David Mowbray

GLOBAL ECOLOGY

ECOLOGY, in the scientific world, is the study of the inter-relationships between living organisms and their environment. Today ecology is the household word which describes the ways that man relates to his natural environment. "A central tenet of ecology is its declaration on inter-dependence—the interdependence of the materials in the earth and sea with gases in the atmosphere, with the plants in the ocean and on land, and with the animals, which in their turn depend upon plants. All living things and all the business and technology that go on across the face of the earth are utterly dependent upon the cyclical processes of the twenty-odd elements that make up living things."

L. Charles Birch

In the developed countries the environmental movement has already attracted substantial popular support, particularly amongst the middle-class, and has already become a liberal reform movement with some impact. The serious political danger in this development is that liberal formulations of the issues often obscure the root causes of environmental problems and imply prescriptions which do not consider such factors as, for example, imperialism, the economic exploitation of the developing countries. The USA possibly could control many of her environmental problems; so could Australia, and both maintain their present high standards of living, often termed 'the quality of life'. And this is what both countries are endeavouring to do but the success of such a policy is dependent on two conditions:

1. USA and Australia continue to extract much of their mineral resources from the third world that is, continued exploitation.
2. The third world does not develop.

Such a concern is therefore superficial.

What is required is a complete re-examination of our economic goals, organization of production and consumption, new trade policies, and the re-distribution of political and economic power.

On the other hand, in the developing countries many people question the relevance of environmental concern for their own compelling development priorities: their main concern is to fulfil 'rising expectations' and to create a just social order. Yet the present environmental problems of developing countries are problems of a different nature.

They are problems that reflect the poverty and very lack of development of their societies. They are problems of both rural and urban poverty. In both towns and in the countryside, not merely the 'quality of life' but life itself is endangered by poor water, housing, sanitation and nutrition, by sickness and disease and by natural disasters. These are problems, no less than those of industrial pollution, that clamour for a solution.

Any solution to these problems must be through development devoid of imperialism, but development will bring with it yet further environmental problems. For example, the processes of agricultural growth and transformation will involve the construction of reservoirs and irrigation systems, the clearing of forests (possibly), the use of fertilizers and pesticides. Industrialization will bring problems of pollution, especially if they are capital-intensive and synthetic industries imported from developed nations. On the other hand labor-intensive industry utilising local natural products adapted to local skills and practices should minimise any local environmental impact.

Both developed and developing countries must consider very thoroughly and come to grips with environmental problems — both local and global. To quote Prof. Birch:

"One thing is clear. In the future we shall sink or swim together, because the problems we face are global. Unless we can thing globally and act globally there can be no future.

Instead of thinking in individual selfish terms, we have got to think in global terms. Unless we recognise that the air, and sea, and soil are not ours, but belong to mankind, and just not mankind now but of the future too, then there shall be no future.

It is the world's biosphere that is at risk, not yours mine or Australia's.

The global ecological problem

The human ecological problems or interrelated environmental problems are those related to population growth, environmental deterioration, depletion of natural resources, hunger and war. Furthermore these problems must be related to those of development and imperialism.

1. POPULATION GROWTH

The phenomenon of human population growth is adequately covered by Prof. May in his article; however two points must be stressed:

1.1) As May states, in weight of numbers Asia is the dominant region, in terms of population growth rates South America is dominant, but in terms of impact on the environment, the developed world (i.e. North America, Europe and Australia) is dominant. Population growth is therefore not a third world phenomenon but a global one.

1.2) If we look at the age composition of the human population we note that it is a young population, e.g. in most underdeveloped nations 40-50 per cent of the population consists of people in the age group 0 to 15 years, which means (if birth rates remain steady and death rate stay
down) these 0 to 15-year-olds will be living alongside their children and grandchildren (even if they all do have small families) before they reach the high death rates of the over 50 year age groups. Even if there is a rapid decline in family size in these countries their population will continue to grow for a long time. In fact, even if we do have an immediate decline to replacement reproduction (Z.P.G.) the population will continue to grow for 50 to 60 years before a stage of zero population growth is reached.

Prof. Nathan Keyfitz of the University of California at Berkley has made calculations for the underdeveloped countries. If there is a birth control miracle and the completed family size drops from approximately 5.2 to 2.4 children per family (Z.P.G.) by the year 2000 A.D., the average underdeveloped nation would grow to 2.5 times its present size, and it would continue to grow till about 2050 A.D. For example, if this happened in India, her population would stop growing about 2050 A.D. with an approximate size of 1.5 billion. (Ehrlich in Mowbray.)

If Australia commenced implementing in 1979 Z.P.G. as a national policy, Australia's population size would probably level out in 60-70 years at between 20-30 million. If present growth rates continue until 2000 but Z.P.G. were implemented in 2000, the population size would level off at approximately 40 million.

2. ENVIRONMENTAL DETERIORATION

The three main factors extending man's impact on the environment far beyond his biological requirements for air, food and shelter are population size, per capita consumption, and environmental impact per unit of production.

TOTAL ENVIRONMENTAL IMPACT =

<table>
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<tr>
<th>Population Size x Per Capita Consumption x Environmental Impact per unit of Production</th>
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These three factors include all the main factors and relationships which could possibly influence the environment.

Commoner, by measuring total environmental impact in terms of 'the level of pollution' notes that in the U.S. the pollution level has increased by 200-1,000 per cent increase in the period 1945 to 1967, whereas he notes that population size has only increased in this period by 43 per cent, and per capita consumption (using G.N.P. as the index) has increased only by 59 per cent. Commoner believes that these factors combined cannot account for the rise in pollution. Such a rise in pollution levels Commoner believes to be through the development over recent years of synthetic organic products through the efforts of modern chemical industries, these synthetic products replacing natural ones. Synthetic products are environmentally much more harmful. These synthetic products, Commoner believes, have been the major factor in causing pollution increase in the U.S. Ehrlich and Holdren refute Commoner's assertion, claiming it to be simplistic and incorrect on simple mathematical grounds. Ehrlich and Holdren claim that the total environmental impact is the resulting interaction of the three factors listed above. All three factors are dependent on each other and one is not necessarily more-or-less important than the others.

What is man's impact on the environment?

Natural communities of plants and animals have evolved over thousands of years a balance with their surroundings. Substances essential for life are taken from the air and from the soil (or water) and are used with the sun's energy by plants to manufacture organic materials which, in turn, provide food for herbivores and carnivores in a food chain. At each stage of the process materials are returned to the soil (or bottom ooze), where they decay and liberate nutrients for the plants to reuse. Ecologists call this a balanced ecosystem. Some nutrient material may be washed out of the soil by rain, but it is replaced by the natural weathering of the rocks. The only input of energy is from the sun. This kind of system is viable for thousands of years, and the key to its success is the recycling of elements within the system.

Man today by his activities threatens the survival of this system. It is more obvious in some parts of the world, but there is only one environment: what happens to a part affects the whole.

2.1) Man poisons the food chains with pesticides, mercury, lead, cadmium, polychlorinated biphenyls, radioactive isotopes. These radioactive elements, pesticides, plastics, etc., that are released into the environment by man may enter meteorological and biological cycles that distribute them and can concentrate them to dangerous levels of life.

2.2) Man disrupts and alters the natural biogeochemical cycles, for example man is increasing the carbon dioxide and particulate load in the atmosphere; man could possibly poison the necessary nitrifying bacteria. The processes involved in feeding large urban populations, and disposing of their wastes results in a gigantic one-way flow of the becoming-scarce phosphate, essential to all life. Man extracts phosphate from the land, uses it in his own processes and eventually loses it to the sea where it can only feasibly be returned to the land in large quantities through geological processes; therefore man is turning a renewable resource into effectively a non-renewable one.

2.3) Man introduces predators into a new environment to control some plants and other animals but often such predators have turned their attention to the native flora and fauna. Other animals and plants introduced for various other reasons have become competitors in the natural habitats of the indigenous life, often supplanting them, or destroying their habitat, or have brought into the habitats diseases against which the native forms have had little or no resistance.
2.4) Man modifies, radically alters, and sometimes totally destroys natural ecological systems, causing many species to become extinct or rare. By removing the ecological dominants, man immediately alters the pathway of energy flow through the system and upsets the major controlling influences within the community. By removing many of the non-dominant species, man reduces the species diversity within that community. But 'diversity enhances stability' within an ecosystem; by reducing diversity man reduces the stability of the ecosystem, especially where the biological community comprises co-adapted species as in natural communities.

Examples include the felling of forests, the drainage of swamps, mining, building roads and airfields and recreation areas, clearing land for agriculture and the multitude of side effects of agriculture, from for example fertilizers, pesticides, single species crops and overgrazing. Furthermore, the building of dams and irrigation systems causes salinization of soils and reduces the number of breeding sites for birds; estuaries, amongst the most productive areas on earth, are threatened by alteration in river flow, structural changes and pollution; urbanization produces the urban sprawl, ghettos, air pollution, water pollution; nuclear power plants produce thermal pollution and create problems concerning the disposal of radioactive wastes; oil spills threaten life in the sea; weapons technology poses a potential but unpredictable threat to total existence.

2.5) Man in causing extinction in either total or local populations of different species reduces the gene pool, from which future evolution can occur. Although extinction is a natural process, that is, it is part of the process of evolution, resulting from a species' inability to adapt to climatic change, or competition with others, or a natural cataclysm — e.g. earthquake, eruption, flood . . . it has been estimated that man has been responsible for causing the extinction of three-fourths of the higher animals that have become extinct since the year 1600; of the many higher animals now rare man has been responsible for greater than three-fourths such reduction.

2.6) Man has stimulated the evolution of many races of species and even new species, some valuable and some harmful (1) by artificial selection, (2) by altering natural selection through changing environments, and (3) by differential extermination of portions of populations, thus favouring the survivors. Some very striking evolutionary changes have been stimulated through subtle chains of cause and effect that begin with man's actions. The selective destruction of insects by pesticides have spurred the development of resistant pests. Pesticides have also produced pesticide resistant vertebrates, e.g. some fish, amphibia and mammals, so creating some novel and bizarre ecological problems, for example higher consumers which are not resistant e.g. man and birds, could receive more toxic doses, thus rendering them more susceptible to the pesticides.

2.7) Man today uses approximately the equivalent to all the energy captured from the sun by land plants in photosynthesis, yet it is a hopeful prediction of some that energy used by man will increase a further 4-5 times by the end of the century, and by 50-fold by the year 2500 A.D. Right now, man's total activities add as much heat to the earth's surface as does the natural flow of heat from the planet's hot interior. If man were to increase his activities so as to generate 10 times as much heat as today, meteorologists warn that the world's climate can be drastically altered. Indeed man threatens the immutable laws of thermodynamics.

The following is a summary of some of the effects of man on his environment, such as air and water pollution, and the effects of pesticides.

2.8) Air pollution.

On health:
(a) high concentrations of carbon monoxide, airborne radioactive isotopes lethal; low concentrations effect unknown;
(b) high levels of air pollution associated with high incidences of such diseases as bronchitis, pneumonia, asthma, pulmonary emphysema and lung cancer.

Ecologically:
(a) man is changing the carbon dioxide content of the atmosphere threatening the cycles and increasing global temperature ('green-house effect');
(b) dust and water vapour, especially from jet planes, is increasing in upper atmosphere producing cloud cover, decreasing temperature and increasing precipitation.

Radioactive isotopes: e.g. strontium 90, caesium 137, iodine 131 and carbon 14 from nuclear fallout are now entering food chains and threaten the life of today and tomorrow (through the reproductive organs).

2.9) Water pollution.

Effects produced include 'eutrophication' and changes in acidity, dissolved oxygen, biological oxygen demand, salinity and temperature producing changes in species abundance and diversity.

Detergents with a high phosphate concentration and hard detergents (non-biodegradable) cause eutrophication and decreased dissolved oxygen (see table).

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effect on aquatic communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewage, fertilizers and organic matter</td>
<td>add nutrients, stimulate oxygen demand and alter salinity levels</td>
</tr>
<tr>
<td>Toxic wastes</td>
<td>poison</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>smother, hinder photosynthesis by blocking light penetration</td>
</tr>
<tr>
<td>Pesticides, Mercury</td>
<td>selective, accumulating poisons</td>
</tr>
</tbody>
</table>
### Chemical groups of pesticides:

**Pesticides**

Pesticides are used in agriculture and for public health measures. The following table lists the main chemical groups of pesticides:

<table>
<thead>
<tr>
<th>Chemical group or action</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic</td>
<td>Arsenicals, Copper-bearing, Copper sulphate, Organic, naturally occurring Nicotine alkaloids, Pyrethrins, Pyrothoids, Rotenoids, Organic, synthetic Chlorinated hydrocarbon compounds, Organic phosphorus compounds, Carbamates, Fungicides, Mercurials, Dithiocarbamates, Others</td>
</tr>
<tr>
<td>Herbicides</td>
<td>Contact toxicity, Translocated (hormones) Sodium arsenite, “oils” 2,4-D; 2,4,5-T, dalapon, Borates, chlorates, Methyl bromide, Vapam, Rodenticides (Mammal Poisons) Pival, warfarin, Endrin, phosphorus, sodium fluorooacetate (&quot;1080&quot;), strychnine, Anticoagulants Immediate action, Other Vertebrate Targets Birds Strychnine, TEPP, Fishes Rotenone, toxaphene</td>
</tr>
</tbody>
</table>

Within each group there is great variation in biological activity and both acute and chronic toxicity to different animals as well as differences in their ability to persist in the environment and in their mobility (how easily they are dispersed), their ability to enter living systems, their ability to accumulate up the food chain (biological magnification). Furthermore, many insects have evolved a resistance to certain pesticides; and also, pesticides do not distinguish between beneficial insects and pest insects, that is the pesticides kill the natural predators of the pest: for example, chlorinated hydrocarbons.

The chlorinated hydrocarbon insecticides are now among the world's most widely distributed synthetic chemicals, contaminating a substantial part of the biosphere. They are dispersed throughout the environment in currents of air and water. Their movement and widespread distribution throughout the world is explained by their solubility characteristics and chemical stability, and especially their tendencies to absorb on organic matter, to be transported in air droplets, and to become concentrated in food transfers from plants to herbivors to carnivores. Their broad toxicity indicates a potential for biological effects on many kinds of organisms. They are seriously degrading biotic communities in many parts of the world. They have been shown to destroy larval stages of valuable aquatic food organisms, to effect the reproductive potential of some birds and fish, and to depress photosynthesis of some marine phytoplankton. Some have been proved to cause carcinogenesis, teratogenesis and mutagenesis in rats and mice.

The essential problems resulting from pesticide use stem from the fact that pest control is still regarded as a chemical problem, whereas it is an ecological problem. The correct method of insect control which must be used in the future is 'integrated control', which is an ecological approach to pest management by combining and integrating biological, chemical and other effective measures into a single unified pest management system. Insecticides must only be used when and where necessary and in a manner that is least destructive to beneficial regulating agents in the environment, and such that they do not affect, or only minimally affect, non-target organisms, e.g. wildlife.

### 3. DEPLETION OF NATURAL RESOURCES

May covers the availability of global natural resources adequately but three points are worth repeating for emphasis:

3.1) In the U.S. a Senate Select Committee reported that in the decade 1959 to 1969 the American people consumed more of the world's resources than all the people of the earth consumed in all previous history. The United States with 6 per cent of the world population uses 35 per cent of the world's energy consumption, 50 per cent aluminium, 25 per cent copper, 40 per cent lead, 36 per cent nickel and zinc, and 30 per cent chromium.

So it has been estimated that a child born in the United States today will consume during his lifetime at least twenty times as much as one born in India, and will contribute about fifty times as much pollution to the environment.

3.2) No nation accounts for the needs of future generations; that is no nation plans for the next 200 years or so.

3.3) Taking into consideration new sources or substitutes and technological innovations of many kinds, even under the best of circumstances the earth cannot provide resources in amounts sufficient to enable all people and future generations to live at a level of consumption enjoyed by the majority today in the developed nations. Furthermore the contrast between life styles dictated by extreme poverty and those permitted by affluence will continue to be a source of conflict and revolution.
4. HUNGER

The main problem associated with over-population is that man lacks the necessary capacity and will to feed himself, despite the 'green revolution'.

4.1) Nutritional requirements

The daily requirements for calories and proteins differ with age, sex, body size, level of activity and climate. Calorific requirement varies from 2000 calories per day for the less active of women to 3000 calories per day for the larger and more active of men. The average requirement is about 2350 calories per person per day. Protein requirements approximate 0.9 grams per kilogram of body weight per day, with 20% of this being high quality protein (animal or soy beans, nuts).

Prof. Borgstrom of Michigan State University estimates that if all the food in the world were equally divided (e.g. by body weight) then everyone on earth would have just sufficient calories and everyone would be protein malnourished. So there exists an absolute shortage of food at the present time. The food problem is not one of calories but a problem of high quality protein, i.e. protein which contains the necessary balance of essential amino acids for human nutrition. Such a commodity is ecologically and economically expensive to produce. Furthermore, Prof. Borgstrom’s absolute shortage occurs if food is equitably shared, but it is nowhere nearly equitably shared. Most of the ‘goodies’ go to the so-called overdeveloped nations. The underdeveloped nations are forced to fend for themselves. Prof. Borgstrom estimates that for every seven units of protein produced in and moving from the generally hungry southern hemisphere to the overfed northern hemisphere only five return. That is protein flows from the protein malnourished to the protein overfed.

For example, the Netherlands is the second largest per capita importer of protein (behind Denmark) in the world. It imports perfectly good protein from soybean presscakes and the Peruvian Anchoveta fisheries, then converts it into ham, eggs, etc., by a process which wastes between 75 and 90 per cent of this high quality protein. So the Netherlands imports cheap high quality protein and converts it into expensive high quality protein which they then export.

About 60 million metric tons of fish are harvested from the sea annually. Of this only 8 million metric tons goes to anyone who could conceivably be called hungry. The rest goes to the overdeveloped countries, where it is often fed to pets; e.g. in the U.S. pets eat huge quantities of high quality protein. The U.S. poor often eat dogfood because it is the best, cheapest food available.

The Peruvian Anchoveta fisheries make up 10 million of the 60 million metric tons of the sea harvest per year. This Peruvian harvest alone would be sufficient to bring up to adequate standard the diet of all Latin America, as far as high quality protein is concerned.

Prof. Borgstrom describes the world protein situation as a “vast swindle”. (Ehrlich in Mowbray.)

The exact numbers of mankind suffering from undernourishment (lack of calories) or malnutrition (lack of essential nutrients, particularly protein) is unknown because data is severely limited. In 1963 the U.N. Third World Food Survey estimated that 20 per cent of the residents of poor countries were undernourished and 60 per cent malnourished, concluding that at least half of the world were hungry and/or malnourished (L. Brown & G. Finsterbusch). Prof. Borgstrom estimated that in 1969 there existed about 450 million well fed people living in comparative luxury as against 2400 million undernourished, malnourished or in other ways deficiently fed and generally poor.

4.2) The Green Revolution

May reviews the possibilities and the problems concerning the Green Revolution, but further points need making:

1. Many people feel that for the Green Revolution to be successful there is need for a ‘Red Revolution’, i.e. complete social and political reform. Remember the Green Revolution is being developed largely through the efforts of the Ford and Rockefeller Foundations.

2. Two further examples of biological problems facing the Green Revolution are:

a) Side effects of damming for irrigation, e.g. the Aswan Dam in Egypt caused a reduction in the productivity of the Nile, destroyed the sardine industry, caused an epidemic of schistosomiasis and produced sanitation problems.

b) The total consumption of nitrogenous, phosphate and potash fertilizers for developed nations for 1966/67 was 42.7 million metric tons; the total consumption for developing nations was 5.6 million metric tons (Brown). Phosphate is very limited in supply and is economically very expensive. Its purchase appears to be out of range for developing nations.

Known potential supplies of phosphorus at expected usage rates will be exhausted before the end of the twenty-first century. Without phosphate fertilizers the green revolution has no hope. Without phosphorus continued life of any form is not possible.

3) Despite these problems it is often stated that the problem today is food surpluses. “We don’t have to worry about food scarcity because the ‘Green Revolution’ has saved the day.” However these surpluses (calorie surpluses only) are small compared to the world’s needs, e.g. the U.S. has less than one year’s carryover supply; what happens in time of widespread famine?
Furthermore food availability should not only be considered in terms of food available to eat but also food people can buy. Curiously enough people who are starving to death don’t have their pockets full of rupees, dracmas or whatever to buy food. A lot of food goes to waste because the world’s economy is set up so that one can starve to death in the presence of food surpluses. It can happen within countries as well, e.g. in the U.S. 20 million are hungry now in a nation which brags of food surpluses.

5. WAR

May reviews the present position of the nuclear arms race. Other aspects of weapons technology that pose grave threats to both man and the environment include the dangers resulting from radioactive fallout from weapons testing by U.S., Russia, China and France; the large-scale destruction of the environment by chemical and heavy bomb warfare as by the U.S. in Indochina, and the threats of biological warfare.

Weapons technology today poses potentially the greatest threat to the environment. Furthermore it consumes vast quantities of resources both in terms of manpower and materials.

5.1) Nuclear weapons threaten to drastically change all life as we know it: radioactive isotopes, e.g. strontium 90, caesium 137, iodine 131 and carbon 14 from nuclear fallout from weapons testing are now entering food chains posing a grave ecological risk. The development of such weapons is only within the capacity of the developed nations. With such weapons developed nations by threat may dominate developing nations. Already some developed nations, such as France ignore the pleas from developing nations such as Peru and other developed nations to stop testing of nuclear explosives which contaminate their environments.

5.2) Chemical weapons, e.g. herbicides and soil sterilants have changed the ecology of areas of high application, simplifying the environment and making it much more susceptible to further factors such as disease, erosion and pest species.

5.3) Biological weapons, e.g. microorganisms, toxins, vectors, pests are produced and manipulated by man in laboratories but when released into the environment they may propagate, spread, evolve and develop relationships with other living organisms quite unpredictably: they might be capable of producing world-wide epidemics. All nations, both developed and developing, may produce chemical and biological weapons. Such is man’s madness.

5.4) The United States in Indochina

The United States has in Indochina by using chemical defoliants and high explosives devastated the land and seriously damaged forests and the soil on which the Vietnamese people depend. Bulldozers equipped to clear jungles to the forest floor have already destroyed $40 million worth of timber and rubber trees. Timber not destroyed outright contains shrapnel that either breaks saw blades or promotes disease that weakens the wood.

In the wake of herbicide and jungle clearing operations come soil erosion, flash floods, and the invasion of economically useless weeds, e.g. bamboo. The estimated twenty million or more bomb craters in South Vietnam disrupt rice farming and fill with water to become breeding places for disease-bearing mosquitoes. Special blockbuster bombs - the largest weapons available short of nuclear weapons - uproot all vegetation in football-field-size areas and kill or injure a large proportion of animal life for almost a mile in every direction. An as yet undetermined cost of the war will be the long-term ecological and socio­logical effects of this devastation.

For further details on ecological effects of Indochina War read Pfeiffer and Westing, Westing, and Westing and Pfeiffer.

In the act of a nuclear-chemical-biological war or from accidents from testing, the environmental threats are unpredictable, but in the long term life as we know it will be irreversibly changed; the air, soil and water will become permanently contaminated.

6. THE CULTURAL BASIS FOR THE ENVIRONMENTAL CRISIS

Let us make man ... to rule the fish in the sea, the birds of heaven, the cattle, all wild animals on earth, and all reptiles that crawl upon the earth. Be fruitful and increase, fill the earth and subdue it, rule over the fish in the sea, the birds of heaven, and every living thing that moves upon the earth, and every tree bearing fruit which yields seed; they shall be yours for food.

Genesis 1, parts of verses 26 & 28.

The American historian Lyn White claims that the ‘historical root of the ecologic crisis’ is religion, particularly the Judeo-Christian tradition. As White says, ‘Human ecology is deeply conditioned by beliefs about our nature and destiny — that is, by religion’. The Judeo-Christian tradition has always, with few exceptions like Saint Francis of Assisi, placed great emphasis on the sanctity of procreation, and ‘godliness’ of science and technology, and the attitude that man is a separate creature from the rest of nature. This anti-ecological consciousness thus conditions man to be ‘fruitful and increase, fill the earth and subdue it. . .

On the other hand, resource administrator and sociologist, Lewis Moncrief, claims that Judeo-Christian tradition is only one of many cultural factors contributing to the environmental crisis. Moncrief blames capitalism with the attendant development of science and technology, and ‘democratization’ for environmental degradation.

These forces, together with urbanization, increased individual wealth, an aggressive attitude toward nature, increasing population and individual resource ownership are directly related to the environmental crisis now being confronted in the Western World.
Stephen Boyden diagrammatically illustrates (see Figure) how some of these cultural processes interact with the natural processes and if continued could possibly lead to the total collapse of the biosphere. Yet these cultural processes are gathering momentum, we don’t know how to stop them, we are not in control.

Man tends to forget that there are limits to the resilience of ecosystems and to his own adaptability.

7. STRATEGY FOR ACTION

These human ecological problems outlined above are ones socialists and marxists must come to grips with. Any solution to global ecological problems is of course complex. However, such a solution must be global and holistic taking into account all factors — biological, political, economic, social and cultural — interacting together (see Forrester, and Meadows). The path towards possible solution must include

7.1) Population control, i.e. the regulation of population size by society (as distinct from family planning). Population control is not simply distribution of pills and IUD’s. People must have adequate nutrition, health, education and incentive. This will only come with development and an end to all forms of imperialism.

7.2) Re-development for the underdeveloped nations. The logic of resource imperialism (see Caldwell) surely means development for underdeveloped nations. All production must be for ‘use values’ and not for ‘exchange values’. This is the ‘crux’ of the matter concerning the use of resources for us in a developed nation. Furthermore ecologically harmful industry must be replaced, there must be a reduced consumption of non-renewable resources, pollution control and improved technology for recycling materials.

7.3) New lifestyles, attitudes — the development of an ‘ecological consciousness’, alternatives to the nuclear family, women’s liberation, etc.

7.4) A Social, Political and Economic Revolution.

Such leaders of the environmental movement as Ehrlich and Commoner, and the economists Boulding and Michan offer solutions within the present capitalist framework. They stress solutions which include a ‘no-growth economy, a more equitable distribution of resources . . . as well environmental effects