent of it will enter the bloodstream but if inhaled, upto 50 percent may be absorbed. It has been demonstrated to be absorbent in a greater capacity in women and children. J. A. Miller reporting in the British Medical Journal *Lancet* states "even modest elevations of blood-lead may be associated with biochemical abnormalities in the human brain." In Sri Lanka the sum total of primary pollutants have not yet been assessed. In the absence of a concentration of vast industrial complexes in this country it is a matter of conjecture whether the concentration of toxic substances and gases exceed the limits and impair the health of the people. But, it is certainly not too early to begin monitoring the atmosphere for pollution.

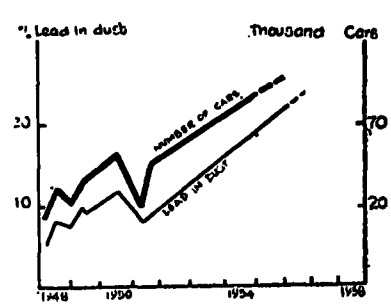
The cases of lead poisoning in the industrial areas and generally by battery manufacturers are now commonplace. However. one aspect of lead that is quite often unnoticed is the lead in air. This lead usually comes from car emissions. Lead is added to our petrol supply as an anti-knock agent. The amount per gallon is infinitesimally small but the volume of petrol being used quickly brings this figure up. In Switzerland measurements were kept of the amount of lead in the city dust and it was found that there is a strong correlation between the number of vehicles in use and the concentration of lead in dust (see figure.) Thus in present society motor cars add greatly to the reservoir of lead as a primary industrial pollutant.

The secondary effects of industrial pollution are more subtle and often far longer-reaching than the primary effects. Chemicals that are considered 'safe' have been known to act synergistically with other chemicals or micro-organisms to produce extremely dangerous toxins. The case of mercury poisoning in the Minimata Bay in Japan is a good example. Another aspect of secondary industrial pollution is when biological concentration is considered. A toxin released into the environment in relatively low concentrations, can be picked up and concentrated to a level dangerous to humans by a plant or organism which is eaten by humans. There are many instances where the effluents of the batik and other textile industries are allowed to flow freely into drains, streams and rivers. One probe some time ago regarding the Wellawatte Canal, revealed it was being polluted not only by industrial wastes, but also by dumping untreated sewage by the CMC and faecal pollution by all those persons who had converted it into a public convenience. The tanneries along the Kelani and the Petroleum Corporation dump much of their affluents either directly into or into the vicinity of the Kelani river. The high concentration of toxic heavy metals in the vegetables (keera) grown in the adjoining swamp lands is the result. The keera produced here is eaten by the residents of Colombo City.

Food Contamination and Chemical Control

Industrial waste has never been monitored systematically or controlled in Sri Lanka. A recent study conducted by the Division of Occupational Hygiene of the Department of Health indicates a concentration at 200 PPM, an alarmingly large figure, when they tested the Keera (green leafy vegetables) from fields around the Kelani river. The source of the chromium was found to be the tanneries upstream of the vegetable growing area. The effluents of these tanneries were dumped, untreated, into a convenient paddy field or marsh which would drain into the Kelani river. The diluted chromium would be picked up, to be biologically magnified in the Keera fields further downstream.

The same study indicated that the levels of pesticides and insecticides in Keera far exceeded W.H.O. standards for human health. It is unfortunate that there exist no specific standards in Sri Lanka to regulate the amount of pesticides and heavy metal containments in the food sold



Lead in dust

ECOLOGICAL IMPERIALISM

In the short run, growing environmental pressures and restrictions in the developed countries will probably result in the export of polluting industries to some of the less industrialized LDC's (Less Developed Countries) who will for the most part be delighted to accept ecological degradation along with economic benefits. However, only a few favoured countries will benefit significantly. Moreover, without continued growth in the now industrialized nations, the growth prospects of the Third World are dim; our growth is essential to their's (Boseru 1975, Quigg 1974). Thus, although the basic rich-poor polarization will be moderated by many complex interdependencies, there is no escaping the basic opposition of interests created by ecological scarcity.

TABLE 1

DDT Concentration Factors
(Ratio amounts in organisms to amount in the environment)

Water	... ...	1
Plankton	... ...	800
Minnows (small fish)	...	11,600
Predatory fish	...	34,800
Fish-eating birds	...	92,000

(From Woodwell, Wurster and Isaacson, *Science*, 1967).

Because predatory birds are being wiped out by DDT and man himself is threatened (he cannot escape being part of the food chains). society has been forced to consider reducing, or banning outright, this pesticide that was once heralded as the solution to all insect pest problems". (*Odum*, 1913).

in this country, though testing of samples is carried out occasionally by the Standards Bureau and other institutions.

The contamination of 'Keera' is particularly cruel in the fact that 'Keera' is the cheapest vegetable to be found on the market and forms a staple in the diet of the poorer classes in the city. It is fed to children in various forms of preparation for its nutritive value.

Keera, however, is not alone as contaminated food. In a random sample of some food, prepared and unprepared, tested by the City Analyst of the Public Health Department of the Colombo Municipality it was found that some vegetables of the fruit type (i.e. chillies, brinjals etc.) and some pulses (i.e. green gram and cowpea) contained insecticide residues. The prepared foods indicated containments introduced in the manufactory process as in consensed milk (Table 2). One of the most irresponsible containment sources detected by this Department was the sweet and cordial production industry. For instance, a food dye called Metanil yellow, proven to cause cancer has been found in popsicles, boiled sweets and cordials.

TABLE 2

Results of tests on four random samples of condensed milk (local).

Sample No.	*Concentration of tin*
1 ...	750 parts per million
2 ...	600 parts per million
3 ...	1000 parts per million
4 ...	700 parts per million

The allowed amount of tin (sn) by the British Standards Act is 250 parts per million

PVC or Polyvinylchloride is a ubiquitous chemical in modern society. It is used in records, insulation for cables, floor coverings, furniture, hosepipes etc. But as vinylchloride, the monomer from which PVC is made, it is extremely toxic. The story of the research done on the toxicity of vinylchloride and the secrecy that the chemical companies cloaked the results in, emphasises their philosophy of "Profits before People".

In May of 1970 a toxicologist named Pierlugi Viola presented a paper where he reported the formation of tumors in rats given larger doses of vinylchloride. As a result of this work, Cesare Maltoni of the Bologna Cancer Institute was commissioned by a consortium of Europe's leading chemical companies to repeat and extend Viola's research.

By the end of 1972 Maltoni concluded that Viola was right; Vinylchloride did produce cancer. He also demonstrated that Vinylchloride was toxic at far smaller doses than Viola first reported. In October 1972 the Manufacturing Chemists Association (MCA) of the U.S. joined the consortium sponsoring Maltoni's work but no mention was made of Maltoni's work or that vinylchloride was proven to cause cancer in the liver and kidneys of people and animals exposed to it.

It was not until the end of January 1974 that the MCA released Maltoni's data. This event was precipitated when a physician named John Creech announced that he had found four cases of a rare liver cancer among Vinylchloride workers. Since then over 40 workers in Vinylchloride are known to have died from this rare cancer.

Referring to this problem of increasing untested chemicals, Gus Speth, the Chairman of the Toxic Substance Strategy Committee says "we can't wait around for people to start dropping". He also notes that between 20-38 per cent of all cancers can be correlated with occupational exposure to these carcinogens.

The E.E.C.'s Sixth Amendment requires all companies that want to market new chemicals to assess the effects of their products on the environment and on human health *before* they are made. It has been acclaimed as one of the most far-reaching social reforms enacted by the European Communities Council of Ministers. What the amendment means is that the long, irresponsible, spree of the chemical industry has come to a halt.

The quantity of man-made organic chemicals that are manufactured is large. It grew from 7 million tonnes in 1950 to 63 million tonnes in 1970. Today over 30,000 different chemicals are produced in quantities over one tonne a year. Scientists have long suspected about 1,000 of them as causing cancer. The present trend of industry means an ever-increasing number of chemicals the average Sri Lankan would be exposed to.

Sri Lanka has fortunately been spared the horror that has gripped so many countries during the last decade, the horror of a disaster involving a chemical industry. Seveso, Louisville, Michigan, Camden and Bridesburg are just some names of towns that were virtually crippled by chemical disasters. In many cases the losses involved family as well as property.

The greatest danger from this flood of man-made organic chemicals comes from the fact that many are sublethal and often carcinogenic. This means that the chemical lowers the vitality of the victim and in the case of carcinogens, the symptoms of cancer sometimes occur decades after the victim has injested the chemical.

Another Third World Disease

The publication of the International Research Centre on Environment and Development in its monthly issue of March 1979 drew specific attention to the dangers to the Third World countries from the chemicals in pesticides. Reproducing a paper from Anil Agrawal under the title "Pesticide Poisoning-Another Third World Disease" it stated;

"An estimated 500,000 people throughout the world are killed or incapacitated by insecticide poisoning every year, though no detailed statistics are available The WHO Expert Committee on the Safe Use of Pesticides, which met recently in Geneva, strongly recommended that developing countries should start setting up national control agencies for registering pesticides as a priority. These agencies should not only register pesticides but also evaluate the nation's needs for new ones and control their introduction. The WHO committee also stressed the importance of health education by well-trained personnel who will go out into the field to instruct farmers in choosing pesticides, storing them and using them safely.

Most peasants and health workers continue to use replacements for DDT in the same way as they used DDT. They still make chemical solutions with their hands and carry bucketsfull of pesticides on their heads. Changing such habits will take a long time, given the difficult administrative conditions in these countries.

The Third World can also expect some very nasty surprises with pesticides. Another WHO committee—its Expert Committee on Vector Biology and Control—has just reported the full details of the 1976 poisoning disaster in Pakistan with malathion, a pesticide that is considered relatively safe (*Chemistry and Specifications of Pesticides*, Technical Report Series No. 620). More than 2500 malaria field workers were poisoned and five of them died. Some time elapsed before the pesticide was linked to the illness and many workers, in fear of losing their jobs, just kept on working. The incident was caused largely by failure to use even elementary precautions during handling and spraying. This shows, says WHO, that poor handling will occasionally occur in large-scale vector control programmes in developing countries, despite clear directions and package labels.

Further investigations of the pesticide samples from Pakistan, however, revealed that their toxicity has increased considerably in recent years. Organophosphorus impurities in malathion can increase its toxicity to exceptionally high levels by inhibiting enzymes in the human body which normally break down, and thus detoxify, malathion. This has been known for 20 years, but, until the Pakistan incident, the impurities were never considered of critical importance to man.

Now WHO investigations have revealed that the concentrations of these impurities

POLLUTION AND HEALTH

Some of the industries that could cause pollution of the atmosphere and water in this country are—Paper, Agro-Chemicals, Cement, Petroleum, Leather Ceramics, Textiles, Rubber, Rice and Saw Mills, Construction Industry, Asbestos and Chemical factories, states the report on "Environmental Management in Sri Lanka".

It is reported that there are three ways by which toxic substances may enter the human body, namely by ingestion, absorption through the skin and by inhalation. It is also reported that the majority of occupational diseases is caused by inhalation as it affords rapid intake of contaminants by the body.

The following table details out some of the agents or pollutants in air and on land and their possible effect on the health of human beings.

Agents or Pollutants in Air	*Possible Effect on Human Health*
Oxides of sulphur in combination with airborne particles (smoke)	Aggravation of existing respiratory diseases and contribution to their development, impairment of lung function, sensory irritation.
Airborne particles	Increase in the effects of gaseous pollutants such as sulphur dioxide, possible toxic effects depending on chemical coimposition (e.g. particles containing lead or asbestos).
Oxidants including ozone	Eye irritation, possible association with asthmatic attacks; impairment of lung function in diseased persons.
Carbon mónoxide	By combining with haemoglobin deprives tissues of oxygen; individuals suffering from cardio-respiratory disease are more sensitive; psycho-physiological effects possible even at low concentrations; smoking is an important source, perhaps more significant than exposure to motor vehicle exhausts.
Lead	Intake through water, air and food enhances the total body burden of this element; in excessive amounts it may develop poisoning.
Asbestos	A possible factor in the incidence of lung diseases along with other air pollutants and smoking—pleural calcification observed also in non-occupational exposure.

Agent or Pollutant in Land	*Possible Effect on Human Health*
Human excreta	Schistosomiasis, taeniasis, hookworm and other infections.
Sewage	Urban filariasis, flies and other disease vectors.
Garbage and vectors inhabiting it	Rodent-borne disease, pollution of water and air from disposal practices.
Industrial and radioactive waste	Effects from stored toxic metals and other substances through food chains.
Pesticides	Contamination of vegetation and secondary foodstuffs and entry into food chain.

can increase several-fold during shipping and storage in tropical countries. Isomalathion (formed by the isomerisation of malathion) has become a major toxicity amplifier in the Pakistan samples. Surveys conducted by WHO in other parts of Asia also revealed samples from Sri Lanka and Nepal that were too toxic to be sprayed indoors. Samples from Indonesia had very low safety margins. WHO has now set the highest acceptable value of isomalathion as 1.8 per cent of the nominal malathion content.

Similar toxicity-boosting mechanisms may not occur in other pesticides because of their different chemical structure. But increases in the use of pesticides in public health and agriculture could increase the danger of toxic effects. The patents of several important pesticides such as malathion has expired —or are about to. This will permit Third World countries to begin to manufacture and formulate these pesticides locally. Dependable quality control systems will then become even more important.

While some international organisations believe that Third World countries should proceed with pesticide manufacture and formulation, others are not yet convinced that this is advisable. Good quality control by Third World governments is necessary even if they don't manufacture pesticides, because even pesticides imported from reputable Western manufacturers could turn out to be of low grade. WHO says all the European manufacturers that supplied malathion to Pakistan gave their full cooperation in investigating the increased toxicity of the pesticide. But the Sri Lanka anti-malaria campaign office is currently facing litigation by a French firm for refusing to accept supplies of malathion which Sri Lankan officials felt were substandard.

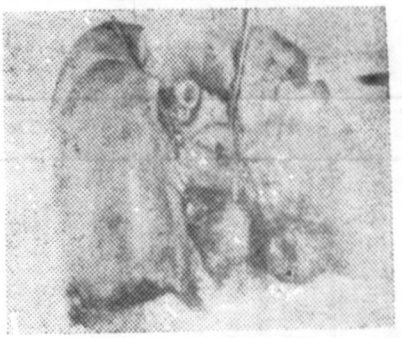
Apparently, the WHO and other international organisations have shown great concern about the danger of the toxicity of malathion though Health Authorities in Sri Lanka needed much prodding before they ceased to store their stocks of malathion in the heart of a highly residential area in Colombo and in the immediate vicinity of the country's premier hospital and medical institution.

Air Pollution

Air pollution in Sri Lanka is partly a consequence of the Industrial complexes with unchecked emissions, but it is more (especially in the cities) a consequence of vehicular traffic. The first effect of vehicular traffic is dust. It is estimated that every breath carried about 40,000 particles of dust in open clear countryside. In the city, particularly where vehicular traffic has a high flow, the number of dust particles carried in each breath is estimated to be over 80,000. In addition, the operation of 120,000 vehicles (approximate vehicular population of Colombo) will add 200–350 tons of carbon monoxide, 20–50 tons of hydrocarbons and 10–20 tons of nitrogen oxides daily.

Today, air pollution from vehicular traffic especially exhausts of cars, buses, lorries and other internal combustion engines is taking its toll not only on human health but also on the ancient treasures. Many of the 'ruins' of the ancient civilizations of Sri Lanka are showing effects of chemical erosion. There exists a strong correlation between this damage and the accessibility to buses and other vehicular traffic. A similar problem is faced by India where the Taj Mahal stands in danger of being eroded by air pollution.

The oxides of nitrogen are particularly harmful to the lungs. They contribute to an increase in respiratory diseases and cancer in urban populations. When the incidence of lung disease, especially in children are looked at an omnious pattern emerges. The greatest concentration of the affected children are either urban or live near major roads or factories.



A healthy lung (top) and a diseased lung (bottom). Cigarettes and air pollution alike shrink our lungs, color them black, and and shorten our lives. (R. J. Henning, St. Vincent's Hospital), *Courtesy "Problems of American Society air and Water Pollution"*. Washington Square Press.

To watch a two or three year old fighting for breath, then walk onto the road to be met by a cloud of exhaust emissions that makes one cough and to be aware of the real damages of air pollution is a sobering experience. The oxides of nitrogen further combine with the hydrocarbons and other pollutants under the force of sunlight to produce a synergism. (See box) This is the infamous photochemical smog of

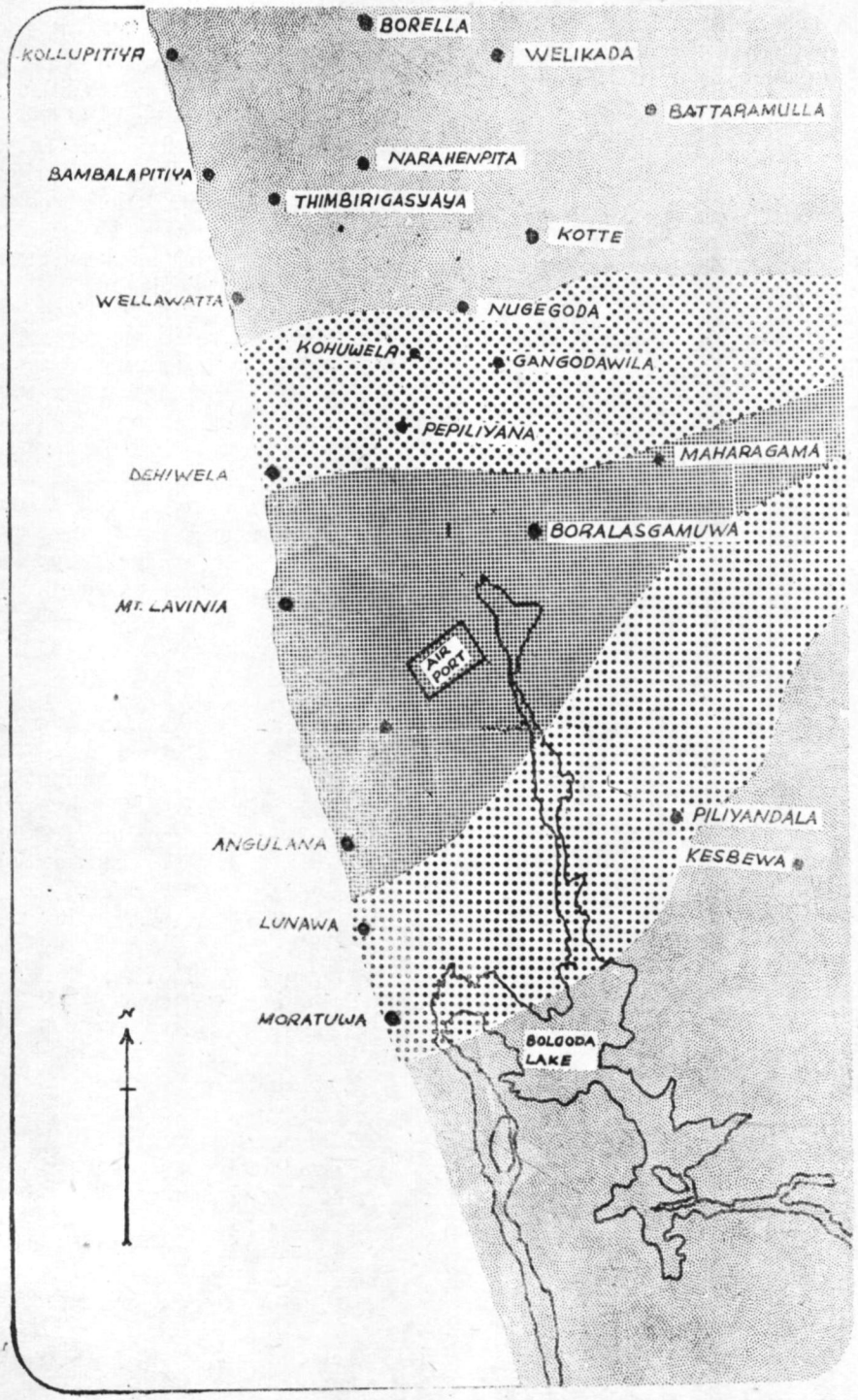
SYNERGISM

When two or more substances react so that the total effect of the interaction exceeds the sum of the effects of each substance. Some examples are the oxides of nitrogen from car exhausts, these by themselves are harmful to the lungs causing respiratory disease, cancer etc. but they combine with hydrocarbons and other pollutants when activated by sunlight to form photochemical smog. Another example of synergism is the way in which relatively safe inorganic mercury was changed by microbial action into the much more deadly organic form. It was this fact that led to the disaster at Minnamata.

The lungs possess the ability to clean themselves of dangerous particulate matter such as asbestos. This is done by an ever moving sheet of mucus propelled by the cells of the lungs. Smoking or inhaling sulphur dioxide interferes with this function and increases the danger of cancerous growths being initiated in the lungs by dangerous particulate matter.

The liver is the organ that is responsible for the detoxifying (rendering harmless) many of the poisons that affect the body. It does this by producing enzymes (chemical components) that detoxify the poisons. Each poison is detoxified by a different enzyme. This is why some commonly used poisons, are found to be relatively 'safe' for humans. We possess an enzyme that detoxifies it efficiently at low dosages. Enzymes are produced within the cells; but often, there are substances which inhibit or block the mechanism of the cell that makes the enzyme. So, if an individual is exposed to a chemical that inhibits the production of the enzyme that detoxifies a specific poison he will not be immune to that poison even though he might have been before exposure to the chemical inhabitor.

that could affect them was plotted out (Fig. 2). The picture that emerges is very uncomfortable. The re-opening of Ratmalana for jet aircraft would affect the area from Dehiwala in the North to Lunawa in the South, including areas like Pepiliyana, Maharagama and Boralesgamuwa.



Noise Pollution that will result in opening of Ratmalana Airport to international air traffic. The estimated noise levels can be demarcated as follows:

Zone 1: Zone where the noise levels will permanently affect the human nervous systems.

Zone 2: Zone where the noise levels will constitute a nuisance or disturbance.

Zone 3: Zone relatively free from negative effects.

MONITORING POLLUTION

It has been clearly established that rapid urbanisation together with advances in modern technology and increasing economic and social pressures are resulting in the chemical, biological and radiological contamination of land, air, food and water; destruction of natural resources; harmful physical agents like noise and radiation and complexity of environmental changes that challenge man's adaptive ability.

In these circumstances monitoring of contamination of the environment has become a matter of urgency. Collection of solid or liquid samples (e.g. food or water) is fairly straight forward. However, the collection of a sample of an air-borne contaminant, that may adversely affect a person by being inhaled, absorbed through the respiratory system or skin, or ingested by contaminating food, hands and other objects involves the the scientific discipline of Environmental Hygiene.

The Committee on Environmental Management in Sri Lanka reported that "Air sampling instruments used in environmental monitoring have to be especially designed to suit various situations. Most of these instruments are very expensive. The Occupational Hygiene Laboratory of the Department of Labour is fairly well-equipped with air sampling instruments as well as instruments used to assess harmful physical agents in work-places. These instruments, used for sampling the atmosphere of work-places, could be used for monitoring the total environment with little or no modification as the scientific principles involved in Occupational Hygiene and Environmental Control are the same.

Both physical and chemical methods are used in the analysis of air samples collected. However, some physical methods, such as dust counting are outside the scope of other laboratories. Facilities for chemical analysis are available in other laboratories namely: the Government Analysts Geological Survey, Drug Quality Control Laboratory and Medical Research Institute".

Ocean Pollution

Pollution of the oceans has become a major problem, on an international scale, and more recently a crucial issue for Sri Lanka too with proposals to set up a giant offshore oil storage complex. A team of experts drawn from the Ministry of Fisheries, Petroleum Corporation and Port Authority is now examining this project further after the Cabinet sub-committee appointed for this purpose decided to refer it recently to a technical committee. These further investigations are being carried out following reports that the proposed complex may cause serious ecological problems if adequate precautionary measures are not taken and also speculation that the risks involved

from possible damage are far greater than the benefits that could accrue to this country.

It has been established that the oceans, which cover more than 70 per cent of the Earth are a critical element in maintaining the world's environment, are the final receptacle for many wastes. Most wastes sink to the bottom, but solid wastes, oil, and garbage contain many floatable materials that are carried great distances by currents and winds. Pollution affects marine life directly through toxicity, which kills some plants and animals and causes reproductive failure in others; it also causes oxygen depletion, biostimulation, and economic losses in shellfish, fishing and recreation industries.

The Island's beaches and the coastal waters are not merely sources of recreation. They are also the means of livelihood for the local population, particularly ma-del fishing and employment in ocean-based recreational activities. It is estimated that nearly 30 percent of the Island's catch of fish is from ma-del fishing. Beach and coastal water pollution in Sri Lanka are caused mainly by faecal pollution, waste water pollution, industrial pollution and oil pollution. An official Committee on Environmental Management which examined this subject, in collaboration with the National Science Council of Sri Lanka, made a case study of the Hikkaduwa area where it found that the two major sources of oil pollution of the beaches have been: Dumping of waste oil at a distance from the coast; and Dumping of waste oil by fishing boats even within the bay enclosed by the reef at Hikkaduwa. The Committee reported that "it would be difficult to prevent the dumping of waste oil at a distance from the coast. Although a harbour has been built at Hikkaduwa, a number of mechanised fishing boats are anchored in the bay enclosed by the reef", though this in itself was regarded as an environmental hazard.

A large amount of waste oil which pollutes both the sea and the beach, is dumped by these boats into the bay. In addition to the oil being a nuisance to the people using the beach or bathing in the sea, the oil is bound to affect the flora and fauna which include the coral, fish and seaweeds of this area. If this menace is not stopped immediately, stressed the Committee, Hikkaduwa could lose many attractive features.

Although there are International Conventions on Pollution of the Sea, their implementation is more followed in the breach. It has been found that still a prominent source of ocean pollution comes from large oil spills, some of which have killed marine birds and plants, left layers of encrusted oil along shores and have cost large sums to clean up. Such spills while concentrated and disastrous, account for less than 20 percent of the large amounts of oil that man introduces directly into the world's waters every year. Most of the chronic pollution originates from the normal tank cleaning at sea of oil carrying tankers, from normal operations of refineries and petrochemical plants, and by fallout of airborne hydrocarbons emitted by motor vehicles and industries. The danger of large-scale accidents increases, however, with the steadily increasing size of tankers: 300,000 ton ships are already in operation, and plans for 800,000 ton tankers have been projected. A single spill from one of the new large tankers could add 20 percent to the amount of petroleum entering the oceans in a single year.

A further preventive measure in this direction in Sri Lanka is that a Coastal Conservation Authority has been set up under the Ministry of Fisheries which immediately began investigations and recommendations regarding the problem of destruction of the coral reefs on the coastal belt of the country. It is also examining measures to prevent sea erosion along the coastal areas and will be assisting in measures to prevent ecological damage of the ocean's resources. (This subject will be dealt with more fully in a subsequent issue of the *Review*).

Cultural Pollution

"Red is all Colombo when you land—red the tall buildings, red the roads and red too the rate flames of spathodea, which, for the rest cannot thrive nor show its full magnificence in the low torrid climate of Colombo. And, up and down in the shade or glare, runs furiously the unresting tide of life. The Main Street is walled in by high barrack-like structures, fiercely western in the heart of the old East, and the big hotels upon its frontage extend their uncompromising European facades. Within them there is perpetual twilight, and meek puss-faced Sinhalese take perpetually the drink orders of prosperous planters and white-whiskered old, fat gentlemen in sun hats lined with green. At night these palaces are visible realization of earthly pleasure to the poor toiling souls from the farthest lonely heights of the mountains and the jungle". (R. Farrer, 1906).

Cultural pollution is a degradation of the social atmosphere and an attendant loss in values and traditions. Three major sources of cultural pollution can be identified in Sri Lanka. Tourism, conspicuous consumerism and population centralization (growth of cities). The quote by Farrer who witnessed and commented on these aspects in 1906 is significant.

Today, tourism is undergoing critical analyses from both social scientists and economists. It would appear that the tourist industry has been moulded with the social and cultural ramifications being treated as afterthoughts. The degradation of the social atmosphere has been documented in many studies. For example one study on Hikkaduwa (by Mrs. Lakshmi Perera) outlines clearly the negative effects of this industry running free with no controls.

Conspicuous consumerism is a disease attached to open-ended growth. It is the antithesis of tradition in Sri Lanka, where the culture has been moulded by the concept of 'non-desire'. Conspicuous consumerism is a product of a 'pecuniary philosophy' which is very deep-rooted and subtle.

Population centralization or the creation of cities and attendant industries provides another input of cultural pollution. Crime rates in cities are five times as high as in non-urban areas. It is a product of the deterioration of the environment physically and aesthetically. It is a fact that the poorer the urban environment the higher the crime rate. Thus modern cities seem not to be the ideal environment for human beings.

There is ample evidence to demonstrate that traditional culture patterns break down in cities. But unfortunately planning of cities often do not take into account these features. High rise apartments for the low income groups are a glaring example. In England and in St. Louis in the U.S. high rise blocks, which on planning appeared the answer to

from possible damage are far greater than the benefits that could accrue to this country.

It has been established that the oceans, which cover more than 70 per cent of the Earth are a critical element in maintaining the world's environment, are the final receptacle for many wastes. Most wastes sink to the bottom, but solid wastes, oil, and garbage contain many floatable materials that are carried great distances by currents and winds. Pollution affects marine life directly through toxicity, which kills some plants and animals and causes reproductive failure in others; it also causes oxygen depletion, biostimulation, and economic losses in shellfish, fishing and recreation industries.

The Island's beaches and the coastal waters are not merely sources of recreation. They are also the means of livelihood for the local population, particularly ma-del fishing and employment in ocean-based recreational activities. It is estimated that nearly 30 percent of the Island's catch of fish is from ma-del fishing. Beach and coastal water pollution in Sri Lanka are caused mainly by faecal pollution, waste water pollution, industrial pollution and oil pollution. An official Committee on Environmental Management which examined this subject, in collaboration with the National Science Council of Sri Lanka, made a case study of the Hikkaduwa area where it found that the two major sources of oil pollution of the beaches have been: Dumping of waste oil at a distance from the coast; and Dumping of waste oil by fishing boats even within the bay enclosed by the reef at Hikkaduwa. The Committee reported that "it would be difficult to prevent the dumping of waste oil at a distance from the coast. Although a harbour has been built at Hikkaduwa, a number of mechanised fishing boats are anchored in the bay enclosed by the reef", though this in itself was regarded as an environmental hazard.

A large amount of waste oil which pollutes both the sea and the beach, is dumped by these boats into the bay. In addition to the oil being a nuisance to the people using the beach or bathing in the sea, the oil is bound to affect the flora and fauna which include the coral, fish and seaweeds of this area. If this menace is not stopped immediately, stressed the Committee, Hikkaduwa could lose many attractive features.

Although there are International Conventions on Pollution of the Sea, their implementation is more followed in the breach. It has been found that still a prominent source of ocean pollution comes from large oil spills, some of which have killed marine birds and plants, left layers of encrusted oil along shores and have cost large sums to clean up. Such spills while concentrated and disastrous, account for less than 20 percent of the large amounts of oil that man introduces directly into the world's waters every year. Most of the chronic pollution originates from the normal tank cleaning at sea off oil carrying tankers, from normal operations of refineries and petrochemical plants, and by fallout of airborne hydrocarbons emitted by motor vehicles and industries. The danger of large-scale accidents increases, however, with the steadily increasing size of tankers: 300,000 ton ships are already in operation, and plans for 800,000 ton tankers have been projected. A single spill from one of the new large tankers could add 20 percent to the amount of petroleum entering the oceans in a single year.

A further preventive measure in this direction in Sri Lanka is that a Coastal Conservation Authority has been set up under the Ministry of Fisheries which immediately began investigations and recommendations regarding the problem of destruction of the coral reefs on the coastal belt of the country. It is also examining measures to prevent sea erosion along the coastal areas and will be assisting in measures to prevent ecological damage of the ocean's resources. (This subject will be dealt with more fully in a subsequent issue of the *Review*).

Cultural Pollution

"Red is all Colombo when you land—red the tall buildings, red the roads and red too the rate flames of spathodea, which, for the rest cannot thrive nor show its full magnificence in the low torrid climate of Colombo. And, up and down in the shade or glare, runs furiously the unresting tide of life. The Main Street is walled in by high barrack-like structures, fiercely western in the heart of the old East, and the big hotels upon its frontage extend their uncompromising European facades. Within them there is perpetual twilight, and meek puss-faced Sinhalese take perpetually the drink orders of prosperous planters and white-whiskered old, fat gentlemen in sun hats lined with green. At night these palaces are visible realization of earthly pleasure to the poor toiling souls from the farthest lonely heights of the mountains and the jungle". (R. Farrer, 1906).

Cultural pollution is a degradation of the social atmosphere and an attendant loss in values and traditions. Three major sources of cultural pollution can be identified in Sri Lanka. Tourism, conspicuous consumerism and population centralization (growth of cities). The quote by Farrer who witnessed and commented on these aspects in 1906 is significant.

Today, tourism is undergoing critical analyses from both social scientists and economists. It would appear that the tourist industry has been moulded with the social and cultural ramifications being treated as afterthoughts. The degradation of the social atmosphere has been documented in many studies. For example one study on Hikkaduwa (by Mrs. Lakshmi Perera) outlines clearly the negative effects of this industry running free with no controls.

Conspicuous consumerism is a disease attached to open-ended growth. It is the antithesis of tradition in Sri Lanka, where the culture has been moulded by the concept of 'non-desire'. Conspicuous consumerism is a product of a 'pecuniary philosophy' which is very deep-rooted and subtle.

Population centralization or the creation of cities and attendant industries provides another input of cultural pollution. Crime rates in cities are five times as high as in non-urban areas. It is a product of the deterioration of the environment physically and aesthetically. It is a fact that the poorer the urban environment the higher the crime rate. Thus modern cities seem not to be the ideal environment for human beings.

There is ample evidence to demonstrate that traditional culture patterns break down in cities. But unfortunately planning of cities often do not take into account these features. High rise apartments for the low income groups are a glaring example. In England and in St. Louis in the U.S. high rise blocks, which on planning appeared the answer to

urban squalor were found on construction to create tremendous social stress. So much so that many of these blocks are now being demolished only 15 years after they were built.

Cultural pollution is not so immediate nor overt in polluting the social environment, as say Industrial pollution is on the physical environment. But the overall effects are deep-rooted and subtle, and once established becomes one of the most difficult types of pollutants to dislodge.

If we now look around us and consider our environment we can see how our environment can be degraded by pollution, be it the poisoning of the drinking water or the use of carcinogenic asbestos for construction and housing.

Pecuniary Philosophy

The effect of a pecuniary philosophy on culture: "This produces pecuniary truth in which that which is true is that which sells, that which you want people to believe, and that which is not legally false. The philosophy had led (in America) to a pecuniary psychology, pecuniary history, even a pecuniary biology which deals with "product evolution" and in the end produces a pecuniary conception of the human animal, with which we can judge the individual worth of our fellows based on their income producing abilities and their public display of symbols of wealth". Such a philosophy had led to what Wagner has termed a 'backwards' technology. Instead of solving problems and meeting needs as expressed by a segment of the population, an attempt is made to create, through definition, a problem or "need". Next, efforts are made to "educate" people so that they will accept definition and finally a solution to the problem is marketed. (J. Moles, 1977).

The Resource Base

Our environment is limited. That is, the amount of resources available to a given group of people is limited to what is present in their geo-political areas. In the end, the world

ENVIRONMENTAL PROBLEM—THE DOMINANT TECHNOLOGICAL CULTURE

In terms of the degradation of the physical and biological environment of the spaceship earth (phrase coined by Buckminister Fuller) the past half decade in man's existence has caused more irreversible damage than ever before. Man, during this period has treated the production and consumption of consumable goods with emphasis on the variety available as against fulfilling basic needs, thus creating a monstrous and dominant technological culture which led to an exponential increase in the levels of utilization of resources both renewable and non-renewable. Writers such as Alvin Toffler, a Sociologist (Future Shock) and Kenneth Watt, an Ecologist (Unsteady State: Environmental Problems, Growth and Culture) amongst others have investigated the nature and impact of the dominant technological culture on the life-style of the individual and society. Toffler concentrates mainly on the socio-cultural and psycological impact of the dominant technological culture on Western Society. The following chosen subject titles found in his book 'Future Shock' illustrate the nature of the problems facing modern man affected by this culture:

'Break with the Past', 'The Technological Engine', 'Knowledge as Fuel', 'The Throw-awaySociety', 'The PaperWedding Gown', 'The Economics of Impermanence', 'The Portable Playground', 'The Rental Revolution', 'Suicides and Hitch-Hikers', 'Monday to Friday Friends,' 'Rent a Person', 'The Pre-designed Body', 'Simulated Environments', 'Life-style Factories'.

Watt on the other hand takes on the role of an empirical researcher, testing the validity of the dominant technological cultural beliefs on the basis of a futuristic planning exercise, with consideration to the important premise of the resource base available for survival of mankind.

The dominant features of this modern culture could be synthesised as follows:

(a) Its requirement of high energy inputs to sustain levels of output and to achieve growth.

(b) Intensive utilization of non-renewable resources.

(c) Dominance of the producer and the dwindling importance of the basic needs of the consumer in the production decision-making process.

(d) Dehumanisation of the consumer with new techniques in marketing and advertising geared towards creating new 'needs'.

(e) Utilization of resources without much concern for recycling.

(f) Implanting of dominant cultural beliefs such as "Growth is all good", "Big is beautiful", "Use of chemical fertilizers is the answer to the world food problem", etc.

The mass-media and improved communication modes have played an important role in shaping this culture to its present state of maturity. Its influence has now spread to the most remote places in Asia, Africa and Latin America, moulding lifestyles suited to the consumerism arising from what is produced, instead of what is needed. There is however resistance from the 'new intellectuals' of the Third World to the present order of the dominant technological culture manifested mainly in the economic form. During the past decade and half the emergence of thinking and the demand for the establishment of a New International Economic Order is an outcome of such manifestation. The emergence of new thinking in the sphere of transfer of technology, the population question, the success of the green revolution are indications of resistance against the implanted beliefs of the Dominant Technological Culture.

The conceptual treatment of environmental problems by the dominant culture, has been to consider them as the necessary outcome of the consistent trade-off that mankind is called upon to make when utilizing the limited resources to fulfil its insatiable wants. These problems therefore have to be understood and their effects minimised. Based on this premise a spurious concern for environmental conservation has arisen in recent times. While many scientific investigations, surveys and studies are conducted on environmental problems with impressive amounts of funding allocated for such purposes, the basic problems of malutilization of resources continues to receive only *little* attention. A rational strategy for managing and allocating the world's natural resources is urgently needed if this civilization is to survive the cycle of birth, growth, decay, decline and death that all other known civilizations have undergone.

The ability to plan its own future has been one of mankind's greatest assets. The emerging science of futuristic study seems to offer the opportunity for modern man to deviate from the stranglehold of the present dominant technological culture and plan an alternative future where the basic decision of what, how and for whom to produce will be made for the benefit of the widest possible segment of the population thus ending the Gross International Waste of resources.

Renton de Alwis

itself is seen as a closed, limited system. This is a major reason for the constant increase in value of rare minerals, fossil fuel energy etc. There is less as less is to be found and the demand is increasing constantly. The resource base is what the financial entrepreneurs would like to control and in some cases do control to a greater or lesser degree. That resource, then becomes a market commodity to be sold to the highest bidder. One unfortunate effect of an open resource base is that poorer countries can afford less and less of a resource that may be found in their own area. Another unfortunate effect is that many rare resources are not 'needed' by 'developing' countries so they sell it in order to get finances to develop, not paying much heed to the question of how and from where they (or their children and future generations) will obtain that resource when they reach the 'developed' stage in manufacturing industry. Once again a clear illustration of the danger is seen in Sri Lanka's case in the present scramble to try and export our newly discovered mineral deposits. The quantum and foreign exchange earnings from our mineral sands—Ilmenite, Rutile and Zircon—have been continuously increasing over the years and reached record levels in 1979.

Another example from this country is that of limestone for cement: though this mineral resource should have been conserved strictly for this purpose, it was found that limestone was mined for road metal, which is to say the least indeed wasteful, particularly in the light of the country's present plight for cement. Again, the mining of clay also for cement manufacture, for white-ware ceramics and making of bricks and tiles has not been carried out on a systematic scale and has been confined only to a few feet below surface even where deposits have been proved to go down deep. It is time we paid more serious attention to this aspect of out natural resources, particularly the conservation of non-renewable resources like minerals, which require rational and long-term exploitation plans together with prevention of waste through poor production and treatment techniques.

Economic and political theoreticians usually refer to goals that do not heed the fact of mean biological base, i.e. GNP or class structure. The problem seems to stem from too narrow a perspective that can only relate to the goals or paths defined by that particular discipline. For example a high GNP cannot justify a decline in public health and nutrition: similarly a growing problem of industrial disease will pay no heed to a change in class structure.

An awareness of the environment means more sensible long-term planning. Considerations of the environment should not be limited to the currently popular "Birds, Bees or Trees" concept but rather a holistic and rational model that attempts to equate as many measurable and related processes as possible.

"We are told that economic growth can ease the pain of poverty—of the equitable distribution of wealth but we know that the quality of physical goods, like the human population cannot grow for ever. It is not clear precisely when and in what form the collusion between the growth ethic and natural limits will occur, but there can be no doubt as to the outcome. Human values will bend or be crushed by biological and physical realities." (*Elrich and Holden*, 1973.)

This statement contains the germ of the current development dilemma. The development dilemma can be characterised by two premises (1) Developed Countries enjoy consumer luxuries and a high standard of life attained through industrial process but have degraded their environment, and (2) Developing countries aspire to attain the standard of the Developed. The dilemma is this: Are the premises true? Will the developing countries have their environments degraded as a consequence of development? Or are the questions framed above a ruse by the developed countries so that they do not have to share the resource base with the developing. It is important to study the development dilemma carefully for it determines the value that we place on the environment.

This argument has been taken even further and put strongly in a recent paper by Samir Amin (whose influence on the 'development' debate is profound) when he stated,

"One could also draw attention to the disturbing frequeney, reminiscent of the world of fashions, with which "new",mostly dubious "themes" are launched, and wonder whether their purpose is not merely to divert attention from the fundamental problems of development and underdevelopment. The parade of such themes as "Population", "Environment", "Zero Growth", "Basic Needs" and "Employment Oriented Strategies," "Income Redistribution", "Intermediate and Appropriate Technologies", "Cooperation among Developing Nations", "Science and Technology at the Service of Development" takes the place of change in the real world of international relations.

What are the factors behind the clearly visible failure? Are those factors purely contingent (the economic crisis) Are they traceable to the "tactical errors" of the Third World (to its divisions and weaknesses, for example). Or do these crises and these weaknesses reflect the impossibility of autocentred self-reliant development within the periphery of the contemporary capitalist system.?"

To understand the development dilemma more fully the problem of resources scarcity has to be appreciated. Today we are fully aware that we are part of a closed system, i.e. the Biosphere, or that the world is finite and contains a finite amount of resources. This is the fundamental reason for the energy crisis too. Many people want more energy while there is not enough to meet the growing demand (at least in the conventional forms). Notwithstanding the problems attached to 'energy addition', the current source is oil. In terms of the dilemma will the use of oil energy in development really cerate a less benign environment? Or is this a ruse by the 'developed' to slow the demand of the developing so that they can have access to more oil with which to maintain their own addicted systems.

If the only way of obtaining the fruits of development is seen as following the path of the developed and if the resources of this world are finite, then it holds true that the global resources base must be shared equitably to attain this goal. But from practical and worldly experience we know that while everyone would be willing to share the 'bads' (exporting polluting industries etc.) they are not so eager to share the 'goods', (subsidising essential mineral or energy export). In this scenario the environment obtains a low value for the exploitation of the scarce resources, or any endeavour that helps maximise industrial development becomes the most important function.

"If, however, development meant the maintenance of the highest quality of life for the populace of a nation, any industry or process that depressed an existing quality of life could be termed 'negative' or an impediment to development. But here, the question that was raised in the development dilemma comes into focus. Could this stance be interpreted as a ploy by the 'developed' countries to slow the consumption of resources by the 'developing countries' so that the 'developed" may not be exposed to increasing competition? Another side of this argument is stated as "The developed countries ruined their environment in order to develop themselves therefore is it right for developing countries to erode their environments too".

Man's well-being and the fact that man is a biological entity linked to his environment are facts that have been poorly considered in the development dilemma. Thus with an increase in awareness as to the interrelations of human well-being with the environment, a different development ethic may emerge. It may well be that in the future a developed country will be one that maintains the most benign environment for its, people.

The Japanese Case

"Environmental pollution affects children first..... Among these people who were recognized thy the authorities of Yokkaichi City (in Japan) in 1971 *as victims of pollution were* 258 *children ages ranging from* 2 *years to* 9, *and* 46 *boys and girls, ages ranging from* 10 *to* 19. *The total number included* 304 *boys and girls....."*

According to a survey conducted by the Study Group for anti-pollution measures for Japanese Primary and Secondary School Children, the ratio of primary and secondary schools that had pupils affected by pollution is reported to be 28.8 percent of all primary and secondary schools in Tokyo. This ratio is 32.8 percent in Osaka Prefecture, 18.7 percent in Kanagawa Prefecture and 24.9 percent in Aichi Prefecture.

From the statistics cited above, we can conclude that environmental disruption had become a definite reality in Japan during the period from mid 1960s to 1970s, and that it began to affect boys and girls in particular. The more concerned a teacher is about this situation, the more seriously he feels that he has to protect his pupils from pollution, and at the same time he recognizes what little power he has in tackling a colossal reality brought about by the policies for unceasing industrial development in Japan. He is really put in a dilemma.

The education of Japan in the 1960s has stressed the ideas which glorify the policies of industrial development and modernization, which have been advocated since the Meiji era. We can find examples of this kind in the social studies curriculum.

This curriculum has an underlying assumption that Japan's rapid emergence as an advanced country in Asia can be attributed to its miraculous economic growth which was attained within an extremely short period of time. And also there was a national aspiration that Japan would become one of the most advanced industrial nations by bringing the growth of its gross national product (GNP) to a peak in the 1960s. This surprisingly high economic growth, however, was attained only at the expense of two great sufferings of many human beings, and of great damage to the environment. This fact became very clear to all of us in the late 1960s. One such example can be found in the environment pollution that took place in areas around industrial complexes, which symbolizes a high growth of GNP.

Japanese teachers in polluted areas therefore had to protect students from various kinds of pollution, and at the same time, they made efforts to criticize statements and descriptions in the textbooks which glorified the high growth of GNP and turned the children's minds to the reality as it were.

Thus environmental education in Japan started, not as a static education but as education against environmental disruption. Being victims of pollution themselves, they have learned to oppose environmental disruption, stated S. Rujioka in 1975.

Land, Water, Forests

The destruction of large ecosystems have their repercussions on the environment. The clearing of mountain forests is a good example. The mountain forests were cleared for tea, coffee and now for vegetable cultivation. The loss of forest cover means rapid desiccation of the soil so that it fragments and is blown away in dry weather. It means rapid water drainage due to the loss of the spongy forest litter and the root systems; it also means rapid breaking and eroding of the soil as there are no trees to break the impact of the falling rain. Thus the top soil is eroded and washed into the sea. The result is a poor, bleached soil on which plants cannot thrive except with a heavy input of fertilizer. The immediate environmental effects stretch further and include flooding due to silted rivers and a rise in the habitats of malarial mosquitoes due to the creation of their favoured ephemeral pooling habitat. In the light of the energy crisis the destruction of the montane forests creates further problems. One of the best energy sources for the island is hydroelectricity but most rivers have their catchment areas deforested. The flow of silt as a result of deforestation cuts the effective life of a dam by 30-50 percent.

The Mahaweli Area

A note of warning has been sounded particularly with regard to the environmental aspects of Sri Lanka's biggest ever development project that of developing the Mahaweli Basin and lands surrounding. Basic to the whole project, for instance, is the conservation of soil and water and this could be effectively achieved only by maintaining an adequate natural forest cover. Drawing attention to the environmental aspects to be guarded against in this project the University's Professor Abeywickrama stated at a seminar that "The entire success of the project would depend on a regular supply of water. The most important tributary of the Mahaweli originates in its upper catchment area at an elevation of 4,000 to 8,000 feet. Some of these areas receive a rainfall of over 200 inches per annum. But, most of this area has steep slopes with high erosion patterns, and effective soil and water conservation in this region is an essential requirement for the development of the project area. If there is high erosion, there will be filtering of the water reservoirs leaving aside the other evils of soil erosion. The reservoirs will be filtered in no time.

Secondly, the rapid run-off will make the water disappear in no time after the rains and the dry weather flow will be reduced and this has also to be guarded against.

Maintaining the natural forest cover is the most effective. Unfortunately this is not possible because the upper catchment area happens to be the most productive and economically important region in the island. Already about 80 percent of this is under cultivation or under some use. Only 8 percent is now under forest and about 10 or 20 under grassland. But the forest area is said to have been 22 percent just a little over 20 years ago in 1956 and according to the Conservator of Forests, from 22.2 in 1956 it has now come down to only about 8 percent which is regarded as a serious thing. Fortunately there is now a ban on the deforestation of this area.

Even with the most careful planning in our operations with a project of this magnitude, unforeseen changes can occur. The opening up of upto 900,000 acres for intensive cultivation and providing water round the year into an area which was seasonally dry can bring about many changes in the environment. First of all there could be changes in soils. It is not only the irrigation right through the year, but the agricultural inputs, fertilizer, pesticides and so on that will be introduced. These can bring about changes. Then there can be changes in insect and pest behaviour and these affect man. These can also result in the introduction of new pests and weeds; because with the long period of drought certain plants and animals which were not there earlier may come in there. These are some of the dangers we have to guard against. Now because of these factors it is necessary to continuously monitor the environmental conditions in all the development areas. Such monitoring can provide us with early warnings of any untoward side-effects and if we find that something is happening then it is expected that we can take remedial measures to correct them".

Another effective illustration has been given by the Conservator of Forests who cited the case of the Horton Plains where the soil level had dropped many inches as a result of potato cultivation, thereby reducing the soil capacity to absorb and retain water mainly because adequate soil conservation measures had not been taken. He maintains that this would happen in all other catchments if such forests were to be replaced by indiscriminate cultivation. Thus both in the conservation of soil and water resources as well as the amelioration of local climatic and other natural environmental conditions forests have a vital role to play. As a deceleration at a recent World Forestry Congress summed it up "Forests counter erosion, protect agriculture, reduce floods, assure clean water, provide amenity and recreation, shelter, wildlife, reduce pollution, generally constituting a defence against environmental deterioration, provide timber, wood-based industrial products and forest products which enter into every sphere of man's activities, and also provide employment. In short, forests make a decisive contribution to environmental, social and economic progress".

There is absolutely no doubt therefore about the protective and aesthetic roles that forests could play, but when we find that within the last two decades the forest cover of Sri Lanka has been reduced from 44 per cent of the land area to 25 per cent the picture is indeed depressing.

In 1956 forests covered around 7.2 million acres. Now it stands at 4.1 million acres. It is estimated that only 9 per cent of the total land area of the West Zone, which is the catchment area of the major rivers feeding the major irrigation schemes consists of a forest cover. And this would be further reduced with around 0.4 to 0.7 million acres here being deforested for the Mahaweli programme. The authorities have awoken to the precariousness of the situation and there are now moves to evolve a Forestry Master Plan. But, as far back as 1973 a Committee appointed to draft a plan for 'Environmental Management in Sri Lanka' reported pointedly on our forests and forestry policies that "it would be inadvisable to deviate from the accepted policies for the purpose of short-term gain. Unmanaged and unplanned exploitation of our forest reserves would be detrimental to Sri Lanka; the damage done thereby to our environment would be irreparable." Unfortuately like many committee reports this one too ended on the shelf. With the dramatically changed energy, construction and land settlement situation however, the position appears far more urgent now.

Urgency for Environment Management Measures

In retrospect we observe that the impact of living conditions makes a change in natural environment necessary, but in the past such changes have been made without sufficient understanding or consideration of their long term impact on the environment's implications for human health and welfare. Results of such errors in planning have resulted in forest covering being indiscriminately razed in excess of their regenerative capacity; the protection we enjoy from our coastal reefs is diminishing with their breaching for industry; inland and ocean waters, dumps for various forms of effluents, with an ominous drop in the fish life they had before; the atmosphere is used to mask the discharge of smoke, gases and other pollutants reducing its capacity to support life. Some diseases thought to be well under control have erupted in epidemic form like malaria, filariasis, hepatitis, dengue fever and bowel ailments The image Sri Lanka enjoyed as a model of public health by various international authorities may be blurred.

With the present demands of a vigorous development programme it is inevitable that Sri Lanka's natural resources would have to be exploited to the fullest extent, but it is patently clear now that an unplanned exploitation of these resources can be most damaging in the long-run or in the interests of future generations. Priority would have to be given to the problems we face in preventing any further degrading of the environment through the various development projects now being planned and implemented. There is a considerable amount of legislation connected with environmental management already on the statute books. But this has not proved sufficient; it appears that the machinery to enforce such legislation has not been clearly laid down. At least, though the existing machinery in various departments and institutions seemed capable of handling these problems of the environment there has been a lack of interest or urgency in taking effective measures. Any steps taken now to manage our environment will be cheaper in economic and social terms than action taken much later is the stark lesson we have learnt from most countries in the developed world and even from our own case.