A RATIONALE FOR MAINTAINING NATURAL AND NEAR-NATURAL AREAS IN DEVELOPING COUNTRIES

BY

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partial fulfilment of the requirements for
the degree of Master of Arts in Environmental Studies

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ABSTRACT

This dissertation seeks to establish that certain natural goods are systematically undervalued and neglected in the decision-making processes of private and public institutions. It is further argued that these natural goods lend security to and enhance the quality of life, hence their continued existence and functioning have considerable value for the survival and well-being of this and future generations. Decision-makers are therefore advised of the need to establish the level at which these natural goods will be maintained in order to prevent their continued decline past some critical point.

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PREFACE

The principal objective of this study is to develop a systematic, logical approach to assessing the trade-offs between economic goods and natural goods by exploring the nature of man and the relationship between man and his environment. Specifically, this dissertation examines the question: "Is there a rational basis for a policy which would seek to maintain in their present condition a significant number of natural and near-natural areas in developing countries"? To answer this question, certain economic, ecological, and philosophical concepts are analyzed from several different perspectives to ensure that subtle but important nuances are thoroughly explored; this may sometimes result in an impression of repetitiveness.

The attempt to extend the horizons of economics to embrace wider philosophical and ecological concerns is believed to be original in its general approach and it is hoped this will serve to stimulate greater interdisciplinary dialogue on the problem of developing better welfare criteria for making environmental decisions.

In order to improve readability, direct references to sources and the use of quotation marks have been greatly reduced. These sources are identified by two numbers in brackets at the end of quoted or referenced material: the first number refers to the work cited (see the numerical listing of References), and the second refers to the page number of the work cited.

The writer wishes to gratefully acknowledge the guidance and assistance of Professor Richard Fuggle and Professor John Grindley of the School of Environmental Studies, and Mrs Myra Mark of the School of Economics, University of Cape Town.

DEFINITIONS OF THE KEY TERMS

COMMON POOL RESOURCES: Public goods which can be depleted.

CONSERVATION: Management of the biosphere to yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs of future generations.

CONSUMER COMMODITY: A man-made object which is intended to be used by an individual to satisfy his needs or wants.

DECISION-MAKER: A legislative or administrative entity responsible for public welfare and common pool resources.

DEVELOPED ENVIRONMENT: That part of the environment which has been designed or modified by man and is maintained by large auxiliary power flows from fossil or other concentrated fuels.

DEVELOPING COUNTRY: Country with an average annual per capita gross domestic product of less than R600 (in 1968 Rands).

DEVELOPMENT: The modification of the biosphere and the application of human, financial, living and non-living resources to satisfy human wants.

ECONOMIC GOOD: A commodity or service that can be utilized to satisfy human wants and that has exchange value.

ECONOMIC GROWTH: The expansion over time in the output of goods and services.

ECONOMIC WELFARE: That part of a society's well-being which is attributable to the consumption of economic goods.

EXTERNALITY: The discrepancy between the costs (or benefits) incurred by the party responsible for some action and those incurred by society as a result of that action.

GOAL: The result or achievement toward which effort is directed.

INDUSTRIAL DEVELOPMENT: A system of development based on the expansion of manufacturing and trade.

INTERMEDIATE TECHNOLOGY: A means of modifying the physical environment on a small scale with simple tools and very little capital.

NATURAL AMENITY: A natural good which has the quality of being pleasing.

NATURAL AREAS: Areas virtually unmodified by man, in which natural ecological processes are unimpaired.

NATURAL ENVIRONMENT: That part of the environment which is of natural origin and operates without energetic or economic input from the power flows directly controlled by man.

NATURAL GOOD: An object or service of nature which benefits man and which may or may not have exchange value.

NATURE: The natural world as it exists without man or his civilization; the world surrounding man and existing independently of his activities.

NEAR-NATURAL AREAS: Areas which have retained much of their natural appearance and functions, but which have been somewhat modified by man; areas where natural ecological processes have to some degree been pre-empted, displaced, or subsidized by man-directed processes, but which would quite readily revert back to natural conditions.

PARETO OPTIMUM: A social optimum in which it is not possible to make somebody better off without making somebody worse off.

POLICY: Any governing principle, plan, or course of action.

PUBLIC GOOD: A good which, if available for anyone, is available for everyone.

QUALITY OF LIFE: The state of well-being of an individual or society based on the extent to which basic needs are satisfied.

SOCIAL WELFARE: The total well-being of society.

STANDARD OF LIVING: A measure of welfare based on the consumption of economic goods.

CHAPTER 1

INTRODUCTION

"The evolution of a land ethic is an intellectual as well as an emotional process." (94-263)

THE OBJECTIVE

A policy of maintaining natural and near-natural areas must be based on rational principles and not simply an emotional commitment to nature if it is to have general and lasting acceptance. A logical approach to developing a policy pertaining to the natural environment would be to study the concepts of various disciplines which are concerned with man and his relationship to nature, and consider how these concepts might be synthesized to construct a viewpoint with a sufficiently broad perspective. Conservation has been defined as the meeting point of cultural, social and economic systems on the one hand and natural systems at the other; conservation actions aim at the planned, harmonious interlocking of these two sets of systems and requires a knowledge of both. (21-190) Decisions affecting the natural environment should be based on an understanding of man's true physical and psychological needs, and the economic benefits of any project or policy should be weighed against potential ecological and psychological costs.

Psychology, economics, and ecology are disparate disciplines which are all supremely relevant to choices of future environments. Each deals with certain aspects of reality and ignores other aspects; none on its own can provide a sufficient set of ideas by which to live and to interpret the world. Neither economics nor ecology, for example, addresses the question: "What kind of world do we want"? Psychology, which deals with human needs and values, can provide guidance for establishing goals. Economic and ecological concepts can be used to assess alternative courses of action in terms of these goals.

Ecology is concerned with elucidating principles governing the interrelationships between living things and their environment, and economics is concerned with examining the effects of certain activities on human welfare. Since man's relationship to his environment is fundamental to his welfare, knowledge of ecological mechanisms and their effects must be considered essential to the economic calculus. Until recently, economists largely ignored this aspect of man's well-being, being concerned primarily with improving the efficiency and distribution of goods and services irrespective of the resulting impacts on environmental quality. The growing and pervasive problem of pollution led to the development of new concepts in economic theory (such as the concept of externalities) to bring these man-created environmental problems into the economic equation. Nevertheless, to date little attention has been paid to another, potentially more serious, set of environmental problems which is far more insidious: the exhaustion of natural and near-natural systems due to man's increasingly disruptive activities, which are growing at an exponential rate together with population and technological expansion.

This dissertation seeks to establish the psychological and ecological importance of maintaining natural and near-natural areas. The approach involves postulating a set of reasonable goals for society based on man's physical and psychological needs, and then examining the relative importance of what is called "economic welfare" and those "non-monetizable" aspects of social well-being for which no market can be

created because they are not interchangeable and cannot be quantified. The thesis developed in this study is that the natural environment provides certain services and amenities which must be maintained if total human welfare is to be maximized.

STATEMENT OF THE PROBLEM

Social, economic, and political pressures to accelerate industrial growth and development are resulting in irreversible modifications to natural and near-natural areas with uncertain consequences for the quality of life and the future of mankind. These environmental changes may impose great social costs which will not be foreseen in time to avoid incurring them. If the true nature of these costs were known, they might be regarded as unacceptable.

This problem is particularly acute in those developing countries which have rapidly growing populations and rising expectations, but which are already overcrowded and short of natural resources needed to meet demands. It is generally assumed that the first objective for a developing country should be to rapidly increase its output of goods and services in order to satisfy society's wants. This laudable objective may, however, mask a most serious difficulty, and prove to be an economic tar baby: attempts to rapidly improve the standard of living and eliminate poverty may meet with environmental and institutional resistance, and resources may become inextricably committed to an ultimately destructive pursuit. The challenge for developing countries is to solve their substantial health and welfare problems without falling into the disamenity and hazard trap that waits for future generations.

The question is whether rapid and unconstrained industrial development constitutes the most sensible approach to solving the formidable

problems facing developing countries. This type of solution appears to have an inherent weakness which could ultimately undermine all the good it promises to do. The industrial system stimulates "wants" which only continued industrial growth can satisfy and thus insinuates its goals into a society's value system. The industrial system stimulates greed, envy, and avarice, (131-26) and this bodes ill for the future of mankind: resources are consumed and the productive base is eroded largely to satisfy unwarrantable wants, while the income gap between the rich and poor continues to widen.

Faced with the pressing needs of the poor, environmental issues tend to have low priority in developing countries, and some maintain that the problem of poverty must be solved before environmental problems can be broached. But it would appear that man may not have the power to solve his problems one at a time. By the end of the century more than 80% of a world population of 7 billion will live in less developed countries. (133-304) With rising per capita consumption levels, the pressure for economic growth will be out of all proportion to the increase in population, and it may not be possible to attain required levels of production due to environmental constraints. There are indications that the global environment is already overburdened. In many parts of the developing world, vast expanses of land are being lost to human use, primarily through deforestation and its shadow, desertification. (35-458) Africa has only 0,5 hectare of forest per person, and the Third World is losing its forest resource base at a rate which would exhaust it completely in 60 years. (35-459) In addition, there remains an area of potentially productive but threatened drylands covering 45 million km^2 or 30 per cent of the world's land surface. (147-7) These lands are losing their ability to support useful species of plant and animal life, and losses to desertification are estimated to be 50 000 km^2/yr. (35-464)

The Global 2000 Report, which projects population, natural resources, and environmental trends over the next 20 years if policies and institutions remain unchanged, depicts conditions which are cause for

great alarm. In addition to substantial losses to deforestation and desertification, between 15 and 20 per cent of all species on earth could be lost by 2000. Air and water quality are expected to decline significantly, water shortages will be more widespread and severe, and climatic changes could have highly disruptive effects over large regions. The demand for fuel wood is expected to exceed the supply by about 25 per cent, and the prices for fossil fuels are likely to increase rapidly as resources dwindle or supplies are interrupted. (77-2,3)

The implications of such developments are ominous. There are great political, as well as ecological, risks implied. Some of today's underdeveloped countries are yesterday's "overdeveloped" countries - when the fertility of the land was lost, the civilization which it supported collapsed. The situation today is far more serious because the entire world is affected. It may be difficult to alter the destructive pattern of development as the sheer momentum of our present activities could well be enough to drive us on for another four or five decades on our present path. But since we do not know how to prevent the collapse that overtook all previous civilizations, it would be advisable to seek new and diverse strategies. (153-180; 70-84)

STATEMENT OF THE APPROACH TO THE INVESTIGATION

The approach to this investigation consisted of (1) formulating a series of questions which were relevant to the central thesis, (2) conducting a multidisciplinary literature search to gather information pertaining to the questions, (3) developing a method of assessing the information gathered, and (4) analyzing alternative policies using various concepts and criteria obtained through the literature search.

This dissertation is concerned with determining the importance of maintaining natural and near-natural areas, with particular reference to developing countries, where pressure for rapid and unconstrained development is high and the perceived value of such areas is low. While it may not be possible to answer the question "How much of the natural environment is necessary to man's well-being?" it is perhaps possible to argue that beyond some point further reductions in natural and near-natural areas will rapidly increase risk to survival and reduce the quality of life.

Questions have a way of raising other questions, and the following list gives some idea of how the investigation branched as the answer to a particular question depended on the answers to several others. How much of the natural environment is left and how much more can man afford to lose? What are the true costs of losing natural and near-natural areas? What is the value of stable and diverse biotic communities? Can ecological imperatives be identified? How important are natural and near-natural areas to the quality of life? What constitutes the "good life" for man? What are man's potentialities and "natural" goals? Can "quality of life" be adequately defined? What is the value of variety for man? How can decision-makers be encouraged to give more weight to values associated with natural and near-natural areas? How can development pressure be resisted? Can "development" be re-defined to incorporate values derived from maintaining natural and near-natural areas? How can "optimum" development be achieved? How can particular developments be evaluated for their contribution to the problem? How can short-term needs be compared to long-term needs? How can social progress be made sustainable? Can systematic procedures be developed for making trade-offs between short-term economic gains and long-term ecological risks? How important are risk and uncertainty? Can the future goals and values of society be predicted, and how can present costs be weighed against future benefits? How important is intergenerational equity? To what extent does problem-solving in the present create problems for the future? How much of a burden can

present generations be expected to assume for the benefit of future generations? Is it reasonable to assume that future generations can look after themselves? Isn't there a possibility that the present pattern of development will result in the exhaustion of vital resources? Who should pay for the high opportunity cost of maintaining natural and near-natural areas? How significant are efficiency goals relative to equity goals? Can a policy of maintaining natural and near-natural areas be made acceptable if affluent nations provide subsidies for poorer nations?

An extensive, multidisciplinary literature search was conducted to obtain information and opinions to provide greater insight into how these questions might be answered. The principal works consulted were in the fields of ecology, economics, psychology, philosophy, planning, and general environmental studies (see References).

A method was developed for evaluating the choice between two policies. One policy would constrain development by maintaining certain portions of the natural environment in perpetuity, and the other would recognize no such constraint. The method involves describing the situation that faces the decision-maker, and then developing an approach to decision-making which is based on formulating reasonable goals and evaluating the policy choices in terms of these goals. Goal formulation is based on an examination of the nature and potentialities of man, and makes particular use of Maslow's "hierarchy of needs" theory. Evaluation of the policy alternatives involves the consideration of various economic and ecological concepts.

STATEMENT OF THE PROPOSED SOLUTION

This dissertation suggests that maintaining natural and near-natural areas is necessary to man's well-being in two respects: (1) environ-

mental buffering reduces risks to survival, and (2) natural amenities contribute to a higher quality of life. It is therefore recommended that developing countries promulgate a policy of balanced and controlled development which maintains significant elements of the natural environment to minimize ecological risks and maximize opportunities for ultimately achieving a high and sustainable quality of life. It is further recommended that more affluent countries subsidize a portion of the costs of maintaining natural and near-natural areas in poorer countries, and assist in developing appropriate technology to meet the basic needs of the poor and provide a sound basis for further development.

Ecological imperatives are difficult to identify, and the quality of life concept is difficult to define. But there are ecological and psychological limitations on man's activities; materialistic Utopian visions must give way to more realistic visions of the future. Development models should seek balance and sustainability achieved through smallness and decentralization, with production and consumption activities conducted in accordance with ecological principles. Personal fulfilment should depend not on gross material satisfactions (beyond what is necessary for meeting basic physiological needs) but on meaningful work, continuing education, close family and community ties, abundant leisure time (well-used), and satisfactions to be derived from natural amenities.

Such a model calls for setting aside extensive tracts of natural and near-natural areas as a form of investment in ecological and amenity resources. These areas would serve as outdoor laboratories for science, lend greater ecological stability to environmental systems, provide protection for present and future utilitarian species, afford opportunities for aesthetic satisfaction and spiritual renewal, give greater variety to life, and maintain options for future wants and needs.

This model of development differs greatly from the current Western urban-industrial model, and its implementation would depend on many

institutional adjustments to compensate for economic externalities, short social and political time horizons, and imperfect scientific knowledge. Some sacrifice in short-term efficiency and economic growth in order to achieve equity and environmental goals will prove to be more efficient in the long-term and allow greater prospects of sustainable growth. Other options appear more efficient (because it is not necessary to pay the full social, political, and ecological costs today) and the future is too heavily discounted (due to limited perspectives and ignorance of future ramifications). If new institutional mechanisms could force internalization of all externalities (and not just pollution costs), and permit an extension of relevant time horizons, then it may be possible to switch to development models which are more appropriate to the present condition of man. There is no reason why this should lead to economic collapse, since production and consumption functions could be shifted into cultural services and greater environmental amenities.

E.F. Schumacher is confident that future generations can enjoy a secure and satisfying existence, if only today's decision-makers choose the appropriate path to development:

> The generosity of the Earth allows us to feed all mankind; we know enough about ecology to keep the earth a healthy place; there is enough room on the Earth, and there are enough materials, so that everybody can have adequate shelter; we are quite competent enough to produce sufficient supplies of necessities so that no one need live in misery. Above all, we shall then see that the economic problem is a convergent problem that has been solved already: we know how to provide enough, and do not require any violent, inhuman, aggressive technologies to do so. There is no economic problem and, in a sense, there never has been. But there is a moral problem... (130-159)

It is difficult to overemphasize the importance of establishing clear and realizable goals for society; without clearly defined goals, it is

impossible to chart a course, and without clearly attainable goals, charting a course is likely to be an exercise in futility. It is recommended that social goals should be based on the true, biologically-determined needs of man. Objectives for reaching the goals should be quantified as far as possible, and minimum standards established and carefully monitored to ensure norms are maintained. While it may be difficult to determine precise levels at which natural and near-natural areas should be maintained, it is suggested that a level set arbitrarily high is preferable to one set too low. If technocrats are correct, and natural environments are not needed for survival, they are still needed for their amenity value. If technocrats are wrong, it will be desirable to have numerous areas in which ecological processes are virtually unimpaired, and which comprise reservoirs of genetic materials which may be needed to construct new development paths.

CHAPTER 2

THE SITUATION FACING THE DECISION-MAKER

"Now we face the question whether a still higher 'standard of living' is worth its costs in things natural, wild, and free.... We of the minority see a law of diminishing returns in progress...." (94-xvii)

INTRODUCTION

Decision-makers in developing countries generally assume that rapid economic growth and industrial development are much to be desired. Many believe that the adoption of modern industrial technology offers the best and fastest way to alleviate the urgent problems of the poor, eradicate gross distributional disparities, accommodate rising expectations, and increase general security and international influence. The enthusiasm for industrial development has been so great that little consideration has been given to the potential dangers of disrupting traditional social patterns and making significant incursions into ecological systems. But social and ecological costs may in fact outweigh the benefits of industrialization in the long run. Industrial solutions to development problems may lead to even greater social and environmental problems and to the emergence of institutions which will prove to be unsatisfactory but inescapable masters.

Decision-makers are inclined to accept environmental disruption as the price of progress and discount the possibility of serious ecological breakdowns, often displaying a too-ready willingness to trust in tech-

nology to solve all future environmental problems. There is a natural intertemporal bias which favours selection of the most efficacious solution to today's problems, even if this may create greater problems for future generations. However, if the socially relevant time horizon is extended sufficiently, so that the sustainability of social progress becomes as important as alleviating the plight of the poor, then more attention needs to be given to long-term risks attached to altering natural environments.

THE PRESSURE TO PURSUE RAPID ECONOMIC GROWTH AND DEVELOPMENT

The Nobel Prize winning economist Arthur Lewis once suggested that economic growth leads to greater control over the environment, implying that ecological problems brought on by industrial development will always be amenable to technological solutions arising out of the process of industrial development.

> What distinguishes men from pigs is that men have greater control over their environment; not that they are more happy. And on this test, economic growth is greatly to be desired. The case for economic growth is that it gives man greater control over his environment, and thereby increases his freedom. (96-421)

Lewis points out that greater control over the environment has lowered death rates, shortened work hours, and freed man from much drudgery. He then goes on to discuss two serious problems which face political leaders in developing countries - (1) the increasing gap between production and aspirations, and (2) the increasing gap between resources and population growth - and concludes that economic growth is the only option available, suggesting that no-growth adherents have forgotten that the consequences of a population explosion may be much

more damaging to existing social structures and moral codes than the consequences of any likely increase in production would be. (96-435)

Lewis's reasoning may be questioned on several points. First, it is not certain that economic growth leads to greater control over the environment. Economic growth could eventually result in destabilization and loss of control over the environment. Second, economic growth may have the effect of increasing aspirations and population growth at a greater rate than it increases production and resource availability, thus widening rather than closing the gaps - there may be a dynamic instability in the interactions between these factors which is exacerbated by economic growth. Finally, Lewis seems unaware of the potential consequences of increasing production in terms of ecological costs - these may be far more serious than the social and moral costs of not increasing production.

There are certain conditions necessary to maintain a given rate of economic growth. Growth of the labour force, combined with growth in the supply of other productive factors and with improvements in technology, result in a sustained rate of growth in the level of output of an economy. (133-305) One might question (1) the necessity (or desirability) of continued growth in the labour force since this creates greater environmental burdens; (2) the long-term availability of other productive factors; (3) the ability of technology to keep pace with rapidly expanding requirements; and (4) the capacity of the environment to withstand impacts resulting from greater output of the economy. The process of economic growth (as presently defined) seems to have two unavoidable consequences: (1) per capita consumption of natural amenities is ultimately reduced (which could impair the quality of life), and (2) there are growing risks to the sustainability of the process.

Perhaps the greatest danger lies in the irreversibility of some of the impacts (so that quality of life cannot be restored after some point) and the fact that other options are systematically foreclosed and vul-

nerability is increased as the process continues (so that risks cannot be reduced after some point). It would seem possible that environmental control could be lost as a direct result of economic growth. The industrial-state paradigm envisages man as infinite consumer of goods and services and sets profit maximizing and economic growth as pre-eminent goals. Managing the earth, with its finite supplies of space and resources and its delicate ecological balance, and conserving and developing it as a suitable habitat for evolving man, is a far different task than that for which the present economic system was set up. (72-134)

How much development do the developing countries need? Mishan suggests the architecture of social compassion should attend primarily to a "floor" of minimal material comfort below which nobody in the community should be allowed to sink. (110-127) Any system of development must be inspired by an acknowledgement of the right of people to acceptable standards of health, nutrition, education, livelihood and social well-being, consistent with human dignity. (147-44) However investment in durable capital goods and advanced education in developing countries has led to rising expectations which are not compatible with social and environmental realities. Perhaps the root of the problem is an inappropriate vision of progress. The narrow concept of industrialization as the expansion of the manufacturing sector and the narrow concept of education as the academic and technical qualifications appropriate to modern, industrialized societies may account for the high failure rate of development programmes to substantially improve social conditions in many countries.

It would seem desirable for developing countries to adopt a different model for development - a more gradual, balanced, wide-based pattern of growth would appear to have greater prospects of success and involve fewer environmental risks. This approach would imply a judicious use of resources consistent with long-established conservation principles. Decision-makers should adopt a firm policy which recognizes constraints on economic growth and declares certain portions of the natural

environment inviolable as long as there is any ecological uncertainty regarding the level at which natural and near-natural areas must be maintained.

The pressure for continued rapid economic growth will prove most difficult to resist. Even in developed countries, where concern for environmental quality and long-term security is much greater, this pressure is sometimes irresistible: the Alaska pipeline brought to the fore the difficulty of making sound environmental judgments when traditional values of national security and economic growth are at stake. (118-309) A more conservative pattern of development, based on intermediate technology rather than sophisticated modern industrial technology, will be difficult to sell to decision-makers who are faced with the exigencies of dire poverty and who are aware of the efficiencies in production achieved by other societies. It is therefore imperative to clearly elucidate the nature of the risks and sacrifices hidden behind the Siren call of industrial development.

THE ADVERSE EFFECTS OF UNCONSTRAINED ECONOMIC GROWTH AND DEVELOPMENT

People seem to have unlimited wants, and there is a widespread aversion to accepting some deprivation now in order to reduce the risk of an environmental catastrophe later.

> The religion of economics promotes an idolatry of rapid change.... The burden of proof is placed on those who take the "ecological viewpoint": unless *they* can produce evidence of marked injury to man, the change will proceed. (129-124)

The problem is that ecological risks are insidious and difficult to discern and evaluate; and since they cannot be conclusively proved to

be intractable, there is a tendency to dismiss them for lack of evidence. But decision-makers should remain cognizant of man's imperfect understanding. Perhaps the most significant insight since Darwin is that it is impossible to transcend the human reference point: our processes of thought may not sufficiently correspond to the structure of nature to permit us an understanding which is even approximately true. (86-155) We may be so constituted that much of nature must remain shrouded in mystery forever.

If it is not possible to satisfactorily demonstrate absolute ecological limits and imperatives, it is possible to compare the adverse environmental effects of development schemes with their salutary effects to date. Ul Haq has commented on the poor success of economic development in developing countries, where for about two-thirds of humanity the increase in per capita income has been less than one dollar a year for the last 20 years. (145-185) The task of closing the gap between developed and developing countries seems hopeless: the increase in the per capita G.N.P. of the U.S. in one year equals the increase that India may be able to manage in about 100 years. (145-185) Attempts to narrow the gap are often counter-productive; many major development projects have later turned into development disasters. The Aswan High Dam on the Nile, for example, brought irrigation to 400 000 hectares of land but may result in the loss of millions of hectares in the Nile Delta where productivity depended on nutritious silt formerly brought by annual floods. (29-68) In addition, the project has resulted in greater evaporation losses, a decline in the sardine fishery of the Mediterranean Sea, and an increase in bilharzia and malaria. (37-55) The Kariba Dam on the Zambezi has also had detrimental effects on general productivity and has resulted in erosion, land shortages, social upheaval, outbreaks of disease among livestock, and famine. (37-191) Attempts to increase cotton yields in Peru through the widespread use of insecticides have actually resulted in lower cotton yields and more pests. (37-264) When one compares the extremely modest accomplishments with the environmental damage which has been wrought in the pursuit of economic development, and considers the possible long-term

consequences of continuing this sort of policy, the alternative of adopting a more conservative policy seems more attractive.

It is suggested that unconstrained economic growth and development may have three types of serious adverse effects in the long-term: future options could be foreclosed, the potential for attaining a high quality of life could be impaired, and ecosystem destabilization could constitute a threat to survival. These effects will each be discussed in turn.

Options Foreclosed

Natural resources essential to industrial processes are becoming more scarce. While improvements in technology may hold down prices for a time, abrupt increases in the real prices of certain resources are likely to occur eventually, and this could effectively make these resources unavailable (particularly to poorer countries). A policy solely committed to industrial development could thus prove short-sighted.

Similarly, there may be significant discontinuities in the exchange opportunity between natural amenities and other goods, so that the demand for natural amenities could approach infinity rather suddenly. Since the supply of these goods cannot be augmented, and they have no close substitutes, it would be prudent to anticipate this point in the exchange opportunity process where the terms of trade are drastically altered and ensure that some reasonable level of natural amenities is maintained.

The concept of irreversibility is vitally important to decisions affecting natural goods since traditional demand analysis, in which the price of a commodity is determined by its relative availability, cannot be applied in a satisfactory way. (114-8) Krutilla stresses that:

> Decisions taken by man which affect irreproducible gifts of nature... differ from decisions which can be undone if the consequences are deemed undesirable on hindsight. In an uncertain economic environment there is a value in the retention of an option which would be otherwise foreclosed. (91-14)

The value of option demand is virtually impossible to estimate but increases in significance whenever the results of a project (1) are irreversible for economic or technical reasons, (2) are large changes rather than small changes, and (3) have no close substitutes. (46-168) The indeterminable nature of this value, and its potential importance in a world in which the scale and rate of change is increasing exponentially, are major reasons for adopting a more conservative approach to development and maintaining a substantial number of natural and near-natural areas.

One example illustrating the importance of option demand is the incalculable value which certain genetic resources may have for future generations. A major concern of the Stockholm conference was the reported weakening of gene pools for agricultural plants and the fact that it is usually in wild or exotic strains that blight-resistant properties are found - strains which are fast vanishing. (141-252) Maintaining genetic diversity in these plants is a sensible form of insurance: of the three hundred thousand higher plants, man relies on only six hundred; only fifteen kinds of plants provide most of the world's food crops. (62-84)

It is impossible to forecast what other species may be required in the future, but if they are to be available when needed it is necessary to provide natural ecosystems to ensure their continued survival. Every species of living organism represents a store of information which is irrevocably lost if it becomes extinct, and preservation may only be possible in the context of the entire ecosystem to which a species belongs. (149-13) Human activities are increasingly disrupting natural ecosystems, and this appears to result in greater extinction rates and other forms of non-renewability. The prospects for arresting these

trends are not encouraging. As human pressure on the land increases, the hope for preserving rare species will fade and in the long term we can only save those species that can survive in a representative system of nature reserves and national parks, and those that are compatible with humans. (53-13)

Maintaining natural environments confers a number of option benefits. There is the value of natural environments that have remarkable qualities for scientific research; the value that individuals place on retaining an option when faced with actions having irreversible consequences; and the value that some individuals place on the knowledge of the mere existence of nature. (91-124) None of these can be expressed in quantitative terms, but it may be that due to the asymmetric implications of technology (which indicates that the supply of natural goods in relation to the supply of man-made goods will always be diminishing) natural environments will represent irreplaceable assets of appreciating value with the passage of time. (88-783)

Quality of Life Impaired

The quality of life (see "Definition of Key Terms", page iv) is to some degree dependent on the quality of the environment. The concept of environmental quality is often defined too narrowly as freedom from pollution, possibly because certain pollution costs are rather easy to visualize qualitatively and estimate quantitatively. However the loss of environmental amenities can occur without pollution, so even if obvious external costs of development are internalized, there may still be significant losses in environmental quality. These could include, for example, foregone ecological, aesthetic, or recreational values due to development projects. For each incremental enhancement of living standards something must be sacrificed - whether it be solitude, independence, ideology, serenity of the environment or the stock of non-renewable resources. (11-xi) Krutilla has developed methods for evaluating the environmental costs of specific developments, but these

are not suitable for use in developing countries where natural amenities are not yet appreciated sufficiently to offset perceived development benefits. (91-133) The problem is that by the time amenity benefits assume values equivalent to those of commodity benefits, the environmental resources necessary to their provision will have been destroyed.

Today's decision-maker can therefore not be exclusively concerned with standard of living improvements if this is at the expense of natural amenities which will contribute to the future quality of life. The practice of *ad hoc* or incremental decision-making (which consists of making decisions at the margin, as they come up, one at a time) may have deleterious consequences for the quality of life of future generations. Decision-makers concerned only about today's optimal position can progress from one optimal position to another, each optimal position corresponding to a deteriorating situation. (106-138) This is true because time, population growth, technological innovation, and changing tastes alter the optimal position and there is no assurance that today's optimal position is on a path which can lead to future improvements in well-being.

The problem of choice is thus complicated by considerations of the future and is further compounded by exceedingly subtle and intricate information problems, such as the problem of measuring disamenity in the absence of former users. Mishan has demonstrated that if all people become affected by the same degree of disamenity, a price-difference or premium for amenity cannot emerge in the market. If an investigator were to interpret such facts as indicating complete insensitivity to disamenity by the community he would obviously understate the social cost. (109-326) It may therefore be prudent to question the long-term utility of material benefits made possible by industrial development and allow for the possibility that natural amenities may be of considerably greater importance to the future quality of life.

Industrial efficiency has generated immense economic wealth, but is

making civilization dependent on technological and social structures so complex that they are almost out of control. (50-269) There may evolve a rather inhuman *1984* type of social system which subordinates individual talents, needs, or desires to the survival of the social organism as a whole. (84-116) Modern, industrial man, in his zeal to attain to ever-higher standards of living, may be eroding the quality of life. Technology has conferred many material blessings upon man but has increasingly deprived him of direct contact with nature, which may be of far greater importance (after basic needs are satisfied) to his well-being. Man is still an enigma, and no science has yet revealed what sources of sustenance are essential to his well-being or how his spiritual and aesthetic needs may best be satisfied. As Schumacher has pointed out:

> The extraordinary thing about the modern "life sciences" is that they hardly ever deal with life as such, the factor x, but devote infinite attention to the study and analysis of the physico-chemical body that is life's carrier... since physics and the other instructional sciences base themselves only on the dead aspect of nature, they cannot lead to philosophy, if philosophy is to give us guidance on what "life"is all about.... To enhance our Level of Being we have to adopt a life-style conducive to such enhancement, which means one that grants our lower nature just the attention and care it requires and leaves us with plenty of time and free attention for the pursuit of our higher development. (130-29, 123, 153)

The current environmental crisis may be attributed to the postwar technological transformation of productive activities which has had a surprisingly small effect on the degree to which individual needs for basic economic goods have been met. (33-271; 31-144) Instead, this new technology has led to the production of a class of economic goods, which may be regarded as non-essential but which provides much sought after comforts, conveniences, and amusements. Developing countries have generally adopted this technology and these values wherever they have been introduced and, in attempting to close the "standard of living" gap with developed countries, are in danger of suffering even

greater losses in environmental amenities. A crucial question is how to determine the point of "ecological transition", which may be defined as a point at which a country's industrial activity reduces rather than enhances the quality of life of its citizens. (121-22) In some countries citizens have a per capita income more than enough to permit them to live enjoyable lives, so far as that capacity depends on income. It may well be that in the United States, for example, the loss of natural amenities in recent years (or perhaps even since the transition from a rural to an urban society) has not been compensated by increased consumption of economic goods.

While it may not be possible to measure the declining marginal utility of extra units of material goods relative to other goods, it does seem that modern economies generate a "throwaway" mentality in which materialism (i.e., the desire to acquire more goods) is encouraged but less value is attached to acquisitions, so that they are not cherished or kept. In pre-industrial or traditional societies, ordinary goods and chattels were themselves a source of gratification, not only in appreciation of their individual workmanship but also because of their real scarcity. (110-120) It may not be intuitively obvious which system confers greater social welfare.

Modern technology and industrial development are intended to free man from the drudgery of ceaseless toil and provide him with abundant leisure, but some observers question whether the results have been truly salubrious. Work has been degraded in the quest for ever-greater efficiency through emphasizing the more mechanical aspects of production. Industrial development has the effect of dehumanizing work, and this reduces the well-being of the worker. Economists tend to regard all "input" as disutility and "output" as utility and so they seek to "lighten men's toil". (106-208) However there may be utilities on the input side - work itself is not necessarily a bad thing, and there may be considerable satisfactions in work with a "human face". (129-141) Unpleasant toil is a result of the meaning of work, rather than the task itself. Technology will never eliminate toil, but the right

social relationships and attitudes will. (99-145) Work contributes to two sets of needs: the lower (physiological and security) needs, and the higher (belongingness, esteem, meaningfulness, cognitive, aesthetic) needs. Work may be considered a disutility in the first case and a utility in the second case. Schumacher lists three functions of human work:

> First, to provide necessary and useful goods and services. Second, to enable every one of us to use and thereby perfect our gifts like good stewards. Third, to do so in service to, and in cooperation with, others, so as to liberate ourselves from our inborn egocentricity. (131-3)

But work in modern industry is inherently unsatisfying:

> Mechanical, artificial, divorced from nature, utilizing only the smallest part of man's potential capabilities, it sentences the great majority of workers to spending their working lives in a way which contains no worthy challenges, no stimulus to self-perfection, no chance of development, no element of Beauty, Truth, or Goodness. (131-27)

Thoreau also commented on the unsuitability of industrial work:

> You come away from the great factory saddened, as if the chief end of man were to make pails; but, in the case of the countryman who makes a few by hand, rainy days, the relative importance of human life and of pails is preserved.... (134-200)

And Kierkegaard saw work as having religious significance, as constituting the path to consummation with God:

> To work is the perfection of the human. Through working the human being resembles God, who also works. And if, then, a man works for food, we shall not foolishly say that he supports himself; we shall rather say simply in order to recall how glorious it is to be human. (83-107)

Just as industrial development does not necessarily eliminate toil, affluence does not necessarily bring true leisure. The multiplication of things and their rising custodial costs bring time into the calculus of allocating one's personal activities; men become enslaved to its measurement through marginal utility. (19-17) Although leisure is considered important to quality of life, it appears to be what economists call an "inferior good" - its value in relation to other goods declines with increases in income. This is because as income rises, the cost of time also rises. Since the amount of time available to an individual is fixed, it becomes increasingly scarce (and hence, expensive) relative to the expanding quantities of commodities that can be purchased with an ever-increasing income; therefore activities that are time-intensive become less attractive. (15-253) Industrial development thus leads to a paradoxical result - part of the goal is to gain freedom from ceaseless toil, but (beyond a certain stage of development) this does not result in increased leisure, and the amount of real leisure a society enjoys tends to be in inverse proportion to the amount of labour-saving machinery it employs. (129-138) Thoreau clearly recognized the value of leisure and the danger of sacrificing it to practice mundane occupations which do not lead to self-fulfilment:

> What are threescore years and ten hurriedly and coarsely lived to moments of divine leisure in which your life is coincident with the life of the universe? We live too fast and coarsely, just as we eat too fast, and do not know the true savor of our food.... It is only the irresolute and idle who have no leisure for their proper pursuit.... No man ever had the opportunity to postpone a high calling to a disagreeable duty.... We avoid all the calamities that may occur in a lower sphere by abiding perpetually in a higher. Most men are engaged in business the greater part of their lives, because the soul abhors a vacuum, and they have not discovered any continuous employment for man's nobler faculties. (134-100, 129)

The pace of life affects the quality of life, and economic growth tends to increase the size and complexity of human institutions governing the pace of life. Once social and economic institutions develop beyond a

certain point, a qualitative transformation takes place and control is effectively lost - human values are displaced as new, impersonal laws assume direction of social and economic processes; quality of life considerations fall by the wayside, and great risks to survival may become unavoidable. Rapid change in a society results in diminished freedoms and greater insecurity due to the failures of moral conventions, spillover effects, and exposure to new dangers and uncertainties. Decision-makers in developing countries should remain cognizant of the psychological costs of rapid development. Faster economic growth tends to introduce greater disruption and the need for making bigger readjustments in previous ways of life and may thus increase the subjective sense of frustration and discontent. (112-203) This is especially relevant to societies which have existed for long periods with low levels of change, for it is then necessary to transform beliefs, habits and institutions. (96-430)

The transition from indigenous to modern technologies, linked as it is to rates of structurally unequal development, has proven an inadequate vehicle for integrated social change. Social disparities tend to worsen, indigenous value systems are degraded, and labour-intensive coping mechanisms are lost. (147-290) The consequence is often increased pressure on the most marginal resources. When faced with drought or other stresses, they collapse: in extreme cases, the productive base may be so degraded that people are forced to abandon their traditional livelihood and habitat entirely. (147-299)

Puzo has documented the effects of economic change on the Ovimbundu tribe of the Luapula Valley in southern Africa which illustrates the far-reaching effects a single change can have on the quality of life of a traditional, polyfunctional society. This society has now adopted a system of intensive agriculture based on a single cash crop (maize), and this development has profoundly altered the social structure, habitat patterns, territorial and kinship concepts, and the use of family labour resources. (123-1092) Reliance on one crop has proved destabilizing:

> The income that the people have come to rely on from maize (sometimes) declines to the point that, for example, migrations of Ovimbundu to the town and elsewhere for cash employment is a significant feature in the area today. Rising expectations probably have much to do with the migrations also. (123-1093)

The people are thus caught in a trap of inevitable periodic social disruption on the one hand and gradual social decay on the other. The inclination to resort to migration demonstrates how one change can precipitate others in a destabilizing chain reaction. Paradoxically, the very success of migrants in adapting to economic opportunity threatens the survival of indigenous livelihood systems - productivity and social ties are lost, traditional coping-mechanisms are lost, and this leads to an increased marginalization of those who remain behind. (147-300)

The industrial ethic offers a tempting array of goods and services to replace more traditional values but the transition may not be readily or painlessly accomplished, and attempts to rapidly transform whole societies may only result in destabilization and a reduction in the quality of life. Traditional societies are associated with behaviour patterns that put a premium on stability - when their religio-cultures break down, there ensues a period of chaos. (63-xi) If rapid economic growth and development result in the loss of social cohesion, stability, and feelings of security, then the price may be too high. Traditional societies are in danger of losing their myths, both sacred and secular, and economic growth alone cannot fill this void.

It may therefore be desirable to embark on a more modest pattern of development, which would allow for what Allison has termed "totemistic values" - if people feel confident that some relationships with their environment are in some sense "sacred", they feel more properly attuned to the world, more confidently "rooted" and less susceptible to "environmental neurosis". (2-127) Maintaining natural and near-natural areas would serve this important psychological function, which could have a multitude of desirable spin-offs: loyalty to country,

devotion to family, concern for the land, feelings of security and well-being, and a generally more responsible approach to life.

Ecosystem Destabilization

All man's activities take place in and are ultimately sustained by the natural environment. The ecosphere is a closed system driven by a single external source of reliable energy, the sun. Man's well-being is dependent on the proper functioning of this system. The ecosphere is comprised of sub-systems (ecosystems) which are inter-related in a complex way, and it is not possible to determine with any degree of certitude the significance particular ecosystems or their constituent parts may have for man's future well-being. Economic activities may be thought of as man-dominated, open systems which are "housed" by the natural environment. Economic processes use "inputs" from the natural and man-made environments to generate "outputs", some of which have utility to man. Economic processes depend entirely on certain ecological processes. If economic growth and development destabilizes natural ecosystems to the extent that crucial ecological processes are disrupted, economic collapse could result. It is therefore necessary to take account of the effects unconstrained economic growth could have on the natural environment, with particular regard to the stability and proper functioning of ecosystems.

Natural environments provide two types of benefits: objects of utility (which have value in their own right) and life-support processes (which are necessary to the continuation of man's activities). The former would include certain species of organisms, and the latter would include nutrient recycling. Apart from their own intrinsic value, species may also be essential sub-elements of ecosystems which contribute to the planet's total life-support system. Both species and entire ecosystems are gravely threatened by the geologically recent advent of exponential human population and technological growth.

Man's activities since the Industrial Revolution have brought about an alarming acceleration in the extinction rate of species. Apart from the direct opportunity cost of lost species (of unknown future value), ecological processes have been altered as niches have become vacant. More populations are getting out of balance, and going toward extremes of great abundance or great rarity. (138-174) While there is some argument about the relationship between diversity and stability, stable populations are characteristic of many organisms in undisturbed ecosystems, and there is ecologic strength and security in complex trophic structures. (138-141) But one of the more significant trends in modern times is towards trophic simplicity, a result of increasing human population and technological impacts. For example, hundreds of species of grasses and herbs which once covered the American prairies have been lost and replaced by a few agricultural crops and weeds, and the land now supports fewer animals. It has been calculated that the original population of game when the European arrived in the United States was two and a half times as great as the present population of domestic livestock, both calculated in cattle units; and yet the vegetation was far better then than it is today. (1-5) Loss of avifauna diversity in North America has brought about increased crop damage, disease vectors, and other problems due to exploding populations of less desirable, exotic species. Such changes tend to be irreversible: it is likely the original balanced avifauna of pre-industrial North America can never be restored. (35-325) In addition to financial and aesthetic losses, there may also be a loss of resilience or stability in some ecosystems. In the Sahel, one observer reports that heavy grazing and drought have resulted in the loss of some species of wild flowers, and since bees need a continuous supply of flowers over the wet season, these losses have seriously affected honey production. The bee is apparently being displaced by the desert locust, which favours bare ground for breeding and has no need of the flowers. The locust represents a threat to agriculture crops, and may eventually impact systems far from their breeding ground. (147-207) All these effects are a direct result of the disruptive influence of man's activities to generate greater economic growth and development.

Economic growth may be regarded as a process whereby economic goods are made available in exchange for certain natural amenities, the extinction of some biological species, and some degree of impairment to environmental life-support systems. (91-277) Historically, the terms of trade have generally appeared favourable but some of man's activities are now on such a large scale that they are beginning to modify biogeochemical cycles and to change the physical or chemical bases of the global life-support system, producing regional or global effects. (13-18) The ecosphere is made up of systems which have varying capacities for exploitation - productive activities must be geared to these capacities or resource exhaustion and non-renewability will result. For example, soil fertility can be effectively lost forever if the land is over-exploited since, even under natural conditions of vegetation cover, nature takes from 100 to 400 years or more to generate 10 millimetres of top soil. (80-2/3) If a system of economic development is to be sustainable, it must operate in accordance with certain principles of ecology.

> The total rate of exploitation of the earth's ecosystem has some upper limit, which reflects the intrinsic limit of the ecosystem's turnover rate. If this rate is exceeded, the system is eventually driven to collapse... there is an upper limit to the rate of exploitation of the biological capital on which any productive system depends. (31-274)

The difficulty is that the "upper limit" is not determinable; it is beyond man's competence to define the absolute minimum supply of all the biological organisms and ecological systems and processes which are necessary to man's survival - or even to enumerate those which are essential - but it is important to realize that such limits do exist. It would therefore seem wise to make provision for a reasonable supply of <u>all</u> natural goods and services in perpetuity.

Economic development programmes are having such serious impacts on local and global ecosystems that their effects must now be anticipated in the

planning process. (43-21) Unfortunately, planners seldom take explicit account of ecological costs because they are so hard to predict and impossible to quantify. The true costs of lost gene pools and ecosystem destabilization, which are potentially far greater than any monetary costs, thus tend to be ignored. (While some losses are truly incalculable, estimates of the costs to repair damage to natural ecosystems in order to restore natural service functions give some indication of the importance of preventing such damage - the estimated cost to restore natural aquatic ecosystems in the U.S. to specified levels by 1983 is $594 billion.) (156-961) The stock of biological and ecological capital in the form of species and ecosystems is rapidly diminishing, but to date this has been substantially unnoticeable. Environmental degradation represents a crucial, potentially fatal, hidden factor in the operation of the economic system. (31-273) These cumulating, deferred costs may not be noticed until they reach alarming - or even disastrous - proportions.

The present scale of man's activities, and the rate at which natural environments are being transformed, may precipitate crises which are completely unmanageable. (122-11) Even if social and political institutions could bring population growth to a dramatic halt, the problem of biological resource destruction would persist. In fact, the problem could then worsen: if and when population growth is dampened in the poorer countries and they begin to experience more rapidly rising per capita incomes, the burden man imposes on the environment may rise more rapidly than before as resource use and throughput grow at faster rates. (60-158) Mishan is pessimistic as to the power of science to forestall tragedy if development continues at its present rate:

> In consequence of the sheer pace of technological innovation, there is an increasing likelihood that evidence about the range of physical side effects of any one or several innovations will come too late to avert misfortune and possible disaster.... Should calamity strike, it is more likely than not to encompass the whole world. True, our knowledge is much greater than it was in the past. But in

> relation to the scale and range of our intervention, it is much smaller. For the full range of ecological and genetic consequences of our current intervention in the biosphere cannot... be known for decades, and they could turn out to be disastrous and irrevocable. (110-84)

Developing countries are not yet committed to the idea that social progress should be sustainable - policies tend to favour the maximum rate of return rather than the optimum rate of return. Inappropriate technologies are being applied to accelerate production regardless of the social or environmental costs involved. Mineral industries replace local agricultural livelihood systems, an example of sustainable systems being damaged by short-term non-sustainable activities. (147-37) And agricultural practices which destroy soil fertility are replacing more balanced practices in order to achieve greater short-term yields. In India, more than half of the land now suffers from some sort of soil degradation, and nutrients are being lost in amounts greater than that being applied in the form of fertilizers. (80-2/4) Man's relationship with the environment is becoming increasingly unstable and the price of present prosperity is growing ecological degradation which threatens the future. Developing countries particularly are reaching the limits of natural systems and destroying the long-term productivity of their land to supply today's food and fuel for rapidly growing populations. (160-18) The United States Council on Environmental Quality is concerned about the relationship between economic development and environmental quality in the Third World:

> ...economic development cannot succeed unless development planning includes careful attention to the natural environment... adverse environmental impacts can result inadvertently from the development process itself and can endanger its results.... The guiding principle, clearly, is that social progress gained through economic development must be sustainable - meaning that the integrity of natural systems must be respected in the development process. (35-458)

Agricultural practices are one example of how natural ecosystems are being simplified and we are required to expend more and more energy in attempts to maintain some stability. (136-29) Energy costs could soon become prohibitive and other costs of ecosystem simplification - lost genetic resources and ripple effects (as tolerance limits are exceeded) to other ecosystems and large-scale ecological processes - could become so excessive as to threaten survival. Expanding agricultural production poses enormous ecological problems. New land cannot be brought under cultivation except at great cost because most remaining uncultivated lands have poor soils and many marginal farming lands may soon have to be abandoned. The introduction of modern innovations like boreholes and roads to market has altered the balance between the traditional pastoralist and his environment to the point that many areas may become too denuded to support livestock at current stocking rates. (123-1076) When land is overexploited, soil structure and fertility deteriorate, vegetation cover is lost and topsoil erosion rates increase, runoff is increased and water tables lowered, pollution increases and the general landscape deteriorates, and the carrying capacity for wildlife, domestic stock, and man is reduced. The ultimate result is desertification. Desertification can only be avoided if certain ecological imperatives are observed. A balanced exchange of water and energy is necessary to the health of what Leopold calls the "land organism", (94-273) but unrestrained agricultural growth often upsets this balance. In drylands, good years (normal rainfall) lead to stock increases or opening of marginal crop lands which damages the natural vegetation and exposes the land to destruction. This process may convert periodic drought into an engine of long-term desertification. (147-14)

Developing countries are most vulnerable to desertification, and ill-advised agricultural schemes intended to permit economic expansion and development may only weaken the land and thereby further weaken the condition of the people. For example, the development of large central watering holes fed by deep wells in arid regions such as Niger and Botswana, have resulted in extensive habitat degradation. (35-467; 126-26)

Unconstrained economic growth and development in the agricultural sector may ultimately cause greater poverty and more malnutrition and disease if it causes failures in the land. The attempt to increase agricultural yields in developing countries through monocultures appears ecologically unsound:

> The green revolution, as presently run, creates huge monocultures which eliminate genetic variability and are unstable and disease prone. It requires enormous inputs of fertilizers, pesticides and energy. On the scale necessary these could have serious ecological effects on the agricultural ecosystem and on surrounding systems. (8-2)

Levels of high productivity are achieved by arresting normal successional processes and simplifying ecosystems, but these gains are purchased at high cost (in terms of energy and other inputs), which is even higher in marginal areas and can be expected to increase over time. These gains in productivity also result in lost soil fertility and increased instability in the system (such as imbalances of predator-prey relationships affecting crop pests) which appears to indicate that benefits will be temporary or only achieved with increasingly unacceptable costs and risks of catastrophic collapse. In contrast, traditional cropping systems, such as the Indonesian combinations of corn and rice, have proved more resistant to pests and more responsive to applications of nitrogen fertilizer than are monocultures. (80-14/11) Agricultural production should be viewed as a sustainable, cyclical process rather than as a short-term, linear process.

Soil, climate, topography, and types of vegetation help determine vulnerability to desertification. Above all, liability to desertification is a function of pressure of land use, as reflected in density of population or livestock or in the extent to which agriculture is mechanized. (147-7) Desertification is not a process which is confined to desert fringes and in fact is more apt to occur in the greener areas of drylands where land use is intense and there are pressures to produce one

specialized crop over a period of many years. (147-221, 27) Desertification is a wide-spread problem, of global significance, but particularly affecting developing regions of the world. Present desertification rates suggest that the world will lose close to one-third of its arable lands by the end of the century. (147-9) This rate is a function of land exploitation patterns deriving largely from a general policy of rapid, unconstrained economic growth and development to meet rapidly growing needs at the lowest possible (present) cost. There is impressive ecological evidence which indicates that this policy is now untenable. If we are to survive economically as well as biologically, industry, agriculture, and transportation will have to meet the inescapable demands of the ecosystem. (31-283) This will require new technologies, acceptance of limitations on growth and development, and a commitment to maintaining some portions of the natural environment.

SUMMARY AND CONCLUSIONS

Decision-makers are faced with the pressing demands of present generations and are therefore inclined to neglect the higher needs of present and future generations. Ecological processes and environmental quality are not being given adequate attention, and it is generally assumed that science and technology will eventually free man from all environmental constraints. But economic growth results in the loss of certain natural amenities and may ultimately lead to loss of control over the environment since many impacts from development are irreversible and reduce future options. Absolute ecological limits and imperatives are difficult to define but they do exist.

Unconstrained economic growth and development could have serious long-term consequences: great social disruptions could result from rapid and profound changes in technologies and institutions; maximizing production involves great energy costs (which may be expected to

CHAPTER 3

MAN'S PLACE IN THE WORLD

"That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics." (94-xvii)

INTRODUCTION

Industrial development may result in a production and consumption pattern which does not truly enhance man's well-being beyond the point of meeting physiological needs. Perhaps rapid and unconstrained economic growth is not only dangerous but unnecessary: there may be alternative policies which lead to more desirable states of development. Decision-makers would be well-advised to explore the nature and potentialities of man, and carefully examine the meaning of welfare, before deciding on a policy of development. A systematic and rational approach to decision-making would consist of formulating goals which are truly essential and reasonable, based on an understanding of the condition of man, and then developing a sound, realistic, and safe policy for achieving these goals.

MAN'S RELATIONSHIP TO NATURE

What is man's relationship to nature, and how vital is that relationship to his continued survival and well-being?

The Value of Natural Goods

Man is completely dependent on the natural environment for energy, materials, vital life-support functions, and certain irreplaceable amenities, yet modern political and economic systems have not developed a procedure for accurately ascribing values to the products of nature. Some of the uses of the natural environment which are unpriced (and often unperceived) are: (1) recreational opportunities and aesthetic satisfactions, (2) storehouse for undiscovered resource substitutes, (3) stabilization of regional and global ecosystems, (4) provision of baseline and monitoring functions, (5) examples of ecological survival, (6) ecosystem rehabilitation models, (7) scientific research, (8) general education, and (9) insurance against unknown problems for further perturbing the ecosphere. (35-338; 43-22; 54-648)

The innumerable specific functions of the natural environment all contribute to the overall functioning of nature which makes life possible. The limited functions of natural and near-natural areas combine to make possible the infinite functions of nature. Since the whole is more than the sum of its parts, it is necessary to develop some mechanism for ascribing the greater value to the component parts - otherwise the essential life-support functions of nature may ultimately be impaired. The logic of conventional cost-benefit analysis is not holistic, and therefore a series of rational development decisions can lead to an irrational result. Unfortunately there is no way to determine the importance of specific areas to vital ecological processes, or even which environmental amenities have greatest utility to man, since man's know-

ledge is grossly imperfect and since there is no unit of measurement. It is therefore necessary to rely on the judgment of specialists, and strive to ensure that estimates are conservative.

Man's Way vs. Nature's Way

The modern urban-industrial model of development has brought about a remarkable transformation in man's relationship to nature. Consumption of natural resources has increased at astronomical rates, and countless natural and near-natural areas have been modified to permit increased production. The symbiotic relationship between town and countryside has turned into a parasitic relationship between city and countryside. Cities are incomplete ecosystems, like the abyssal depths of the sea, or terrestial caves. Giant, mechanised, single-crop farms, which have been created to feed cities, are unstable ecosystems, requiring subsidized inputs at increasing cost. Nature allows such aberrations on a small scale, but technological man has begun to tip the scales drastically as his activities grow out of balance with the supporting natural environment.

Natural ecosystems change and species become extinct by two very different processes: natural evolution, and the impacts of man. The evolutionary process consists of gradual changes in the environment and the gradual modification of species better suited to prevailing conditions. By contrast, the activities of man bring about sudden changes in the environment and rapid destruction of species, so that natural processes have no opportunity to replace them with more suitable materials. Natural ecosystems are "fine-tuned" by natural selection over long periods of time. Man makes sudden (and often large-scale) changes and produces oscillations which nature hasn't time to dampen out. Each time a garden is planted or an exotic plant is introduced, the web is imperceptibly shaken. Multiplied by all the trillions of instances, the disturbances become a tremor. The striking thing is the rate of man-induced change over recent years. Natural patterns evolve

gradually, which permits integration and improvement (catastrophic events, such as volcanic eruptions, have only local and temporary effects) while human patterns are now evolving quickly, which tends to reduce diversity and simplify systems. Man is rapidly simplifying the world by reducing species and habitat diversity. The whole of nature works one way and man works another way. Nature abhors waste, and proceeds by diversification and decentralization; man accepts waste, and believes in specialization and concentration. Nature uses time, spends it carefully, and so maintains equilibrium; man ignores time, makes rapid and arbitrary changes, and so upsets the balance.

One economic concept does not occur in the ecology of animals and plants: overexploitation of natural resources. (98-12) Equilibrium of the biosphere is maintained by many regulating processes which have evolved over geological time periods. Man has come to operate on a different time and space scale than anything else in nature. Since man's approach is at variance with the laws of nature, something must eventually give. And since man is wholly dependent on nature (and not only for raw materials and energy), he would appear to be in a no-win position with his emphasis on maximizing production and striving to maintain present rates of economic growth. The obvious solution is to scale back production and learn to live more humbly, in keeping with man's status as an animal - man's economic goals should be more modest, in proportion to his physical stature in the universe. As ecology has now sufficiently demonstrated, the doctrine that nature is infinitely malleable is not merely an illusion, but a dangerous delusion. (121-14) If complex ecological processes and diverse biological organisms have survival value to man, then provision must be made for protecting some natural habitat from man's more destructive influences.

Spiritual Values

The natural environment contributes not only to man's survival but to the quality of his existence. Direct contact with nature provides man

with aesthetic and spiritual goods which significantly enhance his well-being. Literature is replete with references to the salutory effects of natural influences, which suggests their value in bringing man closer to self-actualization or fulfilment. The most striking testimonials allude to the value of wilderness as a source of inspiration and revelation. There appears to be no substitute for wilderness experiences, and the value of wildness can hardly be appreciated by the uninitiated since its true import cannot be indirectly communicated. There are no words that can tell of the hidden spirit of wilderness, that can reveal its mystery, its melancholy, and its charm. (113-150)

The aesthetic experiences obtainable through contact with wilderness are unique in several respects, as Robert Marshall has pointed out:

> Of the myriad manifestations of beauty, only natural phenomena like the wilderness are detached from all temporal relationship... in the wild places nothing is moored more closely than to geologic ages.... The sheer stupendousness of the wilderness gives it a quality of intangibility which is unknown in ordinary manifestations of ocular beauty... "the beauty that shimmers in the yellow afternoons of October, who could ever clutch it". (Emerson) ...Because of its size the wilderness also has a physical ambiency about it which most forms of beauty lack... when one looks at and listens to the wilderness he is encompassed by his experience of beauty, lives in the midst of his esthetic universe.... A fourth peculiarity about the wilderness is that it exhibits a dynamic beauty... the wilderness is in constant flux.... Another singular aspect of the wilderness is that it gratifies every one of the senses.... Finally, ...for the brief duration of any pure esthetic experience the cognition of the observed object must completely fill the spectator's cosmos.... In the wilderness, with its entire freedom from the manifestations of human will, that perfect objectivity which is essential for pure esthetic rapture can probably be achieved more readily than among any other forms of beauty. (101-78)

Thoreau was another ardent proponent of wilderness values:

> ...in Wildness is the preservation of the World. Every tree sends its fibres forth in search of the Wild.... The story of Romulus and Remus being suckled by a wolf is not a meaningless fable. The founders of every state which has risen to eminence have drawn their nourishment and vigor from a similar wild source.... Life consists with wildness. The most alive is the wildest. Not yet subdued to man, its presence refreshes him. (142-279)

The value of wilderness depends on the condition of man - his perception of its utility is wholly determined by the nature of his relationship to it and all other aspects of his environment. Man fails to appreciate wilderness if (1) he is burdened with physical suffering and deprivation, or if (2) he is so alienated from natural influences that his powers of perception and spiritual capacities have atrophied.

Unfortunately, wilderness has a low carrying capacity and it is obvious that the "spiritual renewal" rationale is largely vitiated by the physical impossibility of accomodating the teeming masses with adequate tracts of wilderness, particularly given the pre-eminence of physiological needs and the malleability of the human spirit. As the developed environment expands, the wilderness recedes. Seneca and Tausig feel wilderness areas cannot survive:

> Crowding threatens to destroy their fragile ecosystems and to degrade their quality to the point where their consumption value will fall to zero for all potential consumers.... The very term wilderness area loses all meaning when the rate of utilization reaches high levels.... Projections of population and income growth rates... point to a pessimistic conclusion.... (133-309)

However, there is some economic value in what economists call "option demand" (maintaining an option, even though it may never be exercised) and "non-participant demand" (taking satisfaction in the knowledge that some particular good exists, even though it will never be

consumed). (109-290) The problem is that no one knows how to measure these values, but they may be more important - particularly to future generations - than is now generally recognized: there is something in the very name of wilderness, which charms the ear, and soothes the spirit of man. There is religion in it. (113-56) Perhaps future generations will attach great value to the simple knowledge that wildness exists, so that in imagination at least a man can still sense a wild delight in the lovely and lonely spots blooming in the world.

Apart from true wilderness, areas which have retained most of the characteristics of a natural enviornment still permit man to experience reverential awe for the beauty and greatness of a creation superior to him, and provide for special forms of recreation and pleasure. (98-76) Natural areas contribute in many ways to man's well-being, and there appear to be no satisfactory substitutes, particularly for city dwellers. Urbanized man finds outdoor activities in natural settings have special satisfactions. Deprived of the physical challenge of surviving through his own abilities, he feels frustrated, unhappy, and vaguely repressed. (113-250) Natural areas are a sanctuary from urban tensions, a place of spiritual renewal, a reminder that other modes of existence are possible, a place to learn about how the world works, and a source of aesthetic gratification.

Attitudes Toward Nature

Man's relation to nature was irrevocably altered with the invention of agriculture. New attitudes toward the ecological community slowly emerged as man gained increasing control over his environment. Modern attitudes toward most natural objects tend to be either one of proprietary interest or one of disinterest; few have a truly "sensible" relation to natural objects - an awareness of nature that adds to one's being rather than one's wealth. Aldo Leopold predicted the coming of a new land ethic (94-261) but warned that it could not evolve as long as man considered the land an adversary or was alienated from the land.

The urban-industrial ethic, which seems in the ascendency, is not compatible with the land ethic. How can one expect a sense of reverential awe for anything in the young when all they see around them is man-made and much of it is aesthetically displeasing? Industrial development has led to landscape blight and a society characterized by aesthetic and ethical vulgarity which represents an incalculable social cost. The urban-industrial man lives as part of a great artificial structure which has no sympathy with nature - personal value systems have been so distorted that the loss of natural amenities are not lamented. Man's life may be impoverished, but he remains insensible to his condition.

Many conservationists have suggested that education can help restore man's appreciation of the natural environment and motivate responsible conservation efforts, but it seems unlikely that education alone can engender the concern that will be necessary to save natural and near-natural areas. Natural values can be appreciated properly only if there is direct, sustained contact with natural goods. Beautiful nature films and wildlife photos, and interesting books and articulate lectures on the need for nature conservation, have a superficial or transient effect because they are not connected in any meaningful way with the way modern man lives. A child can admire the beauty of a tiger in a zoo, or the intricate construction of a honeycomb in a glossy photo, or the incredible trek of the wildebeest in a film, but their significance to modern life is in the same category as Disneyland, comic books, and Tarzan movies. They are, simply put, not relevant - they are not part of the individual's life, and therefore are relegated to an order of reality which borders on the fictitious. If these species disappear in nature, the individual does not feel significantly affected. He may well be satisfied with zoos, magazine photos, and films.

The call for better education will not save the natural environment if patterns of living and development are not changed to be more compatible

with and bring man closer to nature. If nature is to be saved, a special relation is called for - and this seems not to be possible in urban-industrial societies, which are characterized by a "having-oriented" rationality rather than a "being-oriented" rationality. (99-79)

> Perhaps the most serious obstacle impeding the evolution of a land ethic is the fact that our educational and economic system is headed away from, rather than toward, an intense consciousness of land. Your true modern is separated from the land by many middlemen, and by innumerable physical gadgets. He has no vital relation to it; to him it is the space between cities on which crops grow. (94-261)

New Ethics and Laws

Industrial societies regard nature principally as a source of materials for development, but this view seems both unethical and irrational if one reflects that natural goods come from powers outside man and cannot be re-created by man if he destroys them. Primitive societies had a different conception of nature. Reichel-Dolmatoff has described the outlook of a primitive tribe of Indians, the Tukano in the Amazon, which may be typical: man is taken to be a part of a set of supra-individual systems which transcend individual lives and within which survival and the maintenance of a certain quality of life are possible only if all other life forms too are allowed to evolve according to their specific needs. (125-11) This is reminiscent of Leopold's land ethic, which rests on an ecological premise - that the individual is a member of a community of interdependent parts. This outlook can also be rationalized in economic terms, since it is concerned with choice in the face of scarcity: the continued existence of other life forms is chosen, in preference to other goods which might otherwise be provided, in order that the community might survive and enjoy a reasonable quality of life. The land ethic is actually based on sound economic principles.

Industrial societies are characterized by zealous materialism and high mobility which, in many countries, has destroyed the spirit of community, dismantled the extended family, and is now weakening the bonds of the nuclear family. Trust and obligation between individuals is displaced by the efficient functioning of machines and institutions, so that men are alienated from their fellow men, and sympathy and affection are replaced with distrust and resentment. There is a loss of social and psychological security, belongingness and love needs are frustrated, individual self-esteem is lost through role erosion, winning the esteem of others is more uncertain, and potential for self-fulfilment is impaired.

By contrast, traditional societies have a better sense of "home" and "family", and extended family situations generate a greater sense of security and equability. There may be less physical security than in an industrial society (though this is not necessarily so), but individuals feel they belong, are loved, and are needed and esteemed. Given a healthy traditional culture, opportunities for self-fulfilment can be high.

The Effects of Growth

Developing countries pay a price for adopting the urban-industrial model. Efficiency gains are accomplished at the cost of social disruption and loss of identity. Economic growth can, past a certain point, become counter-productive. Everything in nature is limited in size: growth and form are constrained by considerations of function. This is as true of societies as it is of individual organisms. The proper function of society is to ensure to its members companionship, prosperity, security, and culture. (85-23) However, if a society becomes too large, it changes character and function to become a "collectivist society", no longer concerned with the individualistic point of view. Social goals replace individual goals, and individual welfare is diminished as "density commodities" supplant higher goods. (85-57) If higher social and natural goods are to be maintained for the true benefit of the

individual, urban-industrial growth must be controlled. The problem is to design a pattern of development which meets the real needs of all individuals in a society.

The Possibility of Ethical Solutions

Individuals desire to maximize their own welfare, but moral philosophers have long exhorted man to not engage in acts which harm his fellow-man. Passmore lauds Leopold's land ethic but points out that even conventional morality will suffice to demand action against the polluter, the depleter of natural resources, the destroyer of species and wildernesses. (121-19) Economic relations must be subordinated to ethical goals. The driving motive of economics should not be competition but cooperation; not material gain but subsistence for all with dignity. (55-191) The question is whether ethical behaviour can prevail in the face of increasing scarcity.

Richard Leakey says that man's remarkable evolutionary advance was made possible by his cooperative - not his competitive - nature. (92-248) Early man apparently evidenced a strong concern for communal subsistence. However, perhaps man evolved so dramatically because natural selection strongly favoured "tribal fitness", something very different to altruism. Tribal fitness rests on a bipolar virtue: cooperation with tribal brothers coupled with antagonism toward all others. (70-118) Hardin feels that reciprocal altruism (apart from kin altruism) cannot exist, (70-11) or at least cannot persist and eventually replace egocentric behaviour. (70-5) Ethical imperatives are not likely to supplant economic imperatives.

The Need for Institutional Solutions

Social designs cannot be completely free of coercion. Desired ends cannot be reached by trusting to reciprocal altruism, so it is necessary

to design institutions to control individual behaviour. In traditional societies moralists were often effective so long as resources were relatively abundant and myths and taboos regulated behaviour. In a world of increasing wants and increasing scarcity, in which individuals are better educated and more sophisticated, new institutional mechanisms are required. Limitations on freedom - for individuals and for nations - are necessary to the maintenance of other rights and freedoms. If individuals are allowed to pursue their exclusive interests with complete impunity, all will suffer.

> The tragedy of the common pasture is that actions in the best interest of each and every individual are exactly the actions that destroy the commons for everyone.... It is in the best interest of each and every individual to put the interests of the whole society above his own.... (13-156)

The impossibility of One World founded on altruism does not detract from the prospects of One World founded on enlightened self-interest - it <u>pays</u> to cooperate and make sacrifices. But cooperation must be institutionalized and imposed since reasonable individuals will not make sacrifices on a commons, and the whole of the supporting natural environment is a commons.

MAN'S LIMITATIONS IN TIME AND SPACE

Society's activities are governed by three types of decisions - social, economic, and political. Social decisions arise as a consequence of the collective attitudes of individual members of the public, and are most complex to trace because they result from the interaction of innumerable desires and attitudes. Economic decisions are of two types - production and consumption: production decisions depend on available capital and potential returns on investment, and consumption decisions depend on income and current tastes and preferences. Polit-

ical decisions are concerned with the total welfare of society. Social, economic, and political decision-making processes are all subject to a serious bias: information flows tend to be restricted by time and space limitations to what presently exists and to what is in close proximity. Social decisions are regulated by beliefs and attitudes shaped by present circumstances in a narrowly circumscribed environment; economic decisions are taken according to prevailing interest rates and consumption patterns; political decisions are heavily influenced by today's outcries and the degree of accountability of public officials to certain sectors of their constituencies. These temporal and spatial constraints constitute a most significant bias against decisions which are optimal in the long term.

Individual and Institutional Limitations

Man's true needs or ends cannot be determined solely by reference to present behaviour or prevailing tastes and preferences. Contemporary conceptions of man are based largely on today's particular circumstances, and may be grossly misleading. No one really knows what man has been at other times and places; modern man's thinking is cramped by the present, and he is so dazzled by his peculiar gifts that he fails to reflect on the gifts and truths held by his ancestors. Even less is known about what man may yet become. An evolutionary perspective is eminently desirable in decision-makers. Evolution teaches that diversity and adaptability are distinct advantages if a species is to have a future; keeping options open is important. But a planner's image of man is dominated by man's present aspirations and most immediate traditions. Modern man is not a reliable model because, as existentialists have stressed, individuals are terribly limited in time and space. Mankind is more enduring and variable, but more difficult to define and plan for - it is therefore wise to hedge one's bets.

The individual is moulded by social, economic, and political institutions - personal identity flows from institutional designs. Attitudes are

formulated and behaviour is guided by insidious institutional mechanisms, so that the individual becomes culturally conditioned to certain social and economic models. It is very difficult to alter the existing paradigm of economic growth and industrial development, which has proved enormously effective to date in giving man greater control over his environment, but which may prove ineffectual in controlling the environment under new circumstances only now emerging. New developments present new opportunities, which can create new preferences. These shifts in opportunities and preferences have a subtle effect on the process of choice: opportunities create preferences which dictate new choices which create new opportunities, *ad infinitum*. Neither individuals nor institutions have effective control over this process, which may lead to sub-optimal choices.

For example, social costs are perceptions of something lost. (46-134) Maslow has commented on man's inability to count his blessings until they are lost, but some blessings cannot be measured, or even perceived immediately when lost (particularly if lost in small increments over a long time), and in this case new opportunities which may prove sub-optimal can easily be chosen. Satisfactions derived from these new preferences may then further inhibit perception of the lost good even as losses cumulate, further reinforcing the valuation problem. Thus, due to the influence of time, complete loss of a higher good can be suffered without this being regarded as a cost. For example, the erosion of natural beauty in an industrial area, or the loss of pleasing natural smells and sounds due to encroaching urbanization, may constitute real and significant welfare losses. But these normally occur at a rate which is imperceptible so that losses appear inconsequential at the margin, and cumulative losses (if perceived at all) appear unrelated to the provision of specific economic goods.

One might therefore question the logic of consumer sovereignty, upon which the science of economics rests. Consumers are believed to allocate their time and money resources among goods and services in such a way as to maximize their satisfaction, but this may not be true. The

increasing power of corporate advertising and other influences which distort tastes and preferences can impair welfare in an imperceptible fashion, so that individuals are no longer competent to judge the way to maximize satisfaction. Decision-makers should exercise great caution in deciding to what extent one should cater to the wants of people. Present wants may be completely unrelated to real needs. The individual does not always know what is best for him, his personal range of options are severely limited, and the future is unforeseeable (therefore heavily discounted) and of practically no concern past his own lifetime.

In developing countries there is great pressure to develop "high consumption economies" but decision-makers must first define their responsibilities in terms of time and space: to what social unit should they properly be committed? If their ultimate obligation is to society in perpetuity, then it is highly questionable whether social welfare would be served by creating more wants in a world of scarcity to accommodate rising industrial capacity, particularly if this implies the loss of environmental amenities which may be necessary to satisfying higher needs which are unfortunately poorly perceived by present individuals. Rather than be guided by consumer demands, decision-makers should attempt to objectively identify and rank man's true needs and base policy on goals which are not distorted by limited perspectives. Goals related to economic welfare are not sufficient; it is necessary to attempt a definition of total welfare, even though there may be no measurable criteria to apply, so that more acceptable goals can be established and a more logical approach to assessing alternatives (in general terms at least) can follow.

Decision-makers presently appear to assume goals in rather an arbitrary fashion - goals are foisted upon them by some immediate and compelling necessity, and these become pre-eminent by default: options important to long-term goals are lost to today's pressing demands. If the future were not so heavily discounted, and the decision-maker's time horizon were extended, better goals could be formulated and society

would be better off. (Game theory strikingly illustrates how short-term gains can turn into long-term losses very easily - in the case of the variable-sum two-person game, "The Prisoners' Dilemma", the dilemma is resolved only by being longsighted.) (22-70)

Limitations Imposed by Time

Man has a very imperfect understanding of natural processes, particularly their effects over long periods of time. The science of ecology was late in emerging largely because the complex interrelations of living things and their environment are so nicely balanced that the face of nature remains for long periods of time uniform. (41-85) Man has difficulty even imagining the cumulative effects of minor changes in a simple landscape over immense periods of time - he casts a superficial eye over the conformation of a mountain and fails to see the spectacle of motion and change which has given rise to it and which is still in progress. There is security in the slow, deliberate progression of natural processes. When one reflects on the extent to which the world has been transformed by man since the Industrial Age began, and the scale and rate at which change has proceeded in the past few years, and compares this with the condiiton of the world previously - how little it has changed, by comparison, over countless millions of years - one begins to perceive that something dramatic is happening, and concludes that something startling may soon come to pass.

Man is truly familiar only with the events of his own place and time. Art and literature cannot convey an adequate impression of the quality of life prevailing in other places and at other times, and it is not really possible to compare the level of amenity in, say, a highly urbanized society with that in a completely rural society. There are simply no objective criteria to apply. For example, in a developed, urbanized society, outdoor recreation is a good which is "highly income elastic" (preference for the good increases with income, but at a greater rate). (133-198) This fact reveals a subtle transformation

of outdoor recreation opportunities from the category of free goods to that of scarce goods. Formerly such opportunities were abundant, and more time and energies went into such pursuits; now, urban man must pay more (to enjoy less, in the case of certain activities, because congestion and other impacts have reduced quality) but he may remain ignorant of this fact since former users are invisable (i.e., those who enjoyed higher quality experiences are no longer in the market).

This is a major reason why environmental problems tend to get out of control: there is little personal knowledge about previous conditions, effects are often subtle, and future impacts are difficult to forecast. This is particularly true of non-pollution impacts, but developing countries have generally not even recognized the dangers of pollution because there are as yet few industrial and agricultural concentrations, and the pollution perception threshold is high in unsophisticated, impoverished societies.

Man has demonstrated the ability to survive under a wide range of environmental conditions, but a readiness to accept a degraded environment should not be thought a virtue:

> I am sure that we can adapt to the dirt, pollution and noise of New York City or Sao Paulo or Calcutta. That is the real tragedy - we <u>can</u> adapt to it. As we become adapted we accept worse and worse conditions without realizing that a child born and raised in this environment has no chance of developing his total physical and mental potential. (49-26)

The body and mind can tolerate environmental degradation, but only at some cost to physical and mental well-being, so that the quality of life is reduced. Environmental diversity is also important to survival because man may need a range of behaviourial skills to cope with the future.

Man should not get embroiled in a future for which his evolutionary development has not yet prepared him. Many problems of civilized life

have their origin in the fact that we function in the technological world with a biology and psychology dating from the Stone Age. (50-47) There may yet be a genuine psychological need for traditional social patterns and contact with the natural environment. The fact that for over 3 million years a hunting and gathering economy shaped our social, psychological, and physical evolution is surely not to be lightly regarded. (92-145) There have not been any significant biological changes in man since he gave up this way of life 10 000 years ago. Perhaps the unique habit of collecting and sharing plant and animal foods gave rise to man's needs for belonging and esteem which Maslow suspects lie embedded in our genes, and perhaps these needs are threatened by urban-industrial growth. (92-148) If so, the whole fabric of social order is endangered. Man may be dislodged from the social niche for which he has been so admirably fitted over these many generations. There may be no substitute for an appropriate social environment to meet these psychological needs, and if urban-industrial social patterns destroy certain rituals and customs, this may leave a void which cannot be filled by any amount of goods. The combined force of technology and law may then not be sufficient to prevent social collapse.

Limitations Imposed by Space

Man has limits in space as well as in time, and individuals seems to function best in small groups within a familiar environment. Ecological considerations during man's long evolution kept group and territorial size small. Modern cities are unfavourable to human relationships probably because they are incompatible in their present form with needs created during social evolution. (50-282) Many of the unmanageable problems of modern societies are simply due to the ever-increasing size of things. As a thing grows larger, it becomes unwieldy and its survival requirements increase. Kohr says the effective size of a community is defined by four elements: the number of people, the density of the population, the degree of integration with the community, and the relative mobility of individuals. The optimum size of a

society depends on its function. Assuming reasonably high density, integration, and mobility, convivial societies should number about 100 persons, economic societies about 5 000, political societies about 10 000, and cultural societies about 50 000. Given low density, integration, and mobility Kohr suggests the cultural society could be as high as 200 000. Larger societies would repress social functions and create problems rather than bringing further amenities. (85-19) Kohr's analysis indicates that urban-industrial development may ultimately cause more problems than it solves. Perhaps decision-makers should implement controls on production and development to keep societies and their problems to manageable proportions.

The Limits to Growth

The effect a society's size has on the quality of life exemplifies that there are limits to growth. Those who maintain that there are no limits to growth have pointed out various theoretical solutions to physical problems, without due regard for man's limitations in time and space or the effects of reductions in environmental quality. Man occupies an extremely complex, finite world which he does not understand but which he is rapidly altering. Man hopes to understand and control this world with modern institutions and machines. However individual men have limited control over "the means of control". Ultimately, the power of man is limited by the quality of his institutions and his collective knowledge, and these are, unfortunately, grossly inadequate. This is why economic growth, which viewed from the point of view of economics, physics, chemistry, and technology, has no discernible limit, must necessarily run into decisive bottlenecks when viewed from the point of view of the environmental sciences. (129-25) Time, space, and other resources are needed to build a body of ecological and social knowledge and design the institutional mechanisms necessary to safely and effectively manage the environment. If economic growth and development continue at present rates, it is possible that man will destroy his environment, or forever impair the quality of life, before sufficient

understanding and control is gained.

The environmental sciences are concerned with the problem of constraints in the relationship between man and his environment. Very little is known about these constraints, and so environmental decisions are being made with inadequate information. A great deal of uncertainty attends the planning of major developments which affect ecological systems and environmental processes. Our understanding of the environment has by no means kept pace with our capacity to alter it, and our ability to control our impact has fallen far behind; the economic institutions that sufficed when ecological side effects were mild and gradual have abruptly become inadequate. (47-xiv) Economic growth, if unrestrained, will likely lead to dangerous ecological or political breakdowns. The ultimate limit - posed by the effects of the Second Law of Thermodynamics - lies beyond a whole series of possible catastrophes, from poisoned oceans to resource wars. Even if all these could be averted, the quality of life could be expected to deteriorate as growth adds burdens instead of amenities to man's condition.

Man has placed his faith in technology to solve all problems and avoid all dangers: a whole culture has evolved around the principle of fighting against limits rather than learning to live with them. (105-150) Man has always lived in a world in which growth was possible and good; there was always some new place to go (if things went badly), and always something that needed to be done, and nature always provided the necessary space and materials. Up to now, man's problem has been bumping up against his own limitations of physical stature, reasoning, imagination, and cooperative spirit; the obstacles to progress were largely internal. But now men are dimly perceiving that something is changing - man is running into new limits, which are outside himself and his power to control.

Limits to Equity

Those who advocate economic growth and development point to the great poverty and inequity in the world and maintain that as long as there are scarcities in food, housing, health care, and other basic necessities of life, these must be given priority over maintaining the natural environment. The weakness in this argument is that if production of economic goods continues to grow at the expense of the natural environment, there will come a time when no goods will be forthcoming because the natural environment is needed to sustain life. The reason for scarcity is the insatiable demands of people. Satisfying these demands leads to greater scarcity. And all the while the natural environment, which serves to support life itself and provides amenities which enhance the quality of life, is eroded away. Economic goods cannot be given equal footing with natural goods since the former grows at the expense of the latter, and the latter cannot be replenished once exhausted.

This raises a serious ethical problem. It is impossible to fairly distribute the world's goods. Political and economic solutions may yet be found to correct the most serious inequities, but it seems that the environment cannot support a high standard of living for all. This is not just, but it is not rational to pursue unrealistic goals which contain the seeds of destruction. Policy should be based on essential and achievable goals. If all cannot be rich, perhaps all can have their basic needs satisfied. Since there are limits to growth, there are limits to equity. Garrett Hardin has eloquently summed up the situation:

> We are all the descendants of thieves, and the world's resources are inequitably distributed, but we must begin the journey to tomorrow from the point where we are today.... For the foreseeable future survival demands that we govern our actions by the ethics of a lifeboat. Posterity will be ill served if we do not. (69-277)

THE FUNDAMENTAL UNIT OF CONCERN

Before goals, objectives, and policy can be formulated, it is necessary to define the specific object of concern. It is perhaps not enough to say that the welfare of individual human beings is the ultimate concern of decision-makers, since what is good for today's individuals may not be in the best interests of tomorrow's individuals. Bentham proposed the greatest happiness of the greatest number as a guiding principle for decision-makers. But what if the greatest number becomes so great that the greatest happiness becomes unhappiness? Perhaps the single most difficult problem which must be faced by decision-makers is the population problem. Humanitarian concerns need to be weighed against quality of life considerations. Decision-makers must decide whether providing the highest quality of life for some optimum population will be the objective, or whether it will be to provide the optimum quality of life for the highest population which happens to occur. If the latter is selected, then there may be little prospect for the future quality of life. If the former is selected, then some population policy will have to be promulgated and strictly enforced.

There is a need to determine some fundamental unit which can be regarded as the proper concern of politics, since different policy objectives may be appropriate depending whether one considers individuals, institutions, society, posterity, or some other conception of man. All such units are in some way related to individuals of course, but all are fundamentally different and require different policies. By shifting the level of attention to a broader, more integrated level of being, greater "good" may be achieved. Hooker has built two socio-economic models which illustrate the importance of defining the fundamental unit of mankind. One emphasizes the individual, and the other the social group. There are profound differences in what constitutes optimal decisions for each type, and even differences in the meaning of ethics, economics, freedom, law, education, and politics. (75-174) Hooker's analysis indicates that social decisions favouring the family, tribe, or

community lead to healthier situations than those favouring separate individuals. (75-182) Social-oriented ends may be preferable to individual-oriented ends.

Hardin interprets ethics on a supra-individual level which even transcends such conceptions as society and posterity (which are only social entities limited in space or time, and which are still thought of as being composed of discrete and mortal individuals). Hardin suggests the ultimate biological entity is the "germ line", which is carried from generation to generation, is potentially immortal, and appears to be the object of evolution. This entity appears not to partake of reality only because individuals have a limited sensory apparatus and an imperfect notion of time. The reality of species is recognized because species are easily perceived in space and time, but the germ line is more plastic and represents a completely different level of being. But the germ line may be considered an emergent property of life which might be regarded (by an outside, disinterested observer) as the supreme biological entity in any rational value system of the universe. (70-107)

Nature is not an economizer of lives but rather an elaborator of systems. It is not the individual life *per se* which counts, but the perpetuation and elaboration of the biological system of which it temporarily forms a part. If survival is the ultimate criterion of value, then the survival of the system (the only enduring level of organization) must be assured. This may entail some loss of individual welfare or even some sacrifice of lives, but if the choice is between this and a course which may be judged to put the whole system at great risk, then the choice should be obvious - if the system perishes, all lives will perish. The humanitarian perspective, based on anthropocentric principles and not on ecological principles, is not congruent with the evolutionary perspective which is central to an understanding of biological reality. The "sanctity of life" finds no support in nature, if that belief is the justification for cherishing the life of each individual human being above all other goods. (70-116) It is

more important to cherish the life-support systems of nature. Maintaining natural ecosystems necessary to the survival of the species must take precedence to maintaining individual lives.

As Hardin emphasizes, it is not wise to play half of God's role by designing institutions exclusively concerned with improving the lot of the individual - this has the undesirable effect of increasing man's numbers and decreasing man's resources to dangerous levels. If the fundamental unit of concern was society in perpetuity, this approach would be considered irrational. Hardin says there must be limits to altruism. (70-130) One cannot always ascribe pre-eminence to individual human lives; the survival of man, and the quality of future lives, must at some point take precedence. Many decision-makers ignore the subtle and future needs of man because they are preoccupied with the gross needs of the present mass of men. Pinchot said the fundamental principle of conservation policy is that of "use", to take every part of the land and its resources and put it to that use in which it will serve the most people. (113-171) This policy, in a finite world with growing human needs, is ultimately self-defeating. The conservation of nature cannot perpetually yield to the conservation of human lives and welfare because there will come a time when nothing is left that is of any use. The fundamental issue today is the balance between present and future needs, and it is first necessary to define very carefully what these needs are and then arrange them in some order of priority.

Philosophers have not yet developed an ethics which adequately embraces posterity. Species success seems a rather abstract goal, not likely to inspire altruistic behaviour (and there is no possibility for reciprocal altruism). However, if men may be said to love persons, and cherish certain places, and value certain activities, it may be possible to cultivate a concern sufficient to inspire the sacrifices required for posterity.

Man cannot be considered apart from nature. The fundamental unit of

concern cannot be man alone, but must also embrace some part of nature. The individual, however, may not perceive his special relation to nature, nor be concerned about posterity's need for nature. Most people feel that no economic - or indeed political - sacrifice must be made to nature. (98-16) Man appears to be an economic creature first and an ethical creature second; perhaps it is unrealistic to expect the individual to deal with the objects in his immediate environment in an uneconomic manner. It is necessary to first establish man's need for natural amenities and the vital life-sustaining functions of nature, and then turn attention to finding ways to make individual, marginal decisions which will permit welfare improvements within established environmental constraints. What is good for the individual must be consistent with what is necessary for mankind's survival and well-being. Once this principle is accepted, it is then a matter of defining welfare and assessing nature's capacity to provide a given level of welfare for society in perpetuity.

On the assumption that some minimum amount of nature is necessary to the survival and well-being of society, and accepting that this object is more important than the survival of any given individual, then some protection of nature should take precedence over the protection of individuals. There is therefore a point where some object of nature becomes more valuable than the life of some individual. It is even logical to suggest that the protection of large human populations is not of sufficient value to incur a significant risk to the last viable population of some species deemed essential to the very survival of the species, *Homo sapiens*. The question is: where are the lines around man and nature to be drawn?

The land ethic is not likely to be widely embraced as long as there are hungry and desperate men and the concept of welfare is largely limited to physical criteria, or as long as man's welfare is perceived to be unconnected to the welfare of other forms of life. Even future generations seem of little consequence if wants are too great: a man who is not sure how to provide the next meal for his family is

hardly likely to worry much about the problems of posterity. (17-65) Decision-makers should construct an ecological framework for the law of the land, formally granting recognition to the importance of inter-relationships within which no part can, without danger, claim absolute sovereignty in rights over all other parts. (140-xvi) Since the well-being of mankind depends on the well-being of the natural environment, any goal which truly serves the environment serves mankind. From the individual's point of view, concerned exclusively with his own well-being, this congruence is not apparent. The land ethic will not prevail against the economic ethic unless it is recast into law. Even if man is the measure of all things, it is still possible to grant rights to nature by legally attaching natural objects to mankind, as if they were extensions to the body of society. The land ethic <u>can</u> be translated into law - all that is necessary is to formally invest some group with inviolable property rights in nature. It is possible to make new ontological distinctions, legally recognizing the essential interconnections between societies of men and societies of nature. Perhaps someday all mankind shall be, for some purposes, one jurally recognized "natural object". (140-10)

The fundamental unit of concern may therefore be regarded not as the individual, or society, or posterity, or the species or germ line, but as an abstraction composed of the human species and certain natural goods which together form an interdependent <u>system</u>. Decision-makers must be as concerned about maintaining essential gene pools and well-functioning ecosystems as they are about the condition of individual men or groups of men. Men are part of a whole, and it is the whole which is the proper object of attention.

Unfortunately, no one knows which gene pools and ecosystems are necessary to man's survival and well-being, or at what level existing biological organisms and systems must be maintained to be safe. Ecologists may never be able to precisely define all the constituents of the fundamental unit of concern, but decision-makers must ensure that goals and policy will provide for maintaining in perpetuity significant amounts of the natural environment.

SUMMARY AND CONCLUSIONS

Development policy must be predicated on an understanding of man's place in the world - his relationship to nature and to societies of men. Man's vital relation to nature and to fundamental social units has been damaged by urban-industrial developments.

The natural environment provides a wide variety of amenities, materials, and life-support functions of incalculable value. Contact with nature provides man with aesthetic and spiritual satisfactions which have no substitutes and which immeasurably enhance the quality of life. Even the simple knowledge that "wildness" exists has great value for many people, although direct contact is necessary to establish a truly "sensible" relation to nature. However, 20th century man is transforming the world on a scale and at a rate which is totally unprecedented in nature, and new ethical and legal codes are needed to replace myths and taboos which formerly protected natural goods from over-exploitation.

Urban-industrial societies have not only alienated man from nature but have also weakened the viability of social units by promoting materialism and mobility; traditional rural and village societies provide a better environment for maintaining family and community bonds. The larger and more mobile the society, the weaker its interpersonal relations tend to be: competitive behaviour increasingly displaces cooperative behaviour, and economic values prevail over ethical values. Altruistic institutional mechanisms are therefore needed to control individual self-interest so that the best interests of all will be served.

Any individual's perspective is seriously limited by his unique position in time and space. Man's attitudes and desires are insidiously shaped by processes over which he has little control. The average individual may not be competent to choose the way to maximize welfare

because of limited knowledge and short planning horizons; choices which appear optimal today may not be optimal in the long-term. Decision-makers need to carefully define their responsibilites and goals, and it would seem prudent to keep as many options open as possible.

Man has a poor understanding of the effects of time and the limits of space. It is difficult to assess the extent to which man and nature can be degraded by a series of nearly imperceptible changes, but man's evolutionary history indicates that individuals have a genuine need for certain social relations and direct contact with the natural environment. These needs can best be satisfied if communities do not exceed some optimum size. If decision-makers wish to maximize quality of life and minimize risk to survival over long time horizons, then it is necessary to accept that there are social, economic, political, cultural, and ecological limits to growth. Since limits to growth cannot be precisely determined, it would be desirable to constrain growth until man's impacts can be better understood and controlled. This means accepting some degree of suffering and injustice in the world, however a re-ordering of priorities should make it possible to at least meet the most essential needs of all men.

Before decision-makers can formulate rational goals, it is necessary to define the fundamental unit of concern. While man may be the measure of all things, individuals have limited life-spans, cannot exist at all without support from the natural environment, and require certain social and environmental amenities if life is to have any pleasure or meaning. The fundamental unit of concern might be defined as consisting of society in perpetuity along with those elements of the natural environment which are necessary to man's survival and well-being. Since individuals cannot be expected to make sacrifices for posterity or nature, it would be desirable to extend legal protection to natural objects as if they were a part of mankind. And since no one knows what natural objects are or will be necessary to man's welfare, or at what level any biological system must be maintained, provision should be made to maintain substantial portions of the natural environment to protect all natural goods.

CHAPTER 4

THE NECESSITY TO THINK ABOUT THE FUTURE

"Perhaps they wish for their... children not only a chance to make a living but also a chance to express and develop a rich and varied assortment of inherent capabilities, both wild and tame." (94-58)

INTRODUCTION

Decision-makers should be committed to providing for the well-being of future generations, and this requires a commitment to maintaining significant portions of the natural environment. The urban-industrial model of development is destructive of ecological processes and natural amenities of great importance to the well-being of future generations, but it is impossible to accurately estimate the extent and significance of these losses. A guiding principle should be to manage the environment for optimum sustained yield, maintaining adequate levels of all resources for their possible value to future generations. It is not wise to assume that science and technology will always be able to cope with the problem of exhausted resources.

THE SOCIALLY RELEVANT TIME HORIZON

People discount the future heavily because the future is unknown; today's actions have different effects for today and tomorrow, but today's effects carry more weight. The practice of discounting thus favours today's population at the expense of future populations, and so a common procedure for evaluating costs and benefits of exploiting the natural environment (to produce short-term benefits at the cost of long-term losses in natural amenities) distorts total welfare over long time horizons. In the case of actions which cause irreversible losses to future generations, it might be more appropriate to apply a zero or even negative rate of time preference. However normal practice is to largely ignore long-term needs in order to satisfy short-term objectives. Non-renewable genetic resources, natural objects, and ecosystems are being destroyed because future costs are not being given proper consideration.

The natural environment should be managed for the needs of all generations - a true humanitarian is properly concerned with providing for tomorrow, no matter how distant that tomorrow. To allow environmental destruction because the effects will only be felt in some distant future is a most improvident and inhumane policy. No civilization has ever recovered after ruining its environment; if we ruin the whole world, where is the "outside" to renew our civilization? (70-60)

The rate at which irreplaceable natural resources are being lost is already high and still accelerating. Environmental problems will be most severe in developing countries where there are complex environmental pressures, rapid population growth, unprecedented rates of urbanization, and the urgent need to pursue economic development at whatever cost. (84-96) It is difficult to balance a decision-maker's responsibilities between present and future, but it is necessary to anticipate future needs and the effects irreversible decisions have on countless future generations. High levels of consumption and

resource destruction vitiate environmental buffering mechanisms and diminish natural amenities - these problems cannot be solved by technology. If sustainability is the supreme criterion of value, a form of development which does not destroy the natural environment is necessary.

Economic systems have built-in time-lags which may make them unstable. Decisions should be based on anticipated cost-benefit ratios to avoid future disruptions or even collapse. Goods which are certain to become scarce should be taxed at a rate appropriate to the level of the impending scarcity, and in some cases further exploitation should be prohibited. Such manipulations by a central authority are necessary since there are insufficient incentives in the economic sector to provide for the future. Owners of valuable natural goods cannot afford to maintain these goods for their social values and are inclined to use them for benefits which can be appropriated to themselves. There are also greater pressures to provide for today's needs and governments often circumvent the price system to achieve short-term gains for political expediency. There is a bias toward activities which are profitable and productive over short time horizons - the benefits of maintaining natural areas, renovating urban environments, and improving the quality of education are examples of activities which receive insufficient support because they do not immediately contribute to national income, even though they ultimately contribute to maximizing national welfare.

Long-term planning is essential, and future demands must be anticipated and weighed, and all benefits estimated over time, if development is to be rational. Planning should be particularly concerned with the ecological implications of developments since these can lead to irretrievable breakdowns in society, comparable to the devastation of war. Economic analyses are terribly inexact due to the problem of uncertainty (which pertains particularly to ecological effects which are of a character and on a scale new to man's experience), and therefore favourable cost-benefit tests, for example, can hardly be considered

RISING EXPECTATIONS AND THE DISAMENITY TRAP

The phenomenon of rising expectations is spreading throughout the world. Man's increasing demands are being accommodated with little regard for the effect rapid technological growth may have on natural amenities and the quality of life. Negative feedback signals are obscured by production and consumption activities which have generated tremendous momentum. Man's impacts are already so great (and still growing at exponential rates) that there may already be insufficient reaction time to prevent substantial losses of amenities. If modern technology and institutions permit survival without amenity, they are poor champions.

The provision of natural amenities requires significant amounts of space, but the developed environment is spreading rapidly and men are achieving greater mobility. Sociologists have had insufficient time to assess the consequences (apart from obvious, short-term effects) and causal relationships are not sufficiently understood to anticipate future effects. Consumers demand ever-increasing quantities of man-made goods because the price of future disamenity remains unperceived. Developing countries are generally willing to raise their standard of living "at any price" - but the cost may be greater than is realized: underpricing irreplaceable natural areas and species is potentially much more serious than underpricing minerals, oil, or labour. Future generations can be expected to attach great value to natural amenities. The danger is that the source of these amenities will be destroyed or irreparably damaged by the process of development, and the challenge is to take cognizance of this category of goods now, to protect the heritage of future generations.

Hayes has asked whether it is better to save Serengeti now for its value to the future or utilize it by whatever means for the growing needs of hungry people just outside it. (35-469) If physical demands become too great, the sacrifice of such a treasure may actually come to pass.

Referring particularly to the situation in southern Africa, Hanks says:

> I have no hesitation in rejecting the aesthetic value of wildlife and the "wilderness concept" as a justification for conservation in Africa.... It is totally unrealistic to set aside a large area of the continent... when the land in question is surrounded by an overcrowded, degraded and unproductive Bantu homeland. (64-13)

But lines must be drawn somewhere to limit the destruction of nature so that man's higher needs, as well as future needs, can be satisfied. Decision-makers should be concerned with satisfying all of man's true needs, and not just his physiological needs and material wants; the latter are potentially insatiable, and rising expectations for these goods are inevitably destructive of those parts of the earth which give it pleasantness.

From the conventional economic point of view, it may be unprofitable to reduce depletable externalities to zero if transaction costs are significant: the continuation of an "uncorrected" externality obviously may be consistent with Pareto optimality. (15-23) Therefore maintaining natural amenities (which are public goods) may be regarded as inefficient, and their loss can be rationalized in economic terms. However, the ultimate social cost may be inestimable. All sectors of society will bear this cost, but the poor, not having mobility to escape disamenity, will ultimately suffer more from the spillovers of development than the rich. The more direct claim physiological needs have on man's attention should not cause decision-makers to ignore higher needs, or allow material goods to become an exclusive preoccupation of the citizenry. Some short-term sacrifice in material prosperity would be more than compensated by long-term gains in higher, more intangible values provided by natural amenities. Rising expectations should be kept under control so that future quality of life will not be sacrificed to ever-rising standards of living.

MAINTAINING OPTIONS FOR THE FUTURE

The temptation to exploit all available resources for maximum yields may be nearly irresistible if present needs are great, but consideration of future needs - and maintaining the capability of the land to satisfy them - dictates a policy of management for optimum sustained yield. This means that land must be classified and managed for uses which will provide the greatest benefits over the longest time period. Some wilder lands are best suited to serve the special functions of the natural environment, including the function of repository for genetic resources which may have great future value. Such "option values" may confidentally be assumed to promise far greater benefits than any short-term, productive uses of these lands. Far too much development money is being expended in activities that lead eventually to the casual and random destruction of lands and resources that would have been better to have reserved for some more valuable long-term use. (43-73)

Values associated with biotic diversity will be greater in the future as resources become more scarce. The special values of natural and near-natural areas may become unimaginably large. Developing countries should regard such areas as responsible investments in the future, and insurance against over-exploitation and collapse. The greater the number and size of areas maintained, the greater the prospects of future pay-offs or recovery. There is a large margin of ignorance surrounding the urban-industrial model - if some areas are not reserved and options are not left open, man may pass a climacteric after which there would be no alternative but to accept a low quality existence, and deal with an endless chain of crises.

Man may anticipate, with great certainty, that many resources will be scarce in the future, but it is not foreseeable which resources will be needed and in what quantities. If some minimum supply of natural and near-natural areas are not now provided to conserve genetic stocks and maintain vital ecological processes (at least sufficient to permit a

recovery from disaster), then it will become increasingly expensive, in terms of opportunity costs, to provide such "insurance" as time goes on. The rate of ecosystem destruction and species extinction is high, and as the amount of natural goods available shrinks daily, the possibility of effective action becomes more remote. Landscapes created by past agricultural or pastoral activities should be protected to maintain these activities as continuing ways of life. (151-22) Such areas would be important to science and research, and would preserve traditional knowledge. Their aesthetic and interest value could also provide economic returns from tourism. Preserving options is justifiable, even when future demand is uncertain, if restoration to the original state of affairs is exclusively costly. (59-99) There is a value associated with deferring a decision that will have an irreversible consequence potentially inimical to human welfare. (89-1065)

Genetic materials necessary to strengthen domestic strains or meet new needs may acquire an almost incalculable value, and ecosystems essential to their survival thus acquire like value. Since scientists cannot forecast which genetic resources will be needed (and when), all extant species and their habitats should receive substantial protection for their option value; a need for the careful identification of representative examples of major ecosystems and their acquisition on a basis of a national plan becomes a first priority. (76-1378) Careful planning based on land-use inventories would minimize damage and preserve options. The costs of failure to plan the use of land can be high, whether they be measured in terms of destroyed ecosystems, unmet human needs, urban decay, suburban sprawl, or lost revenues. Development should be confined to areas where vital ecological processes will not be affected. Sufficient areas should be provided to conserve genetic resources. Areas of "critical environmental concern" should be so designated and accorded adequate protection. And land-use constraints should be defined and legally codified, with the intention of promoting a balanced pattern of land use which maintains ample options for the future.

THE "EXHAUSTION OF RESOURCES FALLACY"

Many economists have noted that the unit costs of raw materials for industrial output has been generally declining, indicating that technology improvements have more than kept pace with the challenges posed by dwindling supplies and new resource extraction problems. This has led some to conclude that scarcity will not prove a constraint to growth but only a spur to technology. Others suggest that the decline in private production costs of extractive industry outputs might be more than offset by external environmental costs, so that society is paying more per unit of production but in a different coin - environmental amenities - and hence is no better off. The current consensus among leading environmental economists appears to be, however, that the "exhaustion of resources" argument is fallacious, and there is therefore no absolute impediment to continued economic growth.

Baumol and Oates claim that there is no danger of total exhaustion of our resources; it is, rather a matter of increasing costs of extraction. (16-97) The theory here is that as resources become scarce prices will increase, stimulating exploration for new reserves or the development of substitutes. Seneca and Tausig put this case forcefully:

> ...the modern conservation movement has largely freed itself of the exhaustion of resources fallacy (which) is the argument that because there exists only a finite amount of any given natural resource in the biosphere, continued economic growth will inevitably exhaust the supply of this resource.... The flaw... is that it fails to take into account the ability of a market system to adapt to the threat of shortages and of continued technological advance in the process of economic growth.... Scientists and economists now envision a future in which the only essential raw materials will be energy and the most basic chemical molecules. (133-10)

The above argument has at least three serious weaknesses: (1) "resource"

is too narrowly defined; (2) the market system needs time and information to adapt; and (3) technology cannot solve some problems (e.g., thermal pollution, breakdown of ecosystems) and might be too costly or time-consuming in its development, and is not risk-free. Those who consider the exhaustion of resources argument fallacious or no longer relevant have failed to recognize three important facts: (1) natural organisms, processes, systems, and subsystems are themselves essential resources; (2) time and information costs in managing these resources, or compensating for their loss, can be prohibitively high; and (3) it is extremely unlikely that man can achieve meaningful control over all these resources, or find substitutes for them. The notion that man is dependent only on tangible, non-biological, elementary particles is profoundly dangerous. Man lives not by chemical molecules and high grade energy alone, but also by (among other things) ecological principles which cannot be transcended and for which there are no substitutes.

In Baumol and Oates's critique of "zero economic growth", (16-137) economic growth is seen as necessary because it is assumed that material demands will continue to grow. The authors discuss one category of resources - minerals - needed to fuel this growth, and conclude that threatened failures in supply can be indefinitely averted through recycling, improvements in output per unit of input, and the discovery of substitutes. But perhaps they are addressing the wrong problem. Solving the mineral shortage problem will only result in more serious problems if increasing industrial activity puts an intolerable strain on the continued functioning of essential species and ecosystems. The same approach to <u>this</u> problem will be to no avail: biological systems cannot be reprocessed after exhaustion, their efficiency cannot be significantly improved (since living processes are not amenable to technological innovation, being vastly more complex and mysterious than inorganic systems), and there are no substitutes for their fundamental units or some of their vital functions. It behoves decision-makers to remember that "the technological fix" cannot restore or provide meaningful substitutes for some categories of resources. An obvious example is the loss of species or natural processes which serve some essential or valued function (like fixing

nitrogen, or regulating the partial pressure of carbon dioxide in the atmosphere), or are necessary to the enjoyment of natural amenities (like catching a rainbow trout or walking through a yellowwood forest).

Another limitation of technological solutions to the problems generated by economic growth is that it takes time to develop and apply them. Pressures from increasing population and per capita consumption growth rates will increase the rate of resource depletion (necessary to provide industrial inputs) and this rate could outpace exploration and extraction and substitution technology rates. In any case, there must be some ultimate limits (ecological and political) in a finite world, and the odds of reaching at least one critical limit when the scale and rate of transformation is increasing exponentially are frighteningly high. The possibility that pressure will be reduced as limits are reached (and costs become exorbitant) seems unlikely considering the rising expectations of the deprived and given the historical reluctance of the privileged to suffer even the slightest reduction in material well-being in order to bring about a more equitable distribution of economic goods. This situation could prove calamitous; even if there are no theoretical technological limits, there are still most certainly political limits.

The problem of ecological limits is just as serious. Ecologists have learned how difficult and dangerous it is to tamper with the intricate interrelationships of even small ecosystems. While some economists talk about meeting the world's mineral needs "from the mining of common rock, and the distillation of sea water" (42-62) ecologists recognize that this would require inconceivable amounts of energy, present incredible waste disposal problems, and be enormously disruptive of many vital ecological processes. The ecological impacts of such large-scale undertakings are incalculable, but certainly they entail high risk. The ready willingness that some economists have displayed in accepting that rock, sea water, and energy are all that man needs in the way of resources betrays dangerous inattention to some vitally important questions, such as whether technology will be available when needed,

what the ecological effects will be, what costs are attached to increasing special forms of energy production (e.g., the long-term hazards of nuclear wastes), what costs are attached to increasing general energy production (e.g., thermal effects), and what kind of world would result.

Beckerman has suggested that it is possible for earth to carry 20 billion people at current American living standards simply by using the virtually limitless resources that exist of atomic energy, water, air, and the minerals locked up in common rock. (18-226) However he fails to suggest how the problem of heat disposal might be solved, to name just one very real problem which ecologists feel may have no technological solution. He also fails to discuss a host of other problems which could result in traumatic and potentially disastrous ecological, sociological, and psychological upsets along the road to Utopia. The fact that resources theoretically exist in abundance, and technology may be available when needed, does not mean the growth problem may be presumed to be solved. The effects on the biosphere - such as destroying genetic resources (and the resulting loss of biological functions to which man's welfare may be inextricably linked), and the unknown but potentially damaging results from lost or destabilized ecosystems - must all be carefully considered, and the risks weighed, since some of these effects may well constitute megacosts which could make growth beyond a certain point absolutely prohibitive.

It is perhaps desirable to explore a more viable approach to future economic development, one that does not involve so many physical transformations and does not impose so many burdens on the biosphere. Ecology would suggest a "steady-state" approach, with physical stocks and flows being held relatively constant and activities disruptive to natural systems kept at some minimum low level. Such an approach would necessitate a redefinition of economic growth and a new policy to encourage those activities which enhance well-being but are not destructive or disruptive of natural goods. For nature as a whole, economic growth (as presently defined) has great destructive potential

and questionable salutary potential. If man identifies his future interests with nature, rather than material gain or technological advance, he will set about curbing this form of growth and concentrate on solving distributive problems (for political and ethical, as well as ecological, reasons). The choice is between a balanced, harmonious, relatively risk-free existence in association with nature's bounty, against a dangerous and sterile existence in a mechanized wasteland.

SUMMARY AND CONCLUSIONS

Natural goods are being destroyed because future costs are not being considered, and goods which do not immediately contribute to welfare tend to be neglected. The socially relevant time horizon should be extended to encompass future generations in perpetuity. This would require a pattern of development which is not destructive of the natural environment.

Long-term planning must consider the ecological implications of development. Since ecological costs are poorly understood and forecast, risk-aversion should be given high priority. Future quality of life should not be sacrificed to raise the present standard of living. Urban-industrial development reduces the level of natural amenities, which may be more important to future welfare than many man-made conveniences and amusements. Amenity losses can be suffered without being perceived, and it is not possible to accurately estimate the extent of these losses or their effect on welfare.

The natural environment should be managed for optimum sustained yield, and option values should be maintained as responsible investments in the future. If development can proceed without conclusive evidence that costs will exceed benefits, there is great danger that some essential biological resource will be exhausted or some vital life-support

function will be irrevocably impaired. Many biological systems and ecological processes on which man's well-being depends have no substitutes, and institutional management is limited by insurmountable time and information costs. Economic feed-back mechanisms may be frustrated by political inertia, and technological lags may prove intolerable. Maintaining a steady-state economy would substantially reduce the risks of destroying invaluable natural goods.

CHAPTER 5

AN APPROACH TO DECISION-MAKING:

FORMULATING REASONABLE GOALS

"Opportunity for exercise of all the normal instincts has come to be regarded more and more as an inalienable right." (93-167)

INTRODUCTION

A rational approach to decision-making would be to identify man's true needs and then formulate goals based on the satisfaction of these needs. Specific objectives and policies could then be evaluated in terms of these goals, providing a logical framework for assessing alternatives and making choices. In order to identify the needs of man and determine how they may be best satisfied, it is necessary to consider the psychology of man and explore the meaning of welfare.

MASLOW'S HIERARCHY OF NEEDS

The psychologist Abraham Maslow contends that there are discoverable species-specific characteristics of humanness. (103-95) These give rise to the basic needs of man, on which well-being depends. The

basic needs are in the strictest sense biological needs; that is, their deprivation produces disease or illness. (102-734) Maslow feels these needs have a genetic basis and so terms them "instinctoid". An important point is that the organism itself dictates hierarchies of values, which the scientific observer reports rather than creates. (103-97) Thus, a universal value system for man can be objectively determined, and man's true needs can be described and ranked in terms of relative potency, thereby providing a firm foundation for goal determination.

Maslow distinguishes five basic needs (Figure 1): (1) physiological needs (the need for homeostasis or a constant, normal state of the blood stream); (2) safety needs (the need for feelings of personal security); (3) belongingness and love needs (affectionate relations with people in general); (4) esteem needs (which include both self-esteem and the esteem of others); and (5) the need for self-actualization (the need to be true to one's own nature; to do what one is best fitted for). Maslow describes two other needs which seem to be related to the need for self-actualization: cognitive needs (the need to know or understand), and aesthetic needs (the need to perceive beauty and avoid ugliness). (103-36, 39, 43, 45, 46)

Maslow's theory further states that the basic human needs are organized into a hierarchy of relative prepotency. (103-38) As soon as one need is satisfied, a higher need emerges. A want that is satisfied is no longer a want, so that an individual is dominated and his behaviour organized only by unsatisfied needs. (103-38) A man's outlook on the future thus depends on what need is dominating at present. For example, physiological needs are the most prepotent of all needs - if one is hungry, it is hard to imagine a world in which goods other than food play a very major role. Thus an idealist's conception of Utopia depends on his present metabolic state, and the degree to which other needs have been satisfied. (103-36,37)

Maslow feels that one can distinguish between "basic needs" and needs

PROGRESSION OF NEEDS

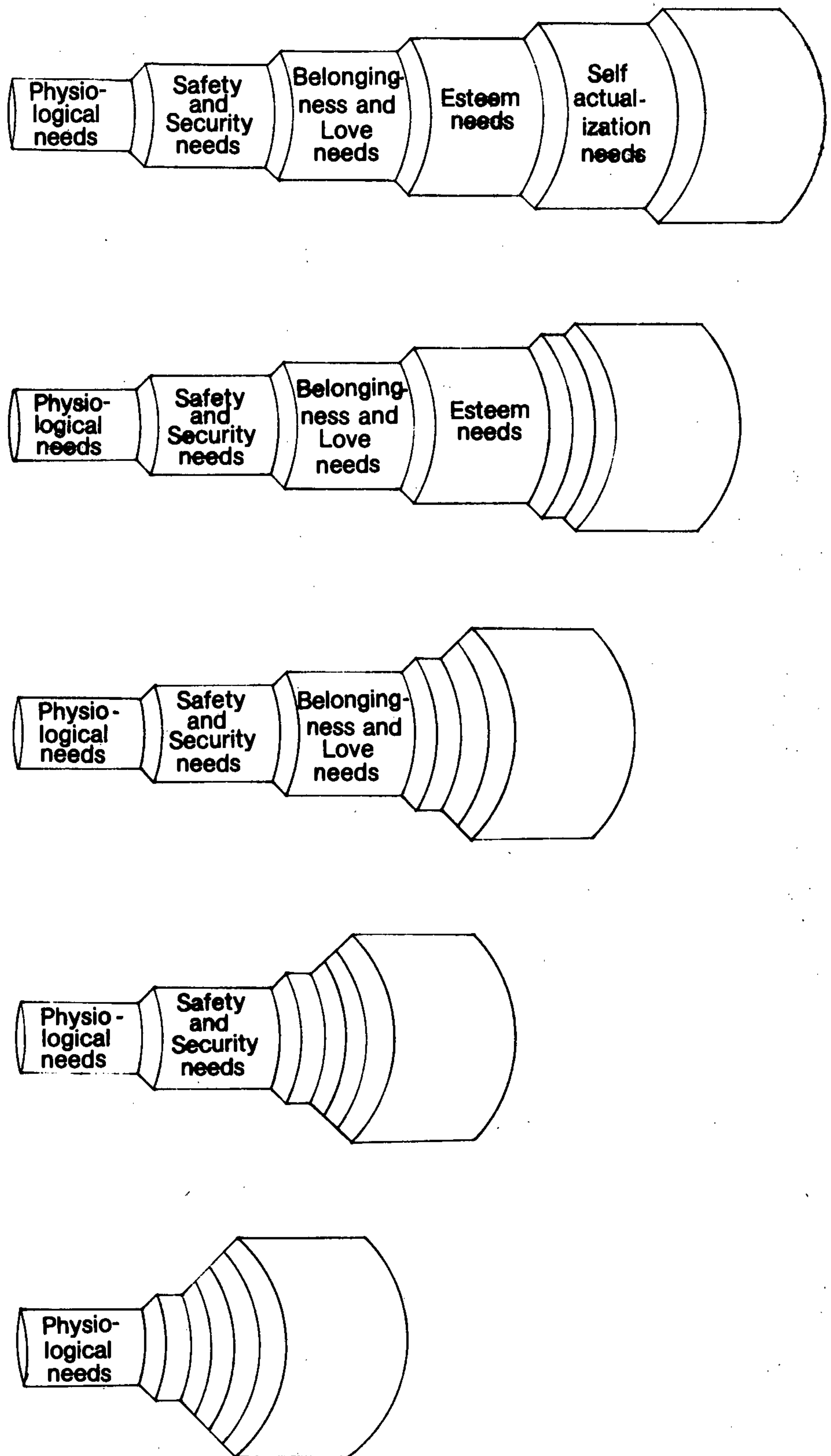

FIGURE 1

which are culturally-induced:

> The basic needs stand in a special psychological and biological status. There is something different about them. They must be satisfied or else we get sick. (103-92)

A "sick" man may be defined as one who's basic needs have been thwarted, and this

> sickness in the individual must come ultimately from a sickness in the society. The good or healthy society would then be defined as one that permitted man's highest purposes to emerge by satisfying all his basic needs. (103-58)

Man's highest need is self-actualization, which refers to man's desire for self-fulfilment, namely, to the tendency for him to become actualized in what he is potentially - to become everything that one is capable of becoming. (103-46) Satisfaction of man's ultimate need - self-actualization - may be regarded as the supreme goal of society.

Maslow's theory provides a rational framework for formulating goals on which to base policy. It even indicates which goals must be given priority, and also reveals how rational men may be misled into giving too much weight to today's most pressing need (because higher needs cannot make themselves felt until lower needs are reasonably satisfied). There remain difficulties however, such as how to decide what social objectives are most appropriate in terms of these goals, and how to deal with the problem of limited resources (for example, is it better to seek the maximum good for the maximum number, even if no individuals achieve self-actualization, or is it better to permit some to achieve self-actualization, even if some others may then have only their lowest needs satisfied?). On the level of society, value judgments must still be made and this requires a careful study of the condition of man. Finally, while it is assumed that man is the measure of all things, individuals are not immortal and do not exist *in vacuo;* it

is therefore necessary to consider the needs of posterity and the continued existence of those natural goods on which man's well-being depends.

THE SPECIFIC GOALS

The foregoing considerations suggest that there are five goals which may be regarded as proper and necessary to the well-being of society. Decision-makers should seek to provide for:

1. Health and physical well-being;
2. Protection from violence and insecurity;
3. Social stability and economic justice;
4. Aesthetic, cognitive, and spiritual satisfactions;
5. The needs and aspirations of future generations.

Ensuring provision of the minimum requirements for health and physical well-being would satisfy physiological needs; protection from violence and insecurity would satisfy safety needs; improvements in social and economic justice would help provide for belongingness and love needs as well as esteem needs; providing opportunities for aesthetic, cognitive, and spiritual satisfactions would contribute to the attainment of the need for self-actualization; and planning for the needs and aspirations of future generations would help ensure that social progress will be sustainable. (Figure 2)

While these goals may be regarded as hierarchical in concept, they should be considered inseparable: all goals are necessary to achieve a state of well-being for society and there should be no question of choosing to maximize some and neglect others. No amount of physical well-being will compensate for the lack of aesthetic and other "higher

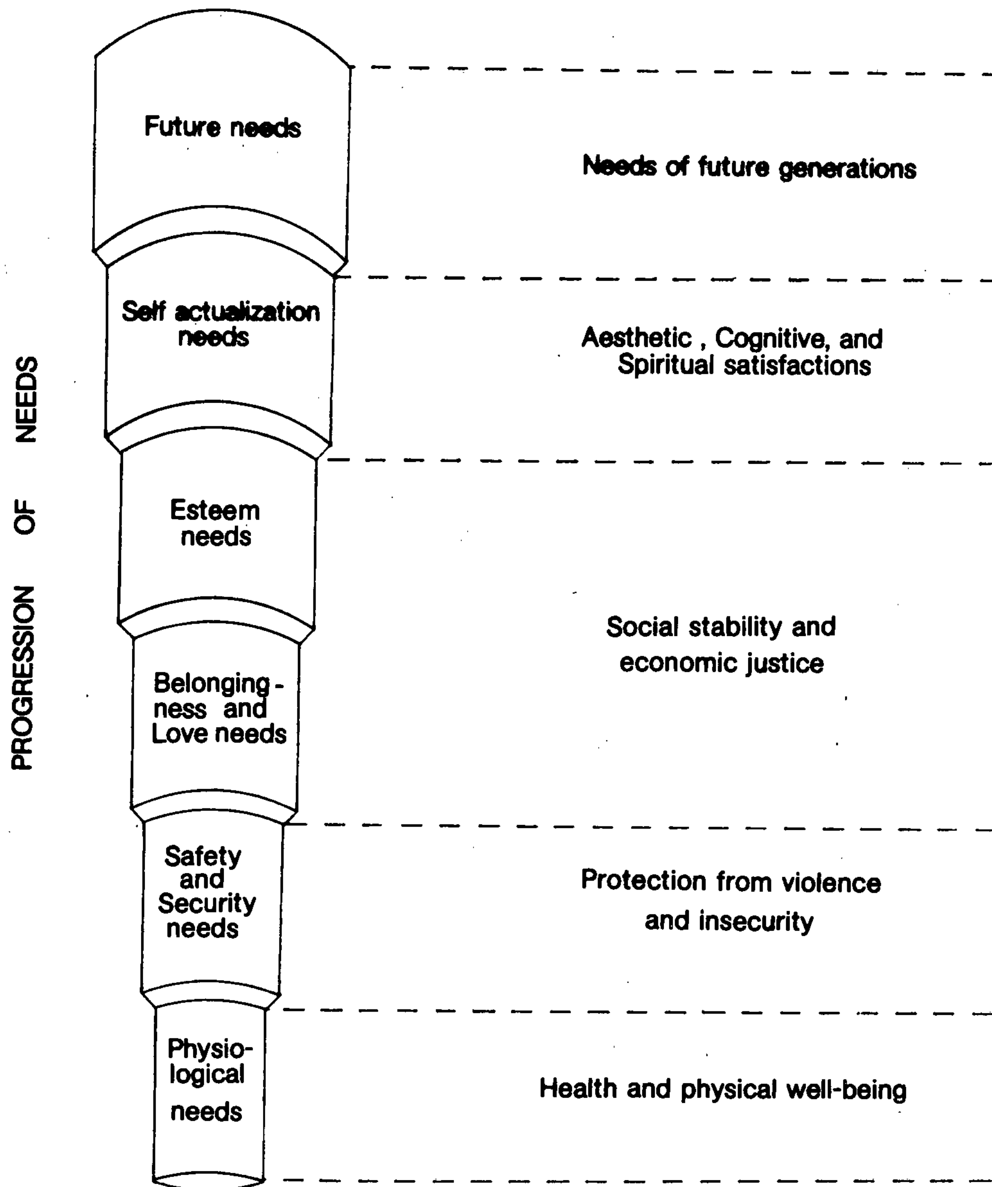

FIGURE 2

order" satisfactions - the need for self-actualization is as important as the physiological needs if well-being is to be maximized. Satisfaction of lower needs is a pre-condition for satisfying higher needs, but over-gratification of a need does not contribute to (and may interfere with) the satisfaction of the next highest need. The five goals are therefore properly regarded as being five aspects of one goal, to maximize social well-being, and the challenge is to design a policy which provides the optimum balance of satisfaction among the five aspects of social well-being.

THE MEANING OF WELFARE

Economists have devised various indices of social welfare, but these do not necessarily actually indicate the well-being of society. The welfare theorem that economists have postulated suggests that in a market of perfect competition, if market costs reflect true social costs, then the best strategy to maximize individual welfare would maximize social welfare. This theorem rests upon the important assumption that collective welfare should necessarily be based on the summation of individual choices. However the rationality of incremental decisions may not be a reliable guide to improvements in collective welfare. Even if it can be shown that for each individual a given action will yield more benefits than costs at the margin, the aggregation of such benefits and costs for a number of individuals may provide a different result. This can happen if costs are enduring and benefits are not, or if the nature of the benefit depends on some advantage relative to others, or if individuals prove incompetent to foresee the eventual consequences of their decisions. Hooker, applying the logic of the welfare theorem, suggests that lemmings can be said maximize their collective welfare when individuals decide to migrate due to overcrowded conditions, although it is well known the entire population can literally end up out to sea. (75-176)

Most indicators of social welfare are related to the provision of comforts or conveniences (and the maintenance of existing social machinery) which may increase well-being up to a point but may after that point actually reduce well-being. These indicators are only presumptions and may therefore be dangerously misleading. Decision-makers need to develop some yardstick for human content; this is the ultimate concern of politics. (2-16)

Modern political systems seem to aim at salvation by machinery; they proceed on the theory that if we can all keep warm and full, the good life will follow. (95-51) Maslow's theory indicates that the satisfaction of physiological needs only precipitates the emergence of new needs (which cannot be satisfied in the same way), and has no lasting value in itself: the blessings we have already achieved come to be taken for granted, to be forgotten, to drop out of consciousness, and finally, even, not be valued any more - at least until they are taken away from us. (103-xvi) Providing for physiological needs is a necessary but not sufficient condition for the good life. Once subsistence levels are passed, men's more enduring satisfactions are to be found in love, trust, friendships and, in a civilized society, are augmented by their perceptions of nature, and of beauty, art and music. (18-74)

It may be that economic growth in developed countries has not significantly contributed to improvements in man's welfare (beyond meeting the most basic needs) and has in fact destroyed some cardinal sources of welfare hitherto available. (106-161) A central weakness of the market system is its inability to formulate public needs above those of the market place. (72-132) It is necessary to rely on other institutional mechanisms to provide for higher needs. Unfortunately, the influence of the economic sector is pervasive (even in planned economies), and it is commonly assumed that expansion of economic welfare necessarily contributes to improvements in social welfare. However, there is no evidence that the rich are happier than the poor, or that individuals grow happier as their incomes increase. (96-420)

This indicates that a policy dedicated to unlimited increases in any standard of living index may be unproductive, or even counter-productive. We have all too easily equated rising standards of living with "the good life"; only recently have we begun to have serious doubts about the association between the two. (16-1) The evidence in economically developed societies suggests that marketing activities so alter tastes and preferences that individuals become persuaded they have illimitable material needs and that welfare depends on their satisfaction. It may be that in consumer-oriented societies the satisfaction of basic material needs stimulates more material desires rather than a striving for self-actualization. (139-19)

Wants vs. Needs

The science of economics is widely regarded as being a trustworthy guide to welfare maximization by revealing how needs may be satisfied in the most efficient manner. Strictly speaking, there are no "needs" in economics. There are only choices - individual and collective. (110-243) Man can choose to improve his welfare by reducing his wants. This is the choice favoured by ecological considerations. But the economist generally seeks to maximize consumption over fairly short time-spans and so concentrates on improving the standard of living, which is measured by the amount of annual consumption, assuming all the time that a man who consumes more is "better off" than a man who consumes less; perhaps the aim should be to obtain the maximum of well-being with the minimum of consumption. (129-52) If a society becomes preoccupied with materialistic aspirations, the individual's higher needs may go unrecognized and unsatisfied while his lower needs are satisfied to the point of satiety. There is a penalty for too much comfort and ease, a penalty of lassitude and inertia and the frustrated feeling that goes with unreality. (113-208) Life may thus be reduced to a shadow of its real potential, as it becomes possible to go through life and never be passionately stirred. (65-65)

The "standard of living" shibboleth has dehumanized man; there should be a shift away from consumption of goods which encourage greed and envy. Peace and fulfilment cannot be attained simply through universal prosperity, and industrial progress can actually reduce man's welfare in the long run. (129-28) The bewildering assortment of goods offers the sort of expansion that is as likely to subtract from than to add to his welfare. (106-161) Certain spiritual or non-material goods should be set above material goods, as the former are infinite and infinitude can never be achieved in the material realm. (129-32) If (as it appears) there is a conflict between these two classes of goods, then, once subsistence levels are passed, it would seem desirable to abandon the pursuit of further material goods and seek more rewarding satisfactions, such as are found in social intercourse, cultural accomplishments, and perceptions made possible through contact with the natural world. It is suggested that there is a point beyond which conventional economic welfare experiences rapidly diminishing marginal utility, and it is at this point where higher order goods experience rapidly appreciating utility. If this point were properly perceived, then total welfare could be enhanced by trading consumption of economic goods for greater consumption of the products of nature and other goods.

After the most basic physiological needs are satisfied, discontent may arise more because of relative rather than absolute deprivation. Sociologists have noted the significance of the individual's perception of his well-being in relation to that of others. Economists recognize this same principle, and call it the "relative income hypothesis". (106-160) The satisfaction of man's true needs are the proper goals of society, and their satisfaction does not appear to depend on income or equity improvements: any sensitive regard to social welfare would seek rather to alter our philosophy of life than to alter income differences. (110-128)

There may be some advantage to living in a traditional society, in which one's position is more or less fixed and accepted. Traditional

societies provide institutions which clearly define roles and relationships, and this lends security to the individual in respect to the rest of society. Such institutional mechanisms may be extremely effective in satisfying three of man's basic needs: safety needs, belongingness and love needs, and esteem needs. Modern industrial society, by comparison, is based on competitive principles and a striving for upward mobility which seems designed to ensure a perpetual state of insecurity, uncertainty, and frustration. Even if one achieves security, acceptance, and respect within his community there is no institutional assurance that these will not be lost.

Work and Leisure

Economic welfare is principally measured in terms of money income and voluntary leisure, but an important aspect of the condition of man is the satisfaction of work. It is interesting to note that economists acclaim economic growth largely for its reputedly salubrious effects in freeing man from ceaseless toil, while others attack "the economic race" for undermining the health of modern man and claim that the pressure for an ever faster working pace renders man unfit for leisure. (98-19) There is no evidence that hard work, or long hours spent in work, is in itself undesirable. Work can be regarded as a good thing which confers at least three benefits: (1) a chance to develop faculties, (2) a chance to join others in a common task, and (3) the production of more goods and services. (129-49) The first contributes primarily to the needs for esteem and self-actualization, the second to the needs for belongingness and love as well as esteem, and the third to physiological and security needs. In industrial societies, work has become more exclusively concerned with the efficient production of goods and services and less relevant to other needs. The potential for self-actualization, for example, is diminished when efficiency considerations lead to mass production techniques. Work should be seen in a Buddhist perspective - it is first joyful and creative activitiy which only secondarily produces something. (55-192)

Even the alleviation of kitchen drudgery has perhaps had insidious effects - members of a family do not eat together so often, or value the act of producing and preparing food so much, and this may be contributing to the breakdown of the family observed in modern societies.

Increases in leisure time may also be of dubious value, depending on how it is used. The mass of men in industrial societies seem bent on the pursuit of mindless or vicarious pleasures and appear absorbed in petty, frenetic activities to allay boredom. This may be partially attributable to the loss of direct contact with nature and a direct concern with fundamental necessities - perhaps meaningful work or pleasure depends on a certain relation to nature. Increases in leisure time made possible by industrial development do not necessarily contribute to welfare since the ability to enjoy leisure presupposes a state of mind, arising from a sense of ease and unhurriedness, which allows a person to immerse himself in the here and now. (110-158) Modern, industrial man has largely lost this ability. And part of the reason is the pace of consumption: if welfare is measured in consumption, then everyone is striving to maximize consumption to maximize welfare. But something else is consumed in the process: time, peace of mind, and the ability to reflect and enjoy. Man may be losing his capacity for gratification and living more superficially. Perhaps there is a negative relation between the technical complexity of a civilization and the individual's capacity for instinctual enjoyment. (110-166)

The Road to Industrialization

Modern man is rapidly losing his power of choice over how he will live. Once the processes of industrialization and urbanization have created a society which is basically hedonistic, it may not be feasible - economically, socially, or politically - to re-create society even though higher goals are subsequently perceived. A collective initiative to forgo immediate and tangible benefits, or to sustain immediate and tangible losses, in order to create for everyone a more wholesome

and radically simple style of life, or to forgo the familiar range of creature comforts and labour-saving devices in the quest for sources of more enduring satisfaction, entails a momentous social decision. (110-135) The road to industrialization and urbanization is paved with expectations of rising incomes and greater opportunities. If it could be demonstrated that this actually leads to a situation in which we need to work harder to pay for our needs, perhaps a new road to development could be chosen. (106-40)

If quality of life, rather than simply the standard of living, becomes the criterion of development, there may be greater recognition of the importance of natural amenities and environmental buffering mechanisms to man's welfare. Large, industrialized societies replace natural amenities with material amenities, such as cars, airplanes, and television sets, which then become increasingly important as the individual finds he can no longer reach the inn, the theatre, the market, the fields, and the streams. (85-19) Kohr distinguishes three types of "necessities": biological, cultural, and technological. Biological necessities are imposed by man's constitution and his relation to the natural environment; cultural necessities are imposed by the social environment; and technological necessities are imposed by the built or man-made environment. Kohr feels that cultural necessities stimulate economic growth by making necessities out of luxuries, and this has the effect of pushing subsistence levels upwards - consumption increases without really improving welfare. Economic growth also increases the size of society and speeds some of its processes, generating technological necessities which are supplied by "density commodities" (such as driving licenses, traffic lights, etc.) Kohr's thesis is that economic growth improves individual welfare until society reaches a critical size and stage of development, and then welfare losses are experienced. The development trap is this: cultural and technological luxuries have a way of turning into undesirable necessities (such as the automobile), and true biological necessities, which make a direct and genuine contribution to well being (such as the sights, sounds,

and smells of nature during a country walk), are displaced and their value tends to be forgotten. (85-41)

Therefore, improvements in economic welfare do not necessarily result in social welfare improvements. Costs of maintaining a complex industrial state increase disproportionately as economic development proceeds so that quality of life can decline with further increases in the standard of living. A major objective of developing countries should be to keep the costs of social machinery down - in the long run, this may be more important than production and distribution objectives. Many of the items included in Gross National Product (GNP) are actually transaction costs, or costs of a faster pace of life, which do not bring greater welfare. Much of an industrial nation's effort and ingenuity is spent in producing sophisticated products and specialized services that cater to basic biological and psychic needs which were more easily, and often more fully, met in pre-industrial societies. (110-46) The real measure of economic and social welfare is not income at all, but the condition of the person or of society - which has only a slight relationship to GNP because GNP as currently calculated includes a large component of negative goods and services. (141-19) (An "amenities index" could theoretically provide more meaningful indicators of social welfare, but the difficulty in quantifying and comparing amenities with marketable goods will probably remain insurmountable.) Decision-makers in developing countries still have the opportunity to direct their societies along more responsible and satisfying development paths, and to discourage dangerous and unfulfilling activities based on the consumption of durable goods and energy (e.g., cars and petrol) by controlling infrastructure and financing (e.g., highway construction and automotive plants). The slate is still reasonably clean, and perhaps expectations are not yet terribly high.

Controlling Development

There are two aspects to man's environment - the natural and the man-made - and each contributes to man's well-being. The level of utility of each member of the community is presumed to depend on two things: his own consumption of private goods and services, and the environmental conditions to which he is exposed. (47-xx) It is difficult to estimate the relative significance of natural and man-made benefits, but decision-makers tend to get fixated on economic utility and neglect natural goods. While there is no question that basic economic needs (food, clothing, shelter, etc.) have priority for any individual, it is important not to lose sight of the fact that consumption of commodity resources may destroy natural goods vital to the satisfaction of other needs. It is possible that developing countries will destroy their supply of natural goods before they have achieved economic goals, and so fail to provide for future needs. It would seem desirable to build safeguards into the economic system against excessive levels of development and protect already scarce supplies of natural goods; such "goods" as wildlife, scenic vistas, space, peace, and quiet should be given full consideration in a policy of development, and a set of incentives should be adopted to ensure their provision in perpetuity. If this is not done, man may lose control over the environment and some of his own institutions, and there will be diminished possibilities for achieving aesthetic satisfactions and experiencing feelings of peace, self-sufficiency, and psychological well-being. In general, people in industrial societies do not seem to find their present mode of life particularly enjoyable; we need to experiment with alternatives which are at the same time less polluting and less wasteful of resources. (120-99)

The Importance of Environmental Quality

Raymond Dasmann has observed that man's basic goals are sequential:

> There are two things of fundamental importance to all people. One is to stay alive. The second is the quality of that existence. The second only comes into play when the first is provided for.... (42-3)

Many people say that developing countries cannot afford to be concerned about environmental amenities, and yet what is the value of a marginal existence? Dasmann's two goals are properly one. If the poor survive only to propagate more poor (and misery), mankind is at a dead end. Adequate attention must be given the second goal, and it must be made clear that the quality of existence depends on the quality of the environment - <u>not</u> on material goods. In fact the problem of staying alive also depends on the quality of the environment: where people are <u>not</u> surviving is where people have destroyed their environment. Where people are surviving, the second goal usually gets corrupted and turned into a striving for material goods and a concern with the "standard" (rather than the "quality") of living.

Allison has described how the horrors of poverty can give way to something more subtle but also crippling - like trading malnutrition for some other, more insidiously degenerative disease. As England solved the problems of working-class poverty, it encountered new problems associated with working-class prosperity: the ugliness, the mediocrity, the frightening expansion of urban and suburban areas, were the outward and visible sign of some deep-seated change for the worse. (2-52) People were saved, but the landscape was sacrificed - the sustaining environment was degraded, diminished. Decision-makers of developing countries should consider whether this is an acceptable scenario, a model worthy of emulation. Is it economic to accept standardization which leads to dreariness and ugliness? If man perceives diversity and beauty as having spiritual utility, then these qualities have true economic value. It is disheartening that many dedicated conservationists are reluctant to argue the economic merits of these "higher values" - is the population so far past optimum that spiritual values must be sacrificed just to meet the physiological needs of man, or should

decision-makers insist that some substantial provision be made for enhancing the quality of life?

The quality of life depends on the quality of the environment, but environmental quality is a most complex concept. It is relatively easy to say what physical factors can lead to degradation of environmental quality, but very difficult to specify what constitutes or leads to a high quality environment. Such judgments may not be subject to scientific determination, and it may be necessary to make rather unscientific and subjective decisions about values and objectives before scientific methods can be applied to the task of maintaining environmental quality. There is much evidence that the natural environment makes a vital contribution to the quality of life. Natural influences inspire men and refine their character, while alienation from nature seems to have a generally debilitating effect on spirit and character. The good life would require that society be so organized that people are not far removed from the immediate sight and sound and rhythms of nature. (110-154)

SUMMARY AND CONCLUSIONS

Man appears to have objectively determinable needs and it would seem reasonable to derive social goals from a study of man's true needs rather than from culturally-induced needs or "wants". Man's biologically determined needs are of three types: materialistic (physiological and security needs), social (belongingness, love, and esteem needs), and moral or spiritual (the need for personal fulfilment). These needs are organized into a hierarchy of relative prepotency, so that the lower needs must be reasonably satisfied before higher needs are felt. There is a danger that decision-makers can get fixated on the needs of lower levels and neglect the higher needs, or get fixated on the needs of today's society and neglect the needs of posterity.

Over-gratification of one need does not contribute to satisfying other needs; the ultimate goal is to provide the optimum balance of satisfaction of the various needs of man for all time. Too much emphasis on materialistic needs leads to environmental problems and shortages of resources to satisfy higher needs. It would seem prudent to recognize environmental limits and the diminishing marginal utility of material goods to provide for physical well-being and security, and restrict the production of superfluous economic goods in order to provide greater social and economic justice and greater opportunities for aesthetic, cognitive, and spiritual satisfactions.

Most indices of social welfare are inadequate or misleading, and economic welfare does not necessarily correspond to social welfare. Man can improve his total welfare by reducing material wants and trading excessive consumption of economic goods for greater consumption of natural amenities.

Industrial development has dehumanized work, reduced the value of leisure, destroyed natural amenities, vitiated environmental buffering mechanisms, and imposed great technological burdens on society. Traditional societies may offer more opportunities for meeting safety, belongingness, and esteem needs than do modern societies. Traditional societies also offer significant opportunities for spiritual and aesthetic satisfactions through intimate contact with nature. Development in traditional societies must be carefully controlled and directed so that social and environmental conditions important to man's well-being are maintained.

CHAPTER 6

THE PROPER PURSUITS OF MAN

"The question is, does the educated citizen know he is only a cog in an ecological mechanism? That if he will work with that mechanism his mental wealth and his material wealth can expand indefinitely? But that if he refuses to work with it, it will ultimately grind him to dust?" (93-64)

INTRODUCTION

Decision-makers have two ultimate responsibilities, and every choice should be evaluated in the light of these over-riding concerns: (1) will a given action in some way contribute to the further development of mankind (so that man may become what he has it in him potentially to become), and (2) does the action entail any increased risk to the survival of mankind? Many decision-makers appear to be concerned only about providing for the lower and culturally-induced needs of man, and show little concern for the way in which present decisions affect posterity's prospects. This chapter will examine the reasons why the most important pursuits of man - to survive and achieve fulfilment - do not preoccupy the thoughts of most decision-makers.

FULFILMENT OF THE INDIVIDUAL AND THE HIGHEST DEVELOPMENT OF MANKIND

The proper concern of the state is to provide its citizens with the good life, the *summum bonum*. Welfare economics is concerned primarily with physical well-being, and accepts consumer preferences as given; man's higher needs may go unperceived and neglected. Psychology and philosophy are concerned with elucidating these higher needs and providing an orderly system of ideas by which to live and to interpret the world. (129-75) Maslow calls for a "normative biology" (102-725) and says it is legitimate and fruitful to regard instinctoid basic needs as rights as well as needs. (103-xiii) This provides the basis for establishing social goals, as well as criteria for evaluating a society: that society is good which fosters the fullest development of human potentials, of the fullest degree of humanness. (102-726) Attainment of the highest need - the need for self-actualization - is the ultimate criterion of success. Decision-makers must consider the quest to satisfy man's highest aspirations as their ultimate concern. The final goal of society should be to produce healthy, fulfilled organisms.

Higher needs are essentially positive in conception. Satisfaction of belongingness and love needs, esteem needs, and cognitive and aesthetic needs produces happiness, joy, contentment, elation, or ecstasy, whereas frustration of these needs may produce only the most subtle signs of disutility. This is in striking contrast to the obvious physical and psychological manifestations of failure when physiological and security needs are not satisfied, and the subtle signs of utility when they are satisfied. Lower needs clamour for attention; higher needs are more difficult to discern. Decision-makers are therefore inclined to adopt a basically negative approach to social goals: they seek to avoid need frustrations rather than to positively meet needs. This attitude results in a bias against higher needs, and a nearly exclusive preoccupation with providing for physiological and security

needs. But filling empty stomachs - as necessary as that may be - will not result in the good life if other needs are subsequently frustrated. Lower needs cease to play an active determining or organizing role as soon as they are gratified. (103-57) It is therefore necessary to plan and provide for the satisfaction of higher needs which, because they can never be completely satisfied, will always provide potential for further gratification and greater well-being.

Economic activity is primarily concerned with satisfying physiological and security needs, but because of the prominence of these needs the term "economic welfare" is often thought of as being synonymous with "social welfare". However, over-gratification of physiological and security needs leads to a kind of psychological suffocation. Materialistic pleasures are necessarily shallow because lower needs have limited potential for gratification. Over-consumption of economic goods only results in satiety or boredom rather than satisfaction, and inhibits the emergence of higher needs. Since the individual is unable to perceive his real needs, he may seek relief from stupefication or agitation through further consumption of a type which provides sensory titillation or some form of escapism. Finally, all that is sought is a kind of effete pleasure, a pale imitation of joy, or else some reckless and desperate source of stimulation.

What is needed is a change in attitudes and behaviour, to be more sensuous in our attitude to the world, more ready to enjoy the present moment for itself, instead of frenetically seeking the power and security that possessions offer. (121-20) Institutions should be designed to free man from greed and short-sightedness. The consumption of consumer commodities and the attainment of great physical security are not man's only pleasures, and do not give purpose to his existence. Civilization's most notable achievements are intellectual and spiritual, and bear little relation to economic welfare and technological developments. Perhaps the ancient Athenians were one of the most successful societies in history: they made their society one designed to bring all its members to the fullest development of their highest powers. (72-133)

Rather than seeking greater material satisfactions through economic growth, the ancients cultivated man's inexhaustible appetite for beauty and knowledge, permitting a kind of growth which truly enhances man's well-being. Economic welfare is a necessary but not sufficient condition to achieve true well-being.

What then is meant by "well-being"? Is the answer not simply to realize fully the extent or potentialities of one's being, to know one's innermost depths and manifold relations, to raise the level of one's awareness of all things, to feel sympathy with the universe, to exult in existence? And are not all common answers too limiting and therefore false?

Nature is of utmost significance in providing for two of man's basic needs: his physiological needs, and his need for self-actualization. The first permits survival, and the second makes survival worthwhile. Both needs must be accommodated; survival must be made worthwhile. Man achieves psychological freedom through his relation with the environment. Exposure to natural influences, such as the beauty and purity found in wilderness settings, has an elevating or ennobling effect, and there may be no comparable source of such satisfactions. The natural environment is primarily a means to the person's self-actualizing ends. (103-68)

THE SUSTAINABILITY OF SOCIETY

A commitment to maximizing individual welfare implies a commitment to posterity. We should be concerned about posterity because men have not yet achieved all that they have it in them to achieve. (120-83) In order that individuals may achieve self-actualization, society must survive. All social goals depend on the sustainability of society. It is therefore imperative to adopt the safest mode of development for meeting the needs of individuals. The first criterion by which a development policy should be judged is its potential for survival. If the promise of individual gain is purchased at the cost of reduced

prospects for society in perpetuity, then the policy should be considered untenable.

The concept of survival is the criterion of value linking economics, ecology, and ethics. The sustainability of a system is the ultimate imperative. Since individuals are almost exclusively concerned with their own finite time horizons, it is necessary to design institutions in such a way that social progress will be sustainable. Individuals are commonly motivated to leave an estate, (89-1069) but more immediate concerns have much higher priority. Decision-makers must balance today's needs against the sustainability principle, and decide on the trade-off between the rate of progress and the degree of risk which is acceptable.

Given the critical importance of ensuring survival, one would assume it rational to always accept minimum risk; however there are two major difficulties: (1) present problems overshadow future problems, and (2) there is great uncertainty as to the nature and seriousness of future problems. The result is an inclination to discount the future and concentrate on today's problems. A preoccupation with rapidly solving the most immediate problems has led to a policy of encouraging economic growth and industrial development and a general belief that the ensuing risks to posterity are acceptable for one of several reasons: (1) if present needs are not met, there may be no future; (2) posterity can only benefit by economic development; (3) if resources are actually finite, posterity will exhaust them ultimately anyway; and (4) the resilience of nature is so great that it is not necessary to be concerned about eco-catastrophes. These presumptions should be more carefully examined.

The primacy of present needs: Satisfaction of present needs cannot take precedence over maintaining the environment's capability of sustaining society. It is paradoxical that environmental destruction is defended on the grounds of saving or improving the condition of priceless human lives when environmental

protection can legitimately be defended on the same grounds. If it is not possible to put a price on a human life, it is not possible to put a price on the sustaining natural environment. Since nature supports human life, if one must choose between saving vital natural goods and saving a given number of individual lives, environmental concerns should take precedence. Even the laudable objective of establishing a floor for poverty, beyond which no one would be allowed to fall, is unrealistic unless it is tied to a population policy to prevent population growth from being checked only by misery, after essential resources are exhausted. Decision-makers should view the destruction of the environment as a matter of great urgency, as great as any other problem. Unfortunately, decision-makers have a propensity to disparage dangers which are not immediate or which are not confined to their constituency - distant or more general dangers tend to be unperceived or ballyhooed.

The effect of today's progress on posterity: Passmore says today's decision-makers can help posterity by making the world better now, and implies that this is the limit of their obligation. (120-92) But what if present improvements can be calculated to engender greater future risks? Increasing productivity today often leads to decreases in the carrying capacity of an area due to resource exhaustion or environmental damage. Man's activities have always had some adverse local and regional impacts, but the scale and rate of present impacts threatens the ability of the whole earth to support life. Unwittingly, we have created for ourselves a new and dangerous world, and we would be wise to move through it as though our lives were at stake. (31-231) Unfortunately, economic institutions are afflicted with myopia: private time preferences differ from social time preferences regarding the importance of a future benefit or cost, resulting in a rate of consumption that is too high and a level of investment that is too low to adequately provide for future generations. Individuals with finite life expectancies are likely to be guided in their private consumption decisions in a manner that is not necessarily optimal for a society that has a

collective commitment to life in perpetuity. (91-61) Consumption decisions which require irreversible developments have the effect of decreasing the buffering capacity of the natural environment, and therefore policies which favour high consumption increase environmental risk. Today's advancements can make posterity worse off.

<u>The implications of finite resources</u>: Beckerman insists that the problem of finite resources is not really a "problem" at all: he maintains that either resources are finite in some meaningful sense, in which case even zero growth will fail to save us in the long run, or resources are not really finite in any meaningful sense. (18-232) This view overlooks the fact that some finite resources are renewable and can sustain society indefinitely so long as limitations governing renewability are observed. This suggests that development should not be based on finite, non-renewable resources, but should rather be directed toward achieving a steady-state system based on renewable resources. The present technocratic system is based on non-renewable resources which will eventually be exhausted - potential replacements are effectively finite because of ecological constraints; this system is already approaching limits and appears to be almost out of control. A new way of life, based on minimum per capita consumption of energy and materials which are certain to remain available, would appear preferable to one that recognizes no limits. What is clear is that a way of life that bases itself on materialism, i.e., on permanent, limitless expansionism in a finite environment, cannot last long. (129-137) Present growth rates certainly cannot be sustained. The decision before us is the choice among the means available to bring the process to an end; and the question is whether there is still sufficient time or control. (16-130) Many economists agree with ecologists that there are environmental limits to growth, but there is still great disagreement as to how near those limits are.

<u>Nature's capacity to cope with man's impacts</u>: Dubos has commented on the amazing resilience of nature after major ecological disturbances (from volcanic eruptions to

ice ages) and the great number of species which have become extinct. These observations have led him to conclude that the need to maintain the balance of nature cannot provide a valid case for conservation. (50-164) There is, however, a profound difference between natural processes and man-directed processes: man's impacts now are occurring on a scale and at a rate which is totally unprecedented in nature. While the earth itself may survive any conceivable disturbance, man may not. If the survival of man is of concern, the balance of nature is of concern; it is surely prudent to allow developments to proceed at nature's pace rather than man's. Although man has modified the natural environment drastically, and destroyed countless ecosystems with relative impunity, there is increasing evidence that costs are now becoming globally significant. Ecologists warn that man cannot risk major modification of the biosphere except at the risk of his own extermination. (43-30) The risks of long-term, global modifications are difficult to assess because little is known about the absorptive capacity of the biosphere or the possible synergistic effects of multifarious impacts - there are too many complex variables and obscure interrelationships, and ecological limits are not known. The theory of emergent properties - which suggests that systems display new, unforeseeable properties at different levels of organization - suggests the possibility that if the natural environment becomes too fragmented, new ecological effects may appear and these may have devastating impacts on man's well-being. The penalty for reducing species diversity and ecosystem stability may be greater (and nearer) than is generally believed. Even a low probability of ecological catastrophe is not a good risk if one considers the magnitude of the cost should it occur. Some conservation effort toward maintaining the balance of nature would reduce this level of risk. The balance of nature exists only because no species has ever triumphed too completely in the struggle for existence. It is possible to win all the battles but one and still lose the war. Man's successes could ultimately be self-defeating.

THE STEADY-STATE SOLUTION

The threat to man's survival is due, ironically, to his considerable accomplishments. Success has permitted a degree of growth and complexity which now challenges man's ability to control his future actions. Primitive man had less control over his immediate environment, but more control over his own actions, so lived in greater harmony with nature. Primitive cosmologies and myths gave rise to ritualistic behaviour which accorded with ecological principles and so had high adaptive value. (125-5) Modern technology has given rise to extraordinary changes in man's relation to nature, but there has been insufficient time to receive and interpret feedback processes necessary to adapt to new conditions. If man is to maintain his evolutionary fitness, he must develop new mechanisms of adaptation or slow the rate of change.

It may be possible to create altruistic institutions to take the place of cosmologies and myths in regulating change and behaviour to permit continued adaptation. The selective advantage of cooperation has been increasing with man's numbers, and man can no longer afford to be in conflict with nature or other men. Man's survival can be attributed, in part, to a gradually expanding system of ethics which first embraced kith and kin but later, out of evolutionary necessity, came to embrace tribe, community, and nation. A new extension of ethics seems necessary because the struggle for survival has entered an entirely new dimension, encompassing all of nature and affecting countless future generations. Man needs to develop a land ethic, and a posterity ethic. The question whether to reduce ecological risks is a moral issue and morality has survival value.

A major constraint on action is uncertainty. Ecological risks are poorly understood, and no one knows the needs of posterity. Uncertainty is what leads to discounting the future, but a better response would be to seek a steady-state. While we may be uncertain as to the

precise nature of the dangers confronting the land and posterity, we may be reasonably certain that there is some significant danger associated with economic growth and industrial development based on finite, non-renewable resources. This growth has, to date, kept the wolf at bay but has also had the effect of increasing the size of the wolf - man is feeding the problem rather than solving or conquering it. What is needed is a restructuring of man's way so as to reconcile him to his ecological niche. (136-115) All renewable resources should be managed on a sustained yield basis to ensure that the overall productivity of the land is maintained in perpetuity. Policy instruments might include zoning, extraction charges, and shadow pricing. The ultimate goal should be to achieve a steady-state economy, which is defined by four characteristics: (1) a constant human population; (2) a constant population (or stock) of goods, including capital; (3) the levels at which the two populations are held constant are sufficient for a good life and sustainable for a long future; (4) the rate of consumption of matter and energy by which the two stocks are maintained is reduced to the lowest feasible level for the human populations. (13-149)

The traditional objective of conservation - achieving the wise and efficient use of scarce resources - is basically in accord with traditional economic precepts and may be understood to ultimately countenance consumption to depletion. If environmental quality and ecological integrity are to be maintained, an explicit commitment must be made to achieving a balanced, harmonious, sustainable use of resources which is <u>not</u> in accord with a materialistic, purely utilitarian economy. It is necessary to adopt an ecological rather than a conservation perspective, and aim at improving the quality of life rather than the standard of living.

SUMMARY AND CONCLUSIONS

The good society may be defined as that society which fosters the fullest development of human potential. Satisfaction of lower needs is a prerequisite to the satisfaction of higher needs but there is a danger that the more subtle higher needs will go unrecognized and unmet as decision-makers confine their attention to the more compelling physiological and security needs. Over-consumption of lower needs does not contribute to well-being but does interfere with the pursuit of higher needs. Institutions must be designed to focus attention on the higher needs, such as the need to perceive beauty and acquire knowledge. The natural environment contributes to the satisfaction of material needs and aesthetic, cognitive, and spiritual needs; a healthy environment is necessary to produce healthy, fulfilled organisms.

Development of the good society must proceed in a way which maximizes the prospects of long-term social survival. Since individuals tend to "live for today" it is necessary to design institutions to ensure that social progress will be sustainable. The urgency of today's problems, along with the difficulty in calculating future risks and the inclination to trust to future technology, has resulted in wide-spread acceptance of a policy committed to rapid and unconstrained economic growth. This policy has led to great environmental problems, fewer options for future action, excessive levels of consumption by some sectors of society, a commitment to an ever-expanding system of production based on non-renewable resources in a finite world, and an unwarranted faith in nature's ability to withstand any level of exploitation and continue to provide for man's needs.

Man is losing control over his own actions and may thereby lose control over the sustaining environment. Adoption of a land ethic seems necessary if the man-nature relation is to achieve equilibrium. An ecological economy would be a steady-state economy.

CHAPTER 7

THE NEED FOR CONSERVATION

"Science has given us many doubts, but it has given us at least one certainty: the trend of evolution is to elaborate and diversify the biota.... Diversity means a food chain aimed to harmonize the wild and the tame in the joint interest of stability, productivity, and beauty."
(94-253; 93-164)

INTRODUCTION

This chapter will introduce two general policy options for development: one would be constrained by a provision for maintaining natural and near-natural areas, and the other would recognize no such constraint. The chapter will then be concerned with determining the special values of natural environments, and the potential costs of overdevelopment.

POLICY ALTERNATIVES

Two general policies for achieving the stated goals will be evaluated:

1. A policy of rapid and unconstrained development in order to quickly alleviate physical suffering and deprivation and improve the general standard of living.
2. A policy of development constrained by a provision for maintaining certain natural and near-natural areas in their present state in order to minimize ecological risks and maximize options which may be important to enhancing future quality of life.

The first alternative would be concerned with achieving maximum economic growth and industrial development, and would not be constrained by any requirements to maintain part of the natural environment in its present state. Principle objectives might be to improve the efficiency of production and the distribution of goods and services to raise the standard of living. Modern technology would then probably be used to increase production and expand and improve the developed environment, and development would likely be based on the urban-industrial model.

The second alternative would restrict the conversion of natural to developed environment by mandating that certain areas are not to be altered in any way which affects the present structure or functioning of the natural environment. While the pattern of development outside these areas might follow the standard urban-industrial model to the extent possible, the use of alternative technologies might be preferable, even though the rate of development and overall efficiency of production would be comparatively low, in order to ensure stability and permit balanced progress.

THE VALUED PRODUCTS OF NATURE

In order to evaluate the two policy alternatives, it is necessary to consider the possible effect on man's well-being of losing certain natural goods and impairing certain natural functions provided by the natural environment. Man may eventually be able to turn "spaceship earth" into an artificial capsule and meet energy and food needs through advances in technology (e.g., nuclear fusion and unconventional agriculture) but for the foreseeable future the provision of many essential goods and services will require the continued functioning of the natural environment. Vital ecological processes and biological organisms have no substitutes and cannot be reconstructed, recycled, or made more efficient beyond a certain point - they are beyond the control of technology. Economic analysis should incorporate ecological analysis, but benefits of the natural environment have received little attention in cost-benefit studies, and the calculation of environmental costs of development is generally restricted to pollution costs, or the management of residuals. The total value of natural goods cannot be calculated, but attempts to estimate the monetary value of some of the benefits indicate they are very high, such as a minimum value of $1,8 million for the services of a 930-ha Georgian river-swamp-forest ecosystem in groundwater storage, soil binding, water purification, and streamside fertilization. (156-961)

The well-being of man depends on the well-being of the land. Leopold's concept of the land as an organism which is becoming moribund engenders new economic arguments for conservation. (93-156) If natural ecosystems are regarded as living things which benefit man, there must be concern about their plentifulness, integrity and vitality. Natural ecosystems can be endangered in the way species are endangered (they can be threatened with extinction) and in an additional way: they can be diminished or impaired - their healthy functioning can be irreparably damaged. Ecologists are just beginning to understand the importance to

man's agricultural and social systems of maintaining the diversity and life-support processes of the natural environment. If man manipulates all ecosystems in an attempt to increase productivity or utility to man, he may destroy some of the goods and services of nature on which his continued existence depends.

Westman has compiled a list of "structural benefits" (nature's free goods) and "functional benefits" (nature's free services) provided by natural ecosystems. The former include marketable products and genetic resources, as well as the use and appreciation of ecosystems for recreation, aesthetic enjoyment, and study. (156-961) The latter include the absorption and breakdown of pollutants, the cycling of nutrients, the binding of soil, the degradation of organic waste, the maintenance of a balance of gases in the air, the regulation of radiation balance and climate, and the fixation of solar energy. (156-961) Natural areas are also important in maintaining soil fertility, stabilizing hydrological cycles, and providing habitat for flora and fauna of incalculable value. (13-101) Natural vegetation prevents erosion, reduces sediment loads in water bodies, decreases flood peaks, and increases water discharge during dry periods. (43-210) Although net productivity may be low, natural ecosystems are characterized by selection for quality rather than quantity of organisms, high ecological efficiency in terms of biomass supported per unit of energy flow, and maximum information content and minimum rate of gain in entropy. (149-11)

The Value of Stability and Diversity

Natural ecosystems serve to maintain ecological equilibrium at the local, regional, and global levels. Stability reduces risks and other costs to man, and permits the continued evolution of a rich diversity of biological organisms. This diversity is important to man because of the vital roles various species play in ecological processes. The interrelationships of living things and the physical environment are extraordinarily complex (no efficiency engineer could blueprint the

biotic organization of a single acre) and so it is not possible to clearly identify which species are performing functions valuable to man. (93-161) For example, the klamath weed in California is a strong competitor but a flea beetle keeps it to the forest; this control mechanism is "invisible" (i.e., the effect cannot be seen until the beetle is removed). (158-36) Since man has no way of knowing which species are beneficial, it would seem prudent to maintain the highest level of species diversity, which necessitates maintaining large areas of natural habitat.

Species diversity is also important because of the direct utility many species may have. Some species serve critical agricultural functions, such as pollination, nitrogen fixation, and the control of agricultural pests. These functions all have great economic value. The wild progenitors of agricultural species possess characteristics needed by domestic strains to resist disease or withstand new conditions. Other species may suddenly acquire great value for medicinal properties, or as new sources of food. Wild plants and animals may permit the establishment of new industries in developing countries. (149-29) The carrying capacity of an area is greater in mixed communities than in one-species communities because different parts of the ecosystem are exploited by different animals, (147-35) and some wild animals which are efficient converters of natural vegetation into meat may be harvested to increase food production without major investment or habitat alteration. The strategy of modern agriculture has been to adapt a few species to a wide range of ecological conditions. Perhaps it would be better to utilize a wider range of species which are already adapted to their present environments. Maintaining natural environments conserves species and habitats which may be needed in the future.

The Value of Natural Influences

Natural environments also provide natural amenities which add interest,

pleasure, and beauty to life. Nature offers a rich variety of sensory impressions of great cognitive, aesthetic, and spiritual value. Contact with nature is important to the quality of life - without natural influences, we risk the loss of our sensual perceptions. (27-20) Little is known about man's perceptions of environmental quality. Goodey says research on the effects of sensory stimuli and the perception of natural beauty and open space has been neglected. (150-59) This vital research, which includes cross-cultural perception, indicators of perceptual quality, and cross-cultural studies of environmental preferences, could have an important bearing on future environmental objectives. Maintaining a large variety of natural and near-natural areas is necessary for this and other research.

Man's physical surroundings have a profound influence on his character and outlook. The fact that natural environments are being traded for developed environments has far-reaching implications. Natural sounds and smells are replaced by the cacophony of traffic and noxious odours. Inspirational views and soothing landscapes are replaced by dreary, cluttered streets and rigid skyscrapers. Unresponsive, mechanical objects supplant living things. The pace and goals of life change. The rich sensory stimulation of nature is lost, and the quality of life is thereby reduced. If the products of nature cannot be enjoyed in any significant measure, life is diminished. Decision-makers should consider natural influences important to well-being, and attempt to guide development so that man will stay in close contact with nature. Some pure wilderness should also be maintained (though few will be able to enjoy it firsthand) because vicarious consumers derive satisfaction simply from knowing that certain rare or remarkable species and environments still exist. (91-22)

The Fragility of Natural Systems

Once modified, natural environments cannot be perfectly restored or simulated. Aesthetic and recreational interests demand authenticity,

and research in the life and earth sciences cannot be conducted in artificial environments. While some functions may be restored, rehabilitation efforts are much more expensive than prevention costs, and never completely successful. Ecosystems can be so altered that they are effectively lost forever. For example, if the Okavango Swamps were ever to go dry, there would soon be irreversible alterations: soils would be oxidized, fires would rage, and plant associations would change. (59-98) No one knows how much change or damage an ecosystem can withstand and retain its capacity for self-adjustment - complex, nonlinear processes are involved and there is no quantitative method of assessing the state of an ecosystem. Proposed changes should be assumed to degrade an ecosystem unless exhaustive investigation indicates otherwise, particularly if there is uncertainty about the significance of the ecosystem over long time horizons. Irreversible decisions affecting local ecological processes, scenic wonders, and gene pools differ from decisions which can be reversed if they prove undesirable. Krutilla suggests it will be efficient to proceed very cautiously with any irreversible modification, and priority use of the natural environment should be assigned to nondestructive pursuits. (91-73) Caldwell advocates a policy designed to reduce the extent of damage to the biosphere until a more adequate applied ecology can be provided to prevent the foreclosure of future possibilities because of present, high-risk, irreversible decisions. (25-937)

Odum's computer analysis indicates that as the proportion of natural to developed environment declines past optimum, there is a rapid deterioration in the quality of the total environment and a rapid increase in costs incurred due to the loss of natural life-support systems. Odum's preliminary estimates indicate there is a precipitous decline of the value of the total environment when the natural environment falls to 40% of the total. (117-187) There is therefore considerable danger in being lulled by slight and supportable environmental deterioration into an overshoot condition. Overdevelopment must be anticipated and prevented, even though making conservative estimates as to what proportion constitutes the optimum means accepting significant opportunity costs.

The Need to Conserve

Conservation has often been interpreted as meaning the wise use of natural resources in an economic sense, over fairly short time horizons, rather than meaning ecological wisdom in the philosophical sense, suggesting the permanent coexistence of man and nature. Natural and near-natural areas are needed to develop and test the scientific theory of ecosystem development, which will lead to greater ecological wisdom and a better understanding of what conservation entails. Central to the idea of conservation is balance: conservation is achieved when the elements are in balance and it is lost if one resource is unduly exploited at the expense of another. (79-13) There must be a balance between the natural and the developed environments. The problem is to foresee where the balance lies, since a thing's value is not always recognized until it is in short supply. Natural goods have normally been in good supply, whereas consumer commodities have been in short supply. Wilderness was feared and hated in earlier times, but it is easy to imagine that the unrelieved prospect of developed environments could be feared and hated in the future. Wilderness was previously shunned because it exposed one to suffering and danger. Today, jaded city-dwellers seek out wilderness to experience certain challenges which involve the pleasure of suffering, and the novelty of danger. (113-56) In developing countries particularly, natural goods are still undervalued, and the benefits of wilderness seem superficial and elitish. Decision-makers must anticipate new value systems as material aspirations are satisfied and the wilderness recedes. While the reduction of the wilderness has been a good thing, its extermination would be a very bad one. (113-187)

If futurist technocrats are correct in assuming that all of man's material needs can be supplied with only energy and basic molecules, and that technology will be ready when needed, then there should be no objection to maintaining substantial portions of the natural environment to meet man's spiritual, aesthetic, and recreational needs. Since amenity resources cannot be augmented, or their scarcity value

reduced, by advances in production technology, and since commodity resources can be augmented by future technology, preservation benefits may be expected to increase over time relative to development benefits. The planner should favour preservation because in the long run this would maximize the flow of benefits from scarce natural environments. Decision-makers must anticipate an increase in the supply of commodities relative to amenities and present decisions must take account of future relative values.

Natural goods have considerable option value but the market cannot communicate the option demand nor can the resource owners appropriate the option value. (89-1065) Future users would pay present owners to maintain healthy ecosystems, gene pools, and psychic phenomena, but transaction costs are infinite. These option values are beyond calculation. For example, Krutilla reports that half of the new drugs currently being developed come from botanical specimens, and since only a small fraction of the potential medicinal value of biological specimens has yet been realized, preserving the option to examine all species among the natural biota represents a value of some consequence for human welfare. (91-15) When evaluating choices between development and preservation, Krutilla stresses the significance of the additional cost attributable to the alternative that forecloses future options, because of the irreversibility of miscalculation. (91-15) The conversion of natural environments gives rise to two irreversible costs: the foregone future extractive output, and also to a loss (in perpetuity) in value from the undisturbed environment. (91-47) It is also important to recognize that benefits from developments tend to diminish over a time as a function of advances, specifically in the technology of production. (91-142) Therefore, the current value of benefits cannot be projected to hold, while the opportunity costs (in lost amenities) can be projected to increase.

> As manufactured goods become more abundant and natural amenities more scarce, the trade-off between them will progressively favour the latter. Natural environments, hence, represent

assets of appreciating future value.
(89-1069)

The destruction of the natural environment represents an irreversible event carrying a cost for present and future generations that normally does not attend the use of commodity resources. (91-265)

The cumulative effects of destroying the natural environment are not yet known, but there may be critical thresholds where social costs become extremely high. When developed systems become too large, they may suddenly put unbearable demands on the natural life-support system. This could be allowed to happen because (1) man undervalues the support he gets from natural environments and (2) man underestimates the rapidly increasing maintenance costs of greater development. The significance of these values and costs, and the insuperable difficulty in estimating them, suggests the necessity of setting high standards for the level at which natural and near-natural areas will be maintained. Even though these standards would perforce be set at somewhat arbitrary levels, they should be absolutely irrevocable unless solid ecological evidence is advanced to justify adoption of a less conservative standard. The great difficulty would lie in maintaining a commitment to standards in the face of rising expectations and greater demands for development.

Odum has attempted to calculate the proportion of the environment which should be left in its natural state. He recommends that until systems analysis procedure can be refined and become a basis for political action, it would be prudent for planners everywhere to strive to preserve 50 per cent of the total environment as natural environment. (117-183) Odum based this estimate on calculations of the minimum per capita acreage requirements for what he considered a quality environment in an area blessed with good soil and abundant water - obviously the figure would vary from region to region, and would depend on many factors. Conservative estimates should be adopted initially; these can be adjusted later as research makes greater precision possible.

The important thing is to define the general principles by which the correct direction can be determined - these principles should not be lightly regarded because they cannot be accurately quantified.

THE ECOLOGICAL IMPERATIVE

In the Founex Report, *Environment and Development*, Miguel A. Ozorio Almeida denies that man need be concerned with the balance of nature:

> The problem to be solved in fact is not achieving an "ecological balance", but, on the contrary, obtaining the most efficient forms of "long-term ecological imbalance". ...In fact nothing short of a chimpanzee society could be considered as fully integrated into ecological equilibrium. (4-43,44)

The real question is not a choice between balance and imbalance, but how to decide what constitutes a reasonable balance. It is not necessary to live as chimpanzees to maintain ecological equilibrium, but it is necessary to accept some limits to man's impacts on nature. The problem is that development threatens to exhaust biological resources and impair certain non-biological resources which are necessary to maintain essential ecological processes at a reasonable cost. This could result in ecosystem breakdowns, which in turn would result in economic, social, and political breakdowns. Technology cannot recreate the unique biochemical factories which power ecosystems, and cannot duplicate the functions of vital ecological processes.

Almeida's phrase "long-term ecological imbalance" is contradictory. All systems which persist must exhibit a state of balance. Ecological systems are self-governing by virtue of regulating or negative feedback cycles. This achievement is termed homeostasis. Positive feedback cycles are rarely found in nature and are brief, disruptive events (such

as fires and avalanches) which are characterized by tumultuous, destructive forces. These events result in a high degree of internal disintegration, eventual exhaustion, and sudden stillness. Such events are contained by discontinuities in the environment, which makes renewal possible.

Homeostasis is so indispensable for the preservation of life that we can scarcely imagine its origin without the simultaneous "invention" of the regulating cycle. (98-6) In negative feedback cycles, a change in one part of the system is soon equilibrated. If impacts are too great or come too quickly, or if the system is altered so as to reduce equilibrating elements or increase response times, the cycle can be broken and the system will collapse. An ecosystem's stability is thus dependent on its various interconnections and their relative speeds of response. (31-38) Man appears to be overloading many ecosystems and interfering with the system of feedbacks which permits equilibrium to be maintained. Rivers which are young in geological time are already eutrophic because man has increased the level of inputs and exceeded the assimilative capacity of the system, while some ancient rivers remain oligotrophic because their homeostatic mechanisms are able to cope with natural inputs. In agriculture, actions to control pests have also reduced predators and this has had the effect of increasing the costs of control and the incidence of failures. Desertification is spreading in arid zones because man has pushed the land too far:

> It is when drought strikes land-use systems that are stretched beyond their usual limits that its consequences can be disastrous and maximum and long-lasting degradation can occur.... These ecosystems are delicately balanced.... Their necessary adaptation to water deficiency results in life forms which are highly specialized... (147-20)

These life forms protect fragile soils; when the natural vegetation is destroyed, the soil is exposed and eventually lost. Failure in resilience usually arises from sudden and severe disturbance - almost always the work of man. (147-21) Habitat degradation occurs quickly in

areas with arid conditions or poor soils, and natural recovery may take impractical periods of time, while reconstitution may be too costly.

It is the complex balance maintained by limiting factors and tolerance limits which has often been ignored and led to the degradation of an ecosystem or the virtual destruction of a population. Exceeding even one tolerance limit in a balanced system can have disastrous ramifications. Many development projects have gone awry because of inattention to limiting factors and tolerance limits. Homeostasis is partly a function of size and susceptibility to extrinsic forces. Man's development schemes are increasing in size and number and therefore creating larger and more nonhomeostatic or artificial ecosystems which have intrinsic instabilities that must be controlled by direct action. (138-132) The cost of control is increasing, as is the risk of collapse. However there is no way to determine how great the risk is, or how destabilizing any given action may be - the inherent complexity of any ecosystem's capacity to counteract external disturbances is beyond man's capabilities of calculation. Even the elimination of certain bacteria from the ecological system to which they belong usually involves a risk of provoking imbalances which at first may not even be suspected, so imperfect is our knowledge of the profound relationships between living creatures. (148-37)

Most ecosystems exhibit a high degree of interrelatedness which has evolved over a long history of species co-adaptation. Some ecologists feel that in such systems there is a relationship between species diversity and ecosystem stability: as the number of biological components is reduced, the system becomes less stable. Ecosystem complexity can therefore be regarded as insurance against stress-induced instability. Natural systems evolve to a point of maximum complexity which may be regarded as optimum for that system's continued stability and survival. If the system's complexity is reduced, its integrity and vitality is diminished and its functioning is to some degree impaired. This need not be significant to man since the system will

tend to adjust to this lower level of complexity; however the more simplified and vitiated the system, the greater the danger that some perturbation will precipitate a collapse rather than an adjustment. Every system has a "breaking point" and this point may be approached in a series of innocuous and apparently costless steps until the cumulative impacts reach a critical level and a traumatic breakdown ensues. Even the ecosphere has limits in terms of self-regulation, but because of its great size and overwhelming complexity, it is impossible to judge how near or far the global system or any regional system may be from the threshold of a failure which would significantly imperil man's well-being or survival.

Man should therefore be concerned about his increasing ecological isolation as the developed environment reduces ecosystem and species diversity. Since man depends on the interlinked functionings of many species, and these dependencies are not always determinable, he should proceed on the assumption that all species have evolved a role in the ecosystem and that the removal of even one species may result in the alteration of that system. Many species once considered completely insignificant are now known to be essential to the economy of the community (e.g., earthworms, ants, termites). Leopold implores man to consider every part of the land mechanism as good, whether this is obvious or not: to keep every cog and wheel is the first precaution of intelligent tinkering. (93-147) When habitat diversity is reduced, species may be lost; if species are lost, other species are then lost or threatened; since ecosystems are composed largely of biological building blocks (all ecosystems are bound together by the structural and functional characteristics of their component species), the ecosystem itself is weakened. (135-25) Ecosystem alterations may be irreversible if too many biotic components are lost or the abiotic base is permanently altered; overcropping of species, destruction of vegetation, soil laterization, or erosion to bedrock can reach levels beyond which regeneration or repair becomes intolerably slow.

The biosphere can be regarded as a living organism - there are limits

to its regenerative capabilities, and if enough parts are destroyed the threshold of survival can be reached. Sir Frank Fraser Darling has cautioned that the ultimate irony confronting technological man may well reside in the fact that nature's most potent threats to human welfare are not her destructive power but the fragility of the web of life, the delicacy of those skeins which bind species to species. (122-8) The most wide-spread cause of "ecological bankruptcy" may be the gradual wearing-out of the environment - the stressing of natural systems beyond their capacity for regeneration. (25-942)

The root of man's ecological problems is that he has adopted dangerous new ways to satisfy his wants. No economic system can be regarded as stable if its operation strongly violates the principles of ecology. (27-42) Accelerating production is already pushing tolerance margins, which should be regarded as a capital asset. Production and consumption can become bad things; it is necessary to regard human welfare as a stock rather than a flow since the stock concept can be viewed in terms of homeostasis: in a limited system, it is necessary to restore depreciated capital. (23-78) Man is impinging on vital mechanisms and is hopelessly ignorant of what the consequences will be, but he certainly faces the possibility of making the planet unfit for life. (153-178)

Global monitoring systems are not likely to provide sufficient warning of impending collapse of large-scale ecological processes since these cannot be altered quickly. Little is known about the interactions of regional ecosystems and sub-continental biomes, but it is at this level that policy guidance is most needed. Policy-makers often fail to perceive impacts of local development on adjoining regions. For example, Hardin contends that development programmes in Nepal have had a devastating effect on other regions because increased population pressures in Nepal have resulted in greater run-off (due to deforestation and erosion) which have increased the severity of flooding in India and Bangladesh. Hardin concludes one can confidently say that the more lives are saved in Nepal and Assam the more lives will be lost

in India and Bangladesh. (70-95) The cost of imbalance due to development may thus nullify the benefits. Almeida's idea that development is desirable regardless of the resulting imbalance may be based on illusory gains. Rapid, unbalanced development can entail excessive costs which are not always obvious but are ultimately paid nonetheless.

The notion that progress is possible without maintaining ecological equilibrium is fallacious and dangerous. Man lives in a world governed by ecological forces beyond his understanding and control. Balance is the result of all forces impinging on the biosphere, and a certain degree of balance is necessary to man's continued existence. Development should not be thought of as a way to "cheat nature", and it must be accepted that there are limits to development. The safest development policy will be that which has the least impact on the supporting ecosystem. Development must adopt in principle the idea of constructing without dramatically changing the ecological character of an ecosystem - activities that maintain rather than activities that change the system should be favoured. (159-15) Development should therefore proceed at a pace and in such a manner that balance is assured.

> The best defence against misapplied technology is the ecological approach, which should govern all actions concerning land.... Successful land use practices collaborate with ecosystems instead of fighting them. (147-46)

THE LIFEBOAT IMPERATIVE

If the urban and agro-industrial model fails or encounters serious difficulties, there must be separate, viable environments to which man can repair and find the materials necessary for existence. As the developed environment has spread, the character of the earth has

changed. What was a self-governing and balanced system is now largely subject to man's influence and is becoming increasingly unbalanced. If the whole of the developed environment is regarded as man's new spaceship, then remaining natural and near-natural areas may be regarded as extremely valuable lifeboats. Surely no ship's master would venture on a perilous and uncharted journey in a new and untested vessel without an adequate number of lifeboats aboard.

Man's circumstances are changing rapidly and there is insufficient information to predict the outcomes of alternative courses of action. In recent years, natural resource managers have developed the concept of "total ecosystem management" which recognizes that we are still relatively ignorant about techniques for managing whole ecosystems. (35-339) This approach involves accepting some reduction in short-term yields in order to ensure stability and renewability; the idea is to manage ecosystems for all their uses and services, not just the most important or more obvious ones. Applied on the level of the ecosphere, total ecosystem management involves maintaining some natural and near-natural areas for their special contributions to the global ecosystem.

Unesco's Man and the Biosphere Programme is promoting the establishment of protected areas for baseline and other scientific studies, for serving as benchmarks for monitoring of changes in the structure and functioning of ecosystems, for the advancement of environmental education, for maintaining ecological stability, and for aesthetic and cultural reasons. (149-5) Such areas would also protect gene pools and fragile environments, and would increase man's options for the future. The concept provides for core areas to be surrounded by buffer zones which could support tourism and recreation, facilitate manipulative research, and serve as bases of comparison with core areas.

Maintaining Gene Pools

Natural and near-natural areas are necessary if valuable genetic

contain an essential protein-making chemical which has improved the food value of sorghum. Such discoveries will become even more important because of the expanded needs of larger populations in the future. (149-14) Some technocrats may not agree, but might concede that maintaining some insurance is a wise policy, well worth the cost. The more materials that are available to agricultural science, the greater the prospects of important discoveries. Recent high-yield varieties of rice and wheat have proved vulnerable to disease and need to be crossed with wild progenitors to gain resistance, but genetic stocks have been seriously depleted. Thousands of varieties of *Triticum spelta*, a relative of wheat, once existed in Iran, but have disappeared completely in the last 20 years. (43-169) The simple fact that pathogens work faster than plant geneticists should be a matter of grave concern to decision-makers - if man becomes too dependent on "miracle" varieties of grain, and they are attacked by some virulent pathogen, world stocks of food may fall drastically. Ultimately, success in outpacing new strains of disease hinges on the preservation of genetic resources. (43-170) Native plants, kept in natural ecosystem reservoirs, are needed for hybridation in the endless battle with disease and insects. It cannot be determined which varieties will be required, or what other plants may produce new domesticates, so it is necessary to provide protection for all wild species.

Gene banks, which keep seeds viable in cold storage, are physically feasible but evolutionary processes are then halted and the species may not be suited to new environmental conditons. Zoos and botanical gardens are not suitable conservation mediums for the opposite reason - evolution continues and tends to render species unfit for natural environments. The prospect of gene and species synthesis is not promising due to high costs, and also because a new gene is not necessarily an adapted gene and may not survive outside the laboratory or, alternatively, may meet with no natural controls and prove destructive. (149-26) Therefore, considerations of efficiency, cost and safety all dictate the maintenance of wild species in their natural habitat.

Maintaining Variety

Odum has said that variety is not only the spice of life but also a valuable stabilizing factor. (115-253) Maintaining variation in the countryside has a cost (reduction in production efficiency) but provides insurance against other costs (such as those associated with disrupted or exhausted environments). Development should be modelled on the evolutionary success of diversification in nature. Perhaps the most forceful argument for maintaining diverse, healthy-functioning landscapes is that we do not know the aspects of that diversity upon which our long-term survival depends. (54-650) It is not just rare and restricted species that are of concern, but all aspects of the natural environment. A system of protected areas should include representative communities and ecosystems from all parts of a landscape. Protected status is usually reserved for endangered species and natural ecosystems which have little agricultural potential. It is important to ensure that all species, communities, and ecosystems are accorded protection. Many regions have come under agricultural use and little indigenous vegetation is left. In such cases, relatively undisturbed or "near-natural" areas should be incorporated into a system of reserves to provide these geomorphological locations to species which need them.

There are several reasons for maintaining near-natural areas: they serve to buffer natural areas and their populations from disturbances; they have characteristic species, communities, and ecosystems which are of interest in their own right; they can be used in ecological investigations of the processes of natural recovery; many have special aesthetic appeal; and they may suggest more suitable methods of exploiting the environment.

Maintaining Areas for Research

Protecting landscapes is less expensive than rehabilitating landscapes. Natural and near-natural areas can make a significant contribution to

man's understanding of how development should proceed, particularly in marginal environments (such as arid regions) where development programmes have often resulted in disaster. Undisturbed ecosystems and traditional land-use practices should be maintained for research purposes, to elucidate the mechanisms of resilience and productivity in stressed ecosystems. (147-248) These "examples of survival" (54-650) have great economic value since study of successful (long established) systems can provide invaluable guidance to designing man-dominated systems or repairing faulty ones. Some natural environments require permanent protection since they are already close to the threshold of non-renewability.

Ecological research, still in its infancy, promises to significantly improve man's ability to manage the environment. The present state of ecological knowledge is woefully inadequate, and development schemes are proceeding without knowledge of their ultimate effects. In Southeast Asia excessive clearing of forests unexpectedly led to lower rice yields by causing fluctuations in river flow. (80-1/11) In Africa attempts to convert enormous areas of savannas and bushlands into large-scale groundnut and sunflower plantations were disastrous failures because the programme was ecologically unsound. (37-116) Every community and ecosystem is different, all are governed by complex interrelationships, and none is adequately understood. The value of maintaining natural areas for scientific study can hardly be exaggerated. Much knowledge has been gained already, and perhaps the clearest lesson to date is that ecosystem manipulation produces uncertain results.

The study of ecology requires more physical space and more time than other scientific disciplines: ecosystems cannot be studied in the lab and their processes sometimes involve cycles of many years. Large natural areas and viable populations are needed for ecological studies. These studies are necessary to provide a better understanding of ecosystem structure, functioning, and dynamics, changes in biotic and abiotic components over time, the ways in which ecosystems differ and interact, and the effects of man's activities. A system of protected

areas, including all major ecosystem types, is necessary to the establishment of baseline and monitoring stations for conducting this research. One of the edges of ecological knowledge is in this area of man's interaction with living systems, his optimal cropping of them to sustain his own numbers, and the utilization of the productivity of vast areas which could nevertheless retain their aesthetic and amenity value. (74-415) Greater ecological knowledge will be needed to deal with future environmental challenges, and advances will depend on the availability of suitable areas for research and verification of ecological theory. The goal of developing some ecological predictive capability is dependent on numerous, long-term studies to examine successional stages, regeneration times for recovery, productivity and carrying capacity, and methods for speeding change and recovery. (149-25)

Ecosystems may some day be described by quantitative laws, so that general responses to various management strategies can be predicted. Development could then proceed on a truly rational basis; until then, a conservative and cautionary strategy should be employed, minimizing impacts and maintaining natural environments to the greatest extent possible.

Maintaining Options

The need to keep options open for man's future is of paramount importance. Land which is presently "untouched", or which has been used in a way which has caused no perceptible deterioration over several generations, should not be disturbed by new development programmes. The International Union for the Conservation of Nature (IUCN) has advocated the establishment of a system of "protected landscapes" which would maintain near-natural areas for their social customs evidenced through land use practices, which are disappearing under modern technology. (78-17) Protected landscapes would have aesthetic value, anthropological interest, and may have high scientific interest

as reservoirs of genetic materials associated with land use practices which are disappearing from lands managed by modern agricultural technologies. Some of these areas could be made available for tourism. (79-13) Anthropological reserves would permit scientists to study the evolution of man and his relationship with the land, and permit societies living in harmony with the environment to continue undisturbed by modern technology. (78-29) It is possible that study of traditional skills and knowledge will prove useful in planning man's future interactions with the environment, and inspire wiser patterns of development. And the preservation of this knowledge may even provide us with variant cultural modes necessary to survival. (152-529) Modern man has not proved a particularly good steward; it would appear at least prudent to make provision for ways of life that are less dependent on destructive use of increasingly scarce resources. (42-136) Near-natural areas can serve this purpose. Such areas could also provide for alternative life styles - those who do not want to live in cities or join agribusiness should have an opportunity to live in near-natural areas where traditional practices and values can be found.

Maintaining Bases of Recovery

The present global pattern of human interventions into natural ecosystems is producing ecological upsets of increasing frequency and magnitude. Escalating costs of control could become insupportable, and large-scale ecological disasters could become alarmingly common. Recovery from such disasters might be extremely difficult if there are insufficient natural and near-natural areas to serve as bases of recovery. Dubos says that undisturbed native marshes, prairies, deserts, and forests are at present the best assurance against the potential hazards inherent in the truncated, oversimplified ecosystems that are being created. (50-165) Natural and near-natural areas can be thought of as a kind of bank where reserve funds are kept while more speculative investments are made elsewhere. If there is a collapse in the developed environment, large remnant patches of natural ecosystems

could serve as reservoirs of ecological vitality and centres from which healing could begin. Perhaps the greatest justification for maintaining large tracts of natural and near-natural areas is to provide the space and resources for renewal if the developed environment falls apart - the lifeboat imperative.

The Cost of Accepting Limits

A policy of maintaining natural and near-natural areas constitutes a self-imposed limit on development and resource consumption. This may lead to less waste and more efficient use of resources, and stimulate development of new and more appropriate technologies which would not be regarded as economically feasible if no resources were reserved. This reservation on resource use would serve as an advance warning of resource limits, and force technocrats to demonstrate what must ultimately be accomplished: the satisfaction of man's needs without further destruction of biological resources. If technology fails to meet the challenge, one then has this reserve to fall back on, and time to develop another strategy while eking out what remains of nature's bounty. Adopting a self-imposed limit would reduce risk, increase prospects for a higher quality of life, improve long-term efficiency at the cost of short-term efficiency, and maintain options for the future.

Decision-makers are faced with great pressure to maximize output over short time periods. Evolutionary responsibilities are overshadowed by present socio-political demands. The opportunity cost of maintaining natural and near-natural areas may seem great to resource hungry populations, but the costs of losing these areas might be unbearable to future resource hungry populations. An accurate evaluation of the policy alternatives would weigh the value of nature's free goods and services in perpetuity against the value of depreciating development projects to today's populations. The opportunity cost of maintaining natural environments is very low if one uses a long time horizon, and this cost should be regarded as an insurance premium. Such an investment

should be considered worthwhile for at least two reasons: (1) the natural environment is rich in biological materials which collectively serve valuable, life-sustaining functions which we only dimly understand, and (2) man has not yet found uses for countless biological organisms which will one day instantly appreciate in value, and it is necessary to maintain a full range of ecosystems to protect these unknown but potentially priceless components - one future finding may well be worth all the opportunity costs of preservation.

SUMMARY AND CONCLUSIONS

Certain natural goods and services have incalculable value for mankind, but their value is not readily perceived and therefore they tend to be accorded insufficient attention in the decision-making process. The natural environment provides diverse materials and functions which have direct utility or lend stability to man-dominated systems. Natural amenities enhance the quality of life, and contact with nature instructs and inspires man, contributing to the process of self-actualization.

Natural ecosystems can be irreparably damaged, and future options irrevocably lost, by poorly planned developments; great caution and restraint should be exercised as long as ecological effects cannot be accurately predicted. The _future_ value of natural goods must be anticipated since losses are irreversible. Some option values may be considered priceless and should be maintained even at great opportunity costs. A self-imposed limit on development would not really be so costly in the long term because such a policy would result in more efficient use of available resources.

In any case, a balance must be maintained between the developed and natural environments. The cumulative effects of losing natural environments may be disastrous, and therefore standards should be firmly

established at conservative levels. The vital importance of homeostasis is not perceived by decision-makers who favour the most rapid path of development. Man's activities are causing more natural systems to get out of balance, and ecologists say that this threatens the continued functioning of the developed environment.

Apart from their stabilizing influence, natural and near-natural areas represent a form of insurance in case the developed environment collapses, and act as banks for maintaining genetic resources and variety in the landscape. They also serve as laboratories for research and preserve a spectrum of land-use options. The total opportunity costs of maintaining substantial portions of the natural environment could well be compensated by future discoveries of new uses for natural goods.

CHAPTER 8

THE INSIDIOUS EFFECTS OF DEVELOPMENT AND POTENTIAL CONTROLS OR SOLUTIONS

"*If, then, we can live without goose music, we may as well do away with stars, or sunsets, or* Iliads. *But the point is that we would be fools to do away with any of them.*" (93-171)

INTRODUCTION

What is called "progress" does not necessarily lead to Utopia. Short-term solutions can give rise to new problems, and these may finally prove intractable. Development cannot proceed indefinitely at the expense of the environment; means must be found by which the activities of man are brought into a harmonious relation with the processes of nature.

THE "VICIOUS CIRCLE SYNDROME"

The Founex Report claims that continued development is the only answer to many of the environmental problems of the developing countries, but fails to consider that continued development may create new and more serious environmental problems which cannot be solved in the same way. (7-27) Herbert Spencer once commented on how greater problems seem to succeed the eradication of "natural" problems:

> Suffering and evil are nature's admonitions; they cannot be got rid of; and the impatient attempts of benevolence to banish them from the world of legislation before benevolence has learned their object and end, have always been more productive of evil than good. (2-36)

Solutions to problems often have a way of producing more problems, more fuzzy and indistinct, and more difficult to solve. The most obvious and direct solutions to today's problems are not necessarily to be desired.

The unconstrained exploitation of remaining natural and near-natural areas to meet the growing needs of man is a self-defeating strategy. This policy is comparable to that of providing new water sources for livestock in lands already overgrazed: the immediate problem is solved, but relief is temporary; livestock numbers increase, and the land is further degraded. The ultimate outcome is negative because the availability of resources per head is reduced and more numbers are at greater risk. Until increases in human populations can be adequately controlled, rapid and unconstrained development will be self-defeating because the long-run consequence of all technical improvement is an enormous expansion of the number of people who live in misery. (22-41) Hardin says the population problem cannot be overcome by development because of Gregg's Law: "You can't cure a cancer by feeding it". (67-74) This harsh metaphor is apt because the global environment is

being rapidly debilitated by the explosive growth of population and technological impacts - the earth is literally being eaten away. The idea of encouraging this growth at the expense of all nature should be considered alarming, yet the major response so far to overpopulation pressure is to find new ways to provide for more people.

This vicious circle persists because of failures of perception - decision-makers cannot clearly see the ultimate effects of their actions. The immediate effect may be most beneficial and salubrious; the ultimate effect may be disastrous. There is no such thing as an isolated act of charity - the effects of everything we do spread far beyond the narrow goal our acts are aimed at. (70-99) The experience of DDT is instructive. The benefits - saved lives and increased prosperity - would appear to far outweigh the costs - a few dead birds and other minor disamenities - but this cost-benefit comparison is too narrow to be valid. Benefits may prove temporary, and more serious ecological costs may be incurred later. DDT applications remove insect predators and create new species of pests, and traditional pests evolve resistance. Consumers also come to expect pest-free produce. The ultimate demand for and costs of controlling insect pests is likely to be far greater than if DDT were never used. And the DDT solution has created totally new problems (long-term threats to health and ecological stability) which are potentially catastrophic. Other actions which have disrupted ecological processes also have great potential for disaster; taken together, man's numerous intrusions into the delicate environmental fabric are producing long-term liabilities which may constitute an unbearable debt.

Modern agricultural practices require pesticides, chemical fertilizers, high-yielding varieties of seeds, and a high degree of mechanization to be successful. But there are serious side-effects to each of these techniques for achieving higher yields, and poorer countries may find it impossible to control these side-effects. Temporary success is no assurance, because the costs of control increase over time. The great danger lies in becoming completely dependent on methods which are

exceedingly costly and vulnerable to disruption.

Bentham maintained that the only proper end and purpose of government is to achieve the greatest happiness of the greatest number. (2-79) This statement contains a sinister trap - the greatest happiness of the greatest number may be no happiness at all. If total welfare could be measured, it would surely be better to provide only for that number of people beyond which the addition of one more individual would result in a net welfare loss for the population. This point can never be determined, but it is important to recognize that it exists. What transcendental principle tells us that the maximum number living the most miserable life is the best number? (66-171) Decision-makers should not attempt to provide more and more if it will ultimately mean less for all and an uncertain future. Development must lead to a balanced society in which basic needs are met and the risk of social collapse is low.

THE "NIBBLING SYNDROME"

No decision can be considered in isolation - the effects of every action combine with effects of other actions to produce results which may be unintended. Shedon calls this the "tyranny of small decisions". (90-206) It is necessary to have a holistic view and a long time horizon to avoid what may be termed the "nibbling syndrome": a series of small decisions, each having a desirable result, when taken together may have very undesirable results. For example, the gradual clearing of forests to develop a region may have no adverse effects until incremental losses reach a significant threshold, and then perhaps the destruction of additional hectares of forest will result in significant costs. Westman says there may be a non-linear relationship between the destruction of a certain amount of habitat and the resulting perturbation of the climate. (156-962) Southwick says it is possible to experience

rather sudden disturbances to populations, and even whole biogeographic regions, as a result of some tolerance level or limiting factor being exceeded. (138-151) The United Nations Report on Desertification points out that in drylands apparently insignificant changes can trigger profound physical effects. Even a small change in one component can radiate effects through the entire ecosystem, and minor shifts in water and energy balance can throw the system beyond the critical threshold whence natural recovery will not normally occur. (147-21)

Decision-makers tend to be unduly influenced by dramatic or obvious events; small, almost imperceptible changes fail to be accorded sufficient attention. Environmental impacts are often insidious. Because these forces act extremely slowly we are apt to ignore their existence or, if we recognize them, to belittle their importance. (58-101) These cumulative effects are seldom explicitly considered until their damage is done. For example, millions of acres of arable land have been destroyed by the progression of salinity and by secondary formations as a result of irrigation in India, Pakistan, Iraq, Iran, and Turkey. (37-61) Numerous examples of local and regional ecosystem breakdowns are known to have resulted from gradual, almost imperceptible alterations, and it is possible that the same phenomenon will finally lead to a breakdown of global proportions.

The difficulty is that no concepts have been advanced to evaluate the cost of incremental losses, and knowledge is lacking for assessing how near the biosphere (or any ecosystem) may be to some critical limit. However it is certain that heavy losses - in both species and natural ecosystems - are presently being sustained, and one may assume limits are more or less rapidly being approached. Decision-makers must look beyond the obvious losses and consider the possible cumulative effect of these losses on complex ecological systems. These systems cannot be understood or their behaviour predicted by examining the properties of their component parts. Man's growing impacts can be expected to have synergistic effects, and these cannot be foreseen. The most prudent course would be to reduce the number of impacts and the level of losses in natural systems.

THE ENGINEERING FALLACY AND INAPPROPRIATE TECHNOLOGY

A major problem around the world, in both market and planned economies, is the "edifice complex", the view that any construction that alters the environment in favour of "progress" is a good thing and virtually any pristine piece of nature can be improved by human intervention. (16-81) The roots of this complex are not difficult to detect. Andrew Jackson, a United States President (1829-1833), once said:

> What good man would prefer a country covered with forests and ranged by a few thousand savages to our extensive Republic, studded with cities, towns, and prosperous farms, embellished with all the improvements which art can devise or industry execute. (113-40)

But we are now in new times, facing new realities, and attitudes must change. Many leaders of developing countries are still possessed of a frontier mentality, characterized by a desire to subdue nature and a willingness to take risks. This was once an admirable trait, but now it is simply too dangerous; not just a few families, but whole nations and future generations are the stakes riding on current high technology gambles.

The "engineering fallacy" is the assumption that future demands (based on projections of current demands) must always be met by some feat of modern engineering which modifies the natural environment in the place where the demand originates. Thompson discusses a major water project in southern California, where it was forecast that an additional 9 million people would require water by 1985. The engineering fallacy is to assume that the problem must be how to get water to the area where these people may want to be; but the problem could be recast as "How do we get the people to the water?" (141-239) The latter is the ecological approach because it permits solutions which are less damaging to the natural environment; such solutions may appear less efficient or less desirable, but in the long run maintaining greater environmental

quality is both efficient and desirable. Passmore says it is a proper criticism of Western society that, in its - often childish - enthusiasm for technological "advance", it has failed adequately to consider the costs of introducing new devices and has defined "costs" far too narrowly. (120-49) Technological gains are sometimes not really gains at all, although this may not be obvious. Seneca and Tausig imply that in the United States access to recreation areas has been improved by the interstate transportation system, high incomes, and sophisticated technology; but actually people used to have better access when they could go through their back door and over the fence. (133-198)

Lynn White feels that engineers have not formulated any truly meaningful ideals to which they can dedicate themselves, unlike doctors, lawyers, academics, and the clergy (who are all committed to liberating man from some real scourge, such as disease, injustice, ignorance and sin). White suggests that engineers study ecology and the humanities in order to develop an ecologically sound and humanized technology to better serve the true needs of mankind. (157-147)

New technologies in agriculture are spreading rapidly over the world, with little regard to whether they are truly appropriate for local conditions. If thousands of people die from famine or flood, the underlying cause may be that the wrong technology was adopted - one that permitted dangerous developments, such as reliance on scientific and mechanized agriculture, which resulted in overpopulation and overcrowding in flood prone areas at the same time it was exhausting the soil and leading to greater erosion. The Founex Report recognizes the need to look at the way in which a development activity relates to the carrying capacity of a country's natural, and even social, system. (7-16) But the recommendation of this report is to continue with development objectives and selectively treat environmental side-effects with remedial actions - there is no discussion of adopting a general ecological approach to development. Perhaps normal development techniques will only worsen the situation - what is wanted is a means of

providing the basic necessities in a balanced, ecological manner.

Kneese advocates greater economic development to improve the material circumstances of the people in developing countries yet fears the combined forces of population growth and urbanization will put dangerous strains on ecological systems. (84-98) The phenomenon of burgeoning urban centres poses several perilous social and environmental problems. If near-natural environments can be made more appealing, perhaps the explosive situation in urban development may be defused. Engelhardt suggests that new industries should not be allowed in "over-populated megapols" because they only attract more people and add to urban problems. (56-136) Odum has shown that as a city grows, it puts a disproportionate strain on the surrounding natural environment. If large areas of natural environment are not preserved to provide the needed input from nature then the quality of life in the city declines and the city can no longer compete economically with other cities that have an abundant life support input. (117-183) The normal response to problems brought on by growth is to borrow resources (at an ever-increasing cost) to support even more growth in the hope that growth will make more resources available. However growth can only make greater demands on the life-support systems of cities. Odum suggests that cities ought to be diverting more of their energy to maintaining the quality and efficiency of the environment already developed, and to reducing the stress on vital life-supporting natural environment. (117-183) The problem is conceptually very simple: since rapid technological and population growth produces a strong drive to convert natural environment into developed environment, this positive feedback must be neutralized by an equally strong negative feedback control built into economic and political systems to prevent over-development. (117-180)

METHODS OF CONTROL

There are no market solutions for maintaining the natural environment because of the high transaction and enforcement costs involved, but it is possible to introduce other institutional mechanisms to diminish these costs. George Berg has defined an institution as an anticipating device designed to pay off its members now for behaviour which will benefit and stabilize society later. (70-80) Instruments of land-use planning include taxation, zoning, *administrative servitude* (in France), and conservation easement (in the USA). (124-15) For example, valuable agricultural lands threatened by urban growth have been saved by a tax structure based on the actual value of the land (rather than the potential value for development), and by strict zoning for agricultural purposes only. Other options are to purchase key areas to form the core of a larger preservation zone over which control can be acquired through "less than fee" techniques, such as the purchase of scenic easements and purchase of the landowner's development rights. The Greenline Park concept in the USA uses all these regulatory tools to maintain "living landscapes", which are areas which have notable scenic, recreational, cultural, and ecological value. (35-247)

Decision-makers should anticipate future conditions of supply and demand, and give full weight to option values lost by irreversible developments. Krutilla advocates a shadow tax to discourage development activities which significantly reduce future options. This tax should be equal to the option value, defined as the difference between expected consumers' surplus and option price, the sum of money the individual would pay now for the right to consume (at a predetermined price) in the future. (91-70) Such a tax could then constitute a risk premium; but even under risk neutrality, there is an option value to refraining from development if it is assumed that new information will arise over the passage of time which will permit better decisions to be taken later if the present (irreversible) project is not undertaken. These considerations would dictate the use of a severence tax or legislative zoning

to impose a premium on or altogether stop developments that involve "nontrivial irreversibilities". (91-268) Baumol and Oates say that in the case of any depletable resource for which production costs rise as supply diminishes, the pricing problem can be solved by forecasting costs to future generations and basing current prices on the costs of consumption over all time periods. Perfect forecasts would lead to an intertemporal Pareto optimum. (15-68)

Institutional solutions are needed to achieve intertemporal efficiency because different generations cannot bargain over inheritence and consumption levels. Severence taxes on the extraction or consumption of depletable resources would lead to a more optimal arrangement. The object is to ensure that the relative scarcity of the resource and the damage done by extraction or consumption is fully reflected in the costs. Such charges may slow development, but they are economically and ecologically correct. The government could assume all property rights associated with the natural environment and then determine the appropriate level of, and charges for, disruption to ecological values. (In some cases, certain species could serve as ecological indicators to provide a low cost monitoring mechanism to regulate use.) Resource extraction or environmental destruction rights could be auctioned to the highest bidder (this would not help determine appropriate levels, but would be an efficient means of administering resource development once levels are set by ecological analysis). This technique would ensure that private users of public goods pay fully for their use.

Another source of intertemporal inefficiency is the fact that in future, benefits enjoyed by a preceding generation may be lost, but the costs may still be there. The later generations would gladly pay the earlier not to undertake the project, so that everyone would be better off, but transaction costs are infinite. The best policy instrument to increase efficiency in this case might be legislative zoning. Zoning is a means of internalizing the potential external costs that might follow from unregulated private development of land and is part of an overall social planning process that attempts to take into account the proper

balance between amenity and economic development and still allow the market mechanism scope for achieving allocational efficiency within the regulated framework. (133-228) Nijkemp recommends

> a land-use plan which delimits the amount and location of natural areas on the basis of information about a desirable future level of urban-industrial development. Then such areas might be zoned into the public domain, before the process of land speculation raises the market price. (114-8)

The United Nations Report on Desertification recommends policies of land zoning based on estimates of climatic risk to discourage the extension of cropping beyond certain environmental limits. (147-52) Zonation can also be used within natural areas to increase genetic diversity and promote gene flow. (149-22)

The benefits associated with natural areas inevitably appear insignificant compared to opportunity costs of foregone development in any "common" context because it is always possible to make somebody better off by giving up a few more natural amenities so long as there is population or technological growth. Thus natural amenities become diluted and debased unless they are set aside and protected from encroaching development. Mishan proposes the establishment of "separate facilities" to maintain those natural amenities which could not survive marginal comparisons in a situation which "is common to all". (106-114) Mishan also recommends that laws be passed which give people <u>rights</u> to natural amenities. Under existing laws, people must pay to preserve amenity and have no means of limiting in advance the level to which their welfares may be reduced in consequence of the spillovers yet to be produced. (109-448) Developing countries should anticipate this situation and provide laws that will ensure environmental quality will be preserved since future generations will undoubtedly place greater value on environmental amenities. The longer this is deferred, the more difficult it will be to return to any former level of amenity since costs will become increasingly prohibitive and there will be nothing to prevent

spillovers increasing without limit, and nothing to prevent the environment sinking ever lower in the scale of amenity. (109-448) If men were invested with property rights in natural amenities, development would proceed along radically different lines: the cost of over-development would become prohibitive, and the earth would retain more of its beauty and pleasantness. There are of course great information and enforcement problems to the implementation of amenity rights.

Stone suggests natural areas and objects could themselves be invested with legal rights. While repairable damage to the environment might be balanced and weighed, irreparable damage could be enjoined absolutely. (140-38) Information problems would also be serious here, since it might be difficult to precisely define when the environment has been damaged irreparably, or determine what actions are responsible for irreparable damage.

The concept of "the public trust" is central to any attempt to maintain natural goods. This is the idea that certain common properties are held by government in trusteeship for the use of the general public. This concept is based on three principles: (1) some resources are too important to make them the subject of private ownership; (2) some resources should be made freely available to the entire citizenry because they partake so much of the bounty of nature; and (3) the government should promote the interests of the general public rather than assist in promoting private benefits. (60-165) Ecological values and natural amenities are among the common properties which must be held in trusteeship. The government should set standards for the provision of these natural goods, and standards, once adopted, should be rigorously maintained. A developing country should not be so committed to the benefits of development that it neglects the responsibilities of the public trust.

APPROPRIATE LAND USE

Natural ecosystems have evolved over millenia and therefore the biotic components are well-adapted to the abiotic conditions. Modifications by man, if abrupt and extensive, are almost always detrimental to the natural system and require great inputs of energy to maintain productivity and equilibrium. Modern technology therefore does not "improve on nature" and benefits may be short-lived. Modern agricultural practices rapidly destroy soil fertility to maximize production, but the farmer cannot compete unless he engages in these practices: agribusiness is a main contributor to the environmental crisis. (31-148) If prime farmlands can soon be degraded, marginal lands can be quickly devastated. Areas which have only recently come into agricultural use tend to be marginal lands - limiting factors are more critical, and development prospects are slight and very risky. The African Special Project on wildlife conservation (undertaken by FAO and IUCN) found extensive habitat degradation as a result of ranching and farming activities in unsuitable areas. (126-26) In savanna and grassland systems, heavy grazing by domestic livestock reduces the storage of nutrients in green leafage and makes plants more vulnerable to drought. Also, vegetation cover is removed and soils are compacted, which increases evaporation and decreases infiltration. These effects are more serious in marginal areas, which may already be stressed by poor soils or adverse climatic factors.

The UN Report on Desertification suggests that in lands too dry for rainfed cropping the natural vegetation usually forms the most efficient pasture in terms of upkeep, grazing returns and protection of the soil surface. (147-49) Lands which are marginal for livestock production may yield greater production from wild animals because the latter can make better use of the indigenous vegetation. Game animals can be used to support recreation and tourism industries, as well as for meat and live sale. Traditional societies living in marginal areas often have recourse to the productions of natural ecosystems during drought

and seasonal food shortages; activities such as gathering, hunting, fishing, and the like are one answer to "famine years" and "hunger months". (123-1094)

Many luxuriant tropical lands are also fragile and unable to sustain agricultural activities. If tropical forests are cleared for shallow-rooted, short-cycle crops the soil soon loses its fertility and is exposed to weathering. Such areas are best left in their natural state for their ecological values, and to maintain future options. It is preferable to practise intensive management of better lands and leave marginal lands in their natural state. For example, it makes much more sense, economically and ecologically, to invest development money in improving the quality of existing rangelands than it does to bring new areas of land into livestock production. (43-106) This approach would permit more natural ecosystems to remain in existence and fulfil their essential functions.

The value of wetlands has also been greatly underestimated, as is evidenced by the substantial sums which have been spent in the United States to restore wetlands. Wetland ecosystems are now being managed as renewable resources, and it is generally accepted that they confer more benefits than any alternative use. This further demonstrates that natural ecosystems can sometimes provide an alternative that is preferable to irreversible development. (35-319)

APPROPRIATE TECHNOLOGY

Modern technologies are not always appropriate to social and environmental circumstances but are nonetheless rapidly displacing traditional technologies around the world. Indigenous technologies are normally rational and in harmony with ecological conditions because they have evolved the capability of utilizing marginal resources in an efficient

manner without degrading the resource base. An important feature of these technologies is that they do not rely on fossil fuel inputs (the costs of which may be expected to increase significantly in the future). Indigenous technologies can be improved by certain intermediate technologies which utilize labour and other relatively abundant resources, rather than capital and increasingly scarce resources (such as petroleum and natural gas). Intermediate technologies are ecologically more acceptable because they are designed to improve soil fertility, retard erosion, and use natural substances. These technologies are easier to use and introduce, and although the potential for high profits may not match that of advanced large-scale technologies, there is less capital outlay and faster return on investment. The risk of technical, organizational, or environmental failure is very low, and problems are small and tractable. Developing countries with poor or limited resources initially require technologies that are generally low cost, easy to use, small scale, based on locally available resources, labour intensive, culturally fitting, and environmentally acceptable. (147-321)

Traditional practices should not be supplanted by modern practices but should form the basis for further development, because they use tested skills and strategies to exploit difficult environments. For example, nomadism has proved a viable strategy in drylands, and shifting agriculture allows fertility to get back into the soil. Nomadic pastoralism and shifting agriculture depend on mobility and low human population densities. If patterns of settled land use are imposed, the land may not be able to support new life styles and growing populations. The 'Kung bushman of the Kalahari have been very successful in a harsh environment for millennia by minimizing damage to the resilience of natural ecosystems and by limiting population growth through various features of their social organization. The recent introduction of agriculture and herding have increased pressure on the resource base with harmful effects. Puzo discusses the Khumbi people in southern Africa, who are farmer-herders (depending heavily on milk) but are also hunters, gatherers, and fishermen. Utilizing game precludes the

problem of bush encroachment (which is brought on by selective grazing of cattle), and so the carrying capacity of the land is not diminished even though the system attains a productivity nearly as great as ranching. (123-1090) Puzo feels that this traditional system is not only eminently adapted to the environment but perhaps is better off without "modernization". Systems like the Khumbi's should be studied to see how intermediate technology might improve production without adversely affecting the ecological equilibrium which it has so admirably achieved.

THE AVAILABILITY OF AID

The Founex Report calls for an increase in aid to poor nations' efforts to improve and protect their part of the global household. (7-31) Many regional and global environmental problems might be averted by appropriate aid programmes. Timely and effective aid can reduce future costs due to major ecological breakdowns, and can save genetic resources which have international significance. Developing countries are often rich in genetic diversity but lack funds to institute conservation programmes. Peoples of developed countries have evinced great interest in and appreciation for wildlife and wild areas; these should therefore be regarded as valuable biological and cultural resources for all peoples of all times. The demand for parks exhibiting wildlife and natural scenery has significantly increased because more affluent peoples have achieved tremendous spatial mobility; it is logical and just to call for subsidies from the source of that increased demand. It may be anticipated that future demand for a wide variety of natural goods (some of which may not now be appreciated at all) will be far greater. It is not reasonable to expect poorer nations, in which such resources happen to exist, to assume the full costs of maintaining these international treasures. The Proposed Principles of the Declaration on the Human Environment makes reference to the special needs of developing countries and the special obligations of the richer countries in providing assistance. (62-171)

Many resources associated with natural and near-natural areas are thought to be valueless by the nation which has them but are of considerable value to other nations or to the world community. Such resources are sometimes scarce on the global level but abundant locally and so use is unregulated. Demand for natural goods always lags behind supply (which is fixed) so that present behaviour is not appropriate - future demand must be anticipated. It is therefore desirable to compensate present users for foregoing further infringement. The Worldwatch Institute has recommended creation of a global cost-sharing scheme under which the wealthier nations would contribute to the cost of protecting wildlife and the ecosystems that support it in the poorer regions of the world. (35-469)

Local populations affected by the establishment of parks, reserves, or other schemes for maintaining natural and near-natural areas should participate in and benefit by such developments if they are to remain viable. When it is necessary to re-establish people in new homes and occupations, financial assistance is available through "funds-in-trust" arrangements with Unesco, whereby Member States can make funds available for specific activities in developing countries. (151-37) Support for maintaining natural areas may be had from the World Heritage Convention, Man and the Biosphere Programme, International Union for the Conservation of Nature, and World Wildlife Fund.

Given present technological and ecological constraints, there are not enough resources to permit every developing country to become an industrial power. Thompson estimates that if all countries were to achieve the economic level of the United States it could mean an increase of 200 times the present natural resource and pollution load on the world environment, which could be insupportable. (141-6) This has led Paul Ehrlich to suggest that developed countries have a special responsibility to assist developing countries in maintaining their traditional ways of life with access to the fruits of industrial societies. (141-6) Peoples of developing nations may have great pride and high aspirations, but decision-makers must set realistic and safe objectives. Modern

technological aid has often had undesirable results, and direct financial aid can be a trap if it leads to perpetual dependency, social decay, or environmental hazard. Aid should be directed at bringing about <u>appropriate</u> development, which does not encourage people to destroy the carrying capacity of their land but to live in harmony with it. Principal objectives of an aid programme might be to promote self-reliance, social stability, and ecological equilibrium. In all cases, aid should be directed at what is clearly obtainable, clearly needed, and clearly safe.

SUMMARY AND CONCLUSIONS

A policy of development which has the effect of increasing demand on the one hand and scarcity on the other is ultimately self-defeating. The very foundations of the biosphere are being threatened by stresses which are essentially imperceptible over a human life-span. The sustaining environment may gradually be weakened until critical tolerance levels are exceeded and essential life-support systems begin collapsing on a large scale.

The widespread application of engineering solutions to human problems has resulted in great ecological damage and may eventually lead to an untenable situation. Over-development must be prevented by adopting appropriate institutional mechanisms if the "public trust" is not to be violated. This involves determining the best management practices for achieving optimum sustained yield from all ecosystems.

The use of appropriate technology to meet human needs minimizes ecological risks, social disruptions, and political vulnerability. Poorer nations should be assisted in developing this technology and should be compensated for foregoing large-scale industrial development. More substantial aid should be provided by the richer nations to assist poorer nations in improving human welfare without damaging the environment.

CHAPTER 9

THE EFFECTIVENESS OF INSTITUTIONS

"The Physics of beauty is one department of natural science still in the Dark Ages.... The art of land doctoring is being practiced with vigor, but the science of land health is yet to be born." (94-146, 274)

INTRODUCTION

Although it is widely recognized that there is some risk associated with pursuing a policy of rapid and unconstrained development based on the urban-industrial model, most decision-makers place great faith in man's institutions - particularly in science, technology, government, and economic institutions such as market and pricing systems - to mitigate or contain all conceivable side-effects. An examination of these institutions reveals certain limitations and weaknesses which would indicate that their potential for dealing with large-scale and long-term environmental problems has been greatly over-rated.

SCIENCE

Science has been extremely effective in producing new instruments of power, and has unleashed a technological revolution which is altering the world at a rate and on a scale which is truly impressive. But science has not been so successful in predicting, explaining, or correcting many side-effects of transforming natural environments. Nature is enormously complex and remains shrouded in mystery:

> The systems of nature are characterized by their diversity, their spontaneity, their variety, their high degree of differentiation, and their multiple functions. The standard methods of scientific and statistical analysis cannot yet be employed in understanding these systems. An analysis of separate components cannot give the necessary insight into the importance of mixtures of effects and interactions of environmental conditions. Our concept of single cause-and-effect events cannot produce usable conclusions in the complex natural environment. (136-4)

The scientific method searches for the causes of observed effects, and is most successful when a problem can be isolated and tested against controls. However many of the problems of development cannot be tested in isolation, and nature's great complexity cannot be reduced to a few simple abstract concepts. It is too often forgotten that in the absence of experimental isolation, real-world feedback makes causes indistinguishable from effects. (13-151) The specific causes of ecological disasters may be extremely complex, and observations may be completely obscured by time and space limitations.

Science has developed a specialized character which is much better at reductionist analysis than at creative synthesis. (25-936) Through reductionist analysis, we attain objectivity, but we fail to attain knowledge of the object as a whole: only the "lowest", the most superficial, aspects of the object are accessible to the instruments we employ. (130-64) Science has been so preoccupied with reductionism

that supraindividual systems have suffered benign neglect. (116-1289) New properties emerge at every level of organization, and the study of lower levels will never fully explain the characteristics of higher levels. Since every system is more than the sum of its parts, it is necessary to study impacts to ecological phenomena at the ecosystem level. Our really big and important problems cannot be solved, or even coped with, on the basis of piecemeal study no matter how sophisticated or technically advanced are the methods employed. (115-252) All of science's failures in preventing ecological disasters are due to the lack of a holistic approach. Maslow insists that the holistic outlook must be adopted, and suggests that the atomistic way of thinking is a form of mild psychopathology. (103-xi)

The prevailing reductionist approach in science tends to isolate scientific disciplines from each other, and all of them from the real world. (31-191) More multi-disciplinary investigations are required, but the explosion of knowledge has brought a greater tendency to specialize. The applications of new scientific discoveries are having increasingly complex and far-reaching ecological and social effects, and more concerted, holistic research must be undertaken by the biological and social sciences. Broad spectrum systems analyses are urgently needed for a number of environmental and social problems, as well as for natural resource management problems. (138-112)

Ecology is not yet close to developing a predictive capability. Ecosystems may be far too complex to ever model successfully. Computer models are limited because some variables remain undiscovered or change character. Ecological events cannot be predicted because their inherent complexity often leads to sudden qualitative changes in response to gradual, quantitative ones. (31-219) It is also impossible to forecast synergistic effects which arise with gradual, quantitative changes in two or more variables. Boulding has cautioned against trusting to mathematics and sophisticated computer programmes for guidance in preventing ecological mistakes:

> By means of mathematics we purchase a great ease of manipulation at the cost of a certain loss of complexity of content. If we ever forget this cost, (it) may be our undoing. (22-115)

Darwin once suggested an interesting exercise in scientific humility to reveal the extent of our ecological ignorance:

> It is good thus to try in imagination to give to any one species an advantage over another. Probably in no single instance should we know what to do. This ought to convince us of our ignorance on the mutual relations of all organic beings; a conviction as necessary, as it is difficult to acquire. (41-89)

The ecologist is thus confronted with a field of study which can never be fully understood, and he finds it necessary to adopt inexact methods, render qualified judgments, and admit that he may be wrong. This leads to credibility problems and a general reluctance to follow the ecologist's advice. Sir Frank Fraser Darling laments the ecologist's apparent inability to make constructive proposals in the face of specific and urgent problems. (39-100) Decision-makers tend to be men of action, bold and positive, who appreciate the hard facts and clear plans they get from engineers and technocrats. Ecologists, by contrast, raise vague alarms, stress the symbolic importance of issues, and warn of distant dangers due to incrementalism or synergistic effects. Technologists solve present problems, while ecologists are usually concerned with preventing possible future problems.

What is reasonable behaviour in the light of inadequate knowledge? Many decision-makers adopt the attitude, "If we're not sure it's bad, let's go ahead". This is exemplified by a statement by Almeida regarding the unknown effects of pollution and attempts to control pollution:

> It is quite clear that the existing situation of incomplete knowledge precludes drastic action in most fields. Action might worsen the situation rather than improve it.... (4-50)

Almeida would defer action on pollution control until all the evidence is in, but by then much irreparable damage could be done. His attitude toward the possible dangers of increasing CO_2 levels in the atmosphere displays a similar disregard for irreversibility, when he suggests that if it takes a hundred years to feel the effects, we may have the time to improve our knowledge and thus risk fewer mistakes in dealing with the problem. (4-49) But once CO_2 levels are raised, there may be no way of dealing with the problem. Unfortunately many decision-makers feel that future scientific discoveries can "undo" today's mistakes and are prepared to leave today's mounting problems for tomorrow's scientists.

Science cannot be trusted to develop the ability to control the effects of failures in complex ecological systems. Ecosystem upsets are becoming increasingly difficult to manage, and scientists disagree on what to do. One example is the experience of the degraded St Lucia estuary: despite a voluminous literature now available neither biologists nor engineers seem to be agreed on a management plan for the St Lucia system. (76-1373) This illustrates the importance of preventative action - isolated ecosystem disasters could prove unmanageable. Then, as more disasters occur, there could be cumulative or synergistic effects destroying the equilibrium of larger systems.

The key concepts of ecology are interdependence, limitation, and complexity. Any policy of development must be concerned with the implications of these concepts: it is not possible to do just one thing; there are limits to any system; ultimate effects are not foreseeable. Ecology is a young and inexact science but it can give guidance to other disciplines. The principal lesson is restraint. The effectiveness of man's powers is limited by his ignorance of ecological forces.

Man's interposition in nature is more likely to be harmful than good because there is an infinite number of wrong answers to any given problem. (25-934) Long-established methods of dealing with nature are safer - the knowledge requirement is far less. Developing countries should not covet Western science and technology since these "wealth-

producing" instruments are likely in the end to cause more harm than good; science has not proved an effective guide to technological action in the natural world. (32-xxiii) As science develops, it no longer merely investigates the world; it creates the world which it is investigating. (22-121) Since man does not have effective control over his instrument for fashioning new environments, he could come to occupy an increasingly inhospitable planet.

A constant theme in planning controversies is the attempt to make (and rationalize) choices between sets of benefits whose financial value can be calculated ("developments") and sets of benefits whose social value is thought to lie beyond financial calculation. (2-27) There is no scientific way to resolve such disputes. Those who put their faith in the scientific method to solve the political, economic, social, and ecological admixture of problems facing developing countries must realize that science has provided no objective criteria for determining what man should strive for and what price should be regarded as acceptable for attaining any goal. Decision-makers need to develop a value system based on a personal acquaintance with nature before planning developments to solve social problems. Science and technology cannot provide mechanical rating systems to forecast what will be important to man. Maslow says it is necessary to proclaim values by which scientific investigation is to be guided:

> I believe it can be shown that normative zeal... is quite compatible with scientific objectivity and indeed even makes conceivable a better, more powerful science (than) when it tries to be value-neutral... (103-xxiv)

Perhaps it would be wise to make a pre-emptive value judgment and adopt a rule that no situations must be allowed which are not containable by simple, straightforward actions. A conservative policy of development has the eminent advantage that it precludes many hydra-headed monsters and keeps programmes manageable. This single virtue is worth many brilliant schemes to solve problems overnight since it avoids the possibly

inextricable morass of large-scale ecological disturbances.

TECHNOLOGY

Historian Arnold Toynbee says the marriage between science and technology (which he dates at about 1660) generated for the West a material power that quickly put the rest of the world at the West's mercy. (143-26) The whole world has become enthralled by the Western way of life. Since the industrial revolution began, modern technology has completely transformed the way of life and the face of the land in developed countries around the world. Developing countries are attempting to adapt this technology to solve a wide range of social problems in a short period of time. The industrial model has been eagerly accepted, even though it has brought many problems and has not yet been subjected to the evolutionary test of survival (Waller calculates that agro-industry has fed less than 4 per cent of mankind so far). (152-530) It is expected that technology will alleviate want by increasing production, but some critics maintain that modern industrial technology generates forces which carry production beyond what is reasonable: success in stimulating production leads to glut, and the way to prevent glut is to produce gluttons. (73-21) At the same time, side-effects of production lead to deterioration in environmental quality. It is highly questionable whether this approach really improves human welfare - social and ecological breakdowns appear inevitable.

Initiators of large-scale development programmes in developing countries have often failed to consider the full costs of importing modern technology. Farvar and Milton, commissioned to study the effects of such programmes, reported that little concern had ever been given to anticipating ecological costs and side-effects. (57-xv) Scudder's study of the Lake Kariba project revealed that no ecological surveys of the lake basin or the relocation areas were initiated prior to the decision to

proceed. (32-xxii) The social effects of developments are also often ignored - the attempt to relieve traditional societies from physical hardships, and provide short-term economic benefits, often results in great social disruptions. Traditional myths and institutions which bring about stable relationships between man and man, and man and nature, are sometimes sacrificed or traded for less effective and less satisfying social institutions.

When technology fails, technocrats claim the failure was due to improper application or other "sheet technicalities", but perhaps these are not random accidents of progress, but rather the systematic consequences of some deep fault in our approach. (32-xxi) Ecological "mistakes" are perhaps unavoidable when there is a major intrusion into a complex natural system; unforeseen effects are inevitable, and the damage is quite likely to be greater than the benefits of the project. Many developing countries have fragile ecosystems with low carrying capacities. Traditional systems of land use may be far superior to modern systems designed for other environments. For example, in drylands it is desirable to keep grazing pressure light by (1) utilizing different animals (each of which uses different parts of the land) and (2) by keeping the animals moving. But modern ranching methods are sometimes adopted to increase productivity, even though this reduces flexibility and often leads to overgrazing and resource degradation.

Once modern technology is applied, it seems to generate a momentum of its own and become an almost autonomous force, creating problems which seem to require still more technology. This dynamic force has its own rationale, which may be completely divorced from man's real needs and highest aspirations. The constant search for technological solutions to new problems (which have been created by other technological "solutions") obstructs and may even preclude long-term planning directed toward higher goals. It is entirely possible that technological advance tends inexorably to destroy the sources of satisfaction of ordinary people regardless of the form of economic or social organization. (2-84) Odum warns that the promise of today's technological

magic could be all too easily traded for a hell-on-earth tomorrow. (115-250)

Modern technology has given man immense power, but man uses this power in ways which are destructive of the environment. Every benefit is purchased at some cost to the environment, but this cost is often deferred and put onto future generations. It is a dangerous illusion to think that man's industrial system can develop independently of nature's life-support system. It is important that environmental degradation not be seen as merely a technical problem - many ecological and social problems are far too complex to be amenable to technological solutions. The enormous problems of the industrial state are ultimately unsolvable in the present paradigm precisely because their origins are in the success of that paradigm. (72-131) Continued reliance on the industrial state model of development is a poor strategy because (1) nearly every technological innovation creates still new environmental problems, (2) resource exhaustion could outpace technological innovation, and (3) there appears to be no technological solution to the ultimate problem - heat pollution.

Industrial development by its very nature destroys natural goods on which man's well-being depends. How much environmental destruction can be tolerated is not known; there must certainly be critical thresholds beyond which the quality of life is rapidly reduced and risks to survival are greatly increased. Once these thresholds are reached, it will be too late to rectify the situation:

> Increases in the demand for the services of natural environments cannot be met by increases in the supply.... There is no known technology for the production of a new natural environment, which is the accident of geomorphology, weathering, and biological processes involving a time span far exceeding human planning horizons. (91-11)

Technology cannot solve those environmental problems which may be expected to arise when the destruction of natural goods reaches a critical threshold - technology can only exacerbate this type of problem by making

possible developments which create even greater scarcity.

Decision-makers need to consider new approaches to solving the problem of scarcity in a finite world. "Technological fixes" invariably have undesirable consequences because modern technology is in conflict with nature. The industrial model of development is not viable because it involves processes which are destructive of the environment and therefore not sustainable. A new approach to development should be adopted - one that is based on an understanding of man's relationship to the natural environment, and will permit progress to be sustainable. Jimoh Omo-Fadaka says:

> Industrialization and a high rate of growth of GNP have brought increased unemployment, poverty, and misery throughout the Third World... the only hope for the people must be based on low-impact technology for the support of small-scale decentralized communities. (42-10)

The spread of mechanized agriculture in India and Pakistan, for example, has significantly reduced the need for labour per acre and displaced hundreds of thousands of farm tenants who have migrated to cities where they cannot find work or adequate housing. (154-168) Stavrianos foresees the emergence of a new technology which will be simple and inexpensive, and lead to a qualitatively different civilization:

> In technology the thrust is adaptation to human needs and aspirations - or transition from aristo-technology, which places excessive demands on capital, energy, and materials, to demo-technology, which makes minimal demands, has correspondingly minimal impact on the physical environment, and can be afforded by poor nations as well as rich. (139-19)

This new technology would be knowledge intensive rather than capital intensive and permit improvements in the quality of life without increasing risks to survival. (139-19) Schumacher has said that he cannot

think of anything which man really <u>needs</u> that cannot be produced very simply, very efficiently, very viably on a small scale with a radically simplified technology, with very little initial capital. (131-21)

Development projects should be scaled down, and then as ramifications of development become generally understood and controllable, scope could be gradually and selectively widened. However, since many complex and far-reaching interactions between man's activities and the environment can never be adequately pre-tested, technological innovation must always be limited. Decision-makers should consider the achievement of greater stability and lower risk to be well worth some sacrifice in the material standard of living. Many material goods and modern pleasures are actually remedial in nature, serving as compensation for the loss of higher goods and greater pleasures that were had in abundance in simpler times. Therefore, increases in the "standard of living" (after basic physiological needs are satisfied) may actually represent increases in the level of subsistence, so that the quality of life is unimproved or reduced. If society's goal is to improve the quality of life, rather than the standard of living, then adopting modern technology may be counter-productive.

Garrett Hardin has remarked that the greatest weakness of Utopian visionaries has been to ask the simple question, "And then what"? (71-5) After man achieves material abundance (which after all only satisfies his lower needs), what will he seek then? A diverse and beautiful natural environment might yield far greater satisfaction (in addition to far greater security) than would more material goods. Krutilla feels future technologies will develop substitutes for conventional natural resources but will never be able to re-create natural goods, and therefore the real cost of refraining from converting our remaining rare natural environments may not be very great. (88-784) It is important to maintain irreplaceable natural goods and discount the value of technological goods.

GOVERNMENT

Individuals extend their influence by creating social, economic, and political institutions, but these become unwieldy and dangerous. As institutions increase in size and complexity, the degree of control exerted by individuals is decreased. Thus, greater influence over nature is purchased at the expense of hazard. Man now faces problems of unprecedented dimensions, which require a superlative degree of perception and coordination to manage. Some of these problems appear to be beyond the control of society's institutions, which are limited in organizational sophistication and integration, particularly in networks of communication. This implies that man should seek to limit his influence, not extend it.

Governments appear to have limited capability of adapting their policies in anticipation of an environmental hazard; only in response to it after it has become apparent. (8-9) But an uncontrolled approach to development, in ecologically sensitive areas particularly, will lead to a series of increasingly serious, interlocking environmental disasters. There is an urgent need for land use surveys on which to base planning for man's inherently fragile and unexpandable resources of land. (154-90) Only recently has it become necessary to recognize that global resources are not infinite, and therefore social commitments must now be limited. Most nations have overestimated the ability of the earth to provide and underestimated the costs of improving welfare; the law of diminishing marginal productivity is beginning to be felt on a global scale.

Optimum levels of resource exploitation cannot be accurately determined, but some decision is required and levels should be selected by political rather than economic processes. Undue reliance on price signals alone can lead to types of resource use that grossly contradict amenity and human values. It is because the market is a limited tool for dealing with <u>collective</u> needs and systems that government planning and a measure

of public financing are indispensable to the creation of a decent human environment. (154-89, 108)

The famous precept of utilitarianism, "the greatest good for the greatest number", sounds laudable but is useless as a guide to political action. One course of action may provide the greatest good in terms of market valuation but another may satisfy the greatest number. In the absence of objective standards of valuation, it is necessary to rely on the judgment of policy makers. There is a danger in democratic and socialist countries that satisfying the greatest number may lead to a "greatest good" per capita which is very low. (In a totalitarian country, the danger may be reversed - the greatest good may accrue to only a few, and the greatest number may suffer miserably.) There is no clear rule by which to be guided, but it is necessary to achieve some balance between private and public welfare.

Allison says individuals always want to maximize their private welfare, even at the expense of the public welfare, and their wants are normally predictable. If population density is such that someone will lose if another gains, then the expressed private interests of all parties is (1) unrepresentative, (2) uninformative, and (3) self-cancelling: they are unrepresentative because private benefits do not reflect public benefits; uninformative because all private benefits are very similar; and self-cancelling because granting a private benefit to one person is offset by imposing a cost on someone else. Therefore it is important to look beyond the individual's expressed desires and consider what ideal public good can be done or undone by sets of alternatives. Public benefits are often too thinly spread to attract much support and can therefore be systematically eliminated, to the detriment of future users. Public benefits must be evaluated differently to private benefits because they have significant and lasting general effects. (2-68)

Political processes tend to proceed by a calculus that is sequential and incremental rather than comprehensive. (49-61) This "incremental rationality" does not lead to an optimum condition; it is necessary to

make comprehensive plans for the long-term. Krutilla says decision-makers must take a broad view of resource use as a system which needs all its parts, and not make trade-offs in isolation:

> If such decisions come up one at a time... all of the resources or configurations of land forms and biota necessary to indulge less common tastes will be extinguished over time.... No adequate mechanism exists in the public sector for automatically allocating among the qualitatively different demands in their relative proportion. (89-1067)

Politicians and bureaucrats are motivated to allocate society's resources in a way which will further their careers, and the costs of a severe misallocation of society's resources can be enormous. (133-107) All institutional arrangements and political systems are characterized by failures of accountability and accessibility. Freeman lists three factors militating against optimum social and environmental decisions: (1) policy makers act in their own self-interest; (2) policy makers search for policies whose costs are hidden or can be shifted to less influential elements of their constituencies; (3) policy makers try to postpone decisions (since every decision has a cost) and to avoid the costs of a decision by shifting the responsibility for making it. (60-167) Decision-makers have the power of determining which alternatives will be considered - some groups, some issues, and some techniques of political action are defined as unacceptable, if not illegitimate; the definition of alternatives is the supreme instrument of power. (136-176) This permits "nondecision-making" by cultural and ideological values, by established procedures, by strong opposition, or by imperfect administration of policy. (136-177) There are thus many pitfalls in institutions for governing.

Responsible decision-makers will attempt to fairly consider all alternatives and choose the one which will maximize total social welfare. Philosopher Charles Frankel says a decision is responsible when the man or group that makes it has to answer for it to those who are directly or indirectly affected by it. (67-66) Truly responsible decisions are

rare because decision-makers usually are not held directly accountable by large segments of the population who are nonetheless affected by their decisions.

Even if a decision-maker sincerely wishes to maximize social benefits, he has perceptual and conceptual biases which may prevent him from sharing the views of those who will be affected. In addition, a problem will usually be defined in terms of one's ability to deal with it, which inhibits one's understanding of the true nature of the problem. Political and bureaucratic organizations are based on principles and assumptions which limit their vision, understanding, and response. Also, the political process gives limited information on public preferences to decision-makers, particularly the intensity of preferences, and therefore even voting does not necessarily lead to a clear articulation of the public interest. (133-106) Finally, some groups have greater influence than do others by virtue of better organization or financial resources. For example business interests enjoy advantages over environmental groups, and are likely to be more enduring. Decision-makers must guard against bias and undue influence, and be open to all alternatives - but it would appear that the possibilities of a meaningful ecological politics hardly seem to exist. (136-179)

In developing countries, ecological circumstances are not always favourable for rapid development but officials often forgo ecological surveys and disregard ecological criteria because of ignorance, bias, or high costs. The temptation to produce fast and highly visible results is usually overwhelmingly great. To obtain ecologically sound development planning, it is necessary to construct procedural or institutional barriers and channels to constrain the normal operations of human behaviour. (25-936) Passmore notes the danger of authoritarian approaches to ecological crises, but sees no way to overcome the selfishness of economic habits which does not entail the shifting of decisions about choices from the market to governments. (121-23) Hardin points out that institutions can be altruistic, whereas individuals are not by nature altruistic; institutions can therefore, if designed properly,

serve as reliable decision-mechanisms. (70-80)

Maslow regards man as being by nature good, but social institutions must be designed to bring out this goodness:

> Individual and social interests under healthy social conditions are synergic and not antagonistic.... From this misconception (that they are antagonistic) follows the phrasing of civilization and all its institutions - school, church, court, legislation - as bad-animality-restraining forces... (103-85, 86) Recognize instinctoid needs to be not bad, but neutral or good, and a thousand pseudo problems solve themselves and fade out of existence. (103-87)

The self-perceived role of the decision-maker is crucial - is he to restrain evil in man, or is he to free man's good impulses from frustration? It is healthier to think of social institutions as instruments for assisting individuals in satisfying their needs, which are good or neutral - institutions need not "control" man; they should rather serve to liberate him from his lower basic needs so as to permit his attaining fulfilment.

All development must be based on sound planning. Allison says planning problems are not technical problems but political problems. (2-14) The fundamental problem however is basically ecological: determining which interrelationships are more critical to human and ecological well-being. (25-928) The development process is inherently ecological and demands an ecological approach. Planners face a formidable challenge:

> Planning must accommodate a complexity of factors including diverse social and economic benefits which cannot be readily compared, long time horizons which create imponderable forecasting probabilities, a lack of a pricing mechanism for both social benefits and land held in the public domain, and an infinite array of individual and combined investment possibilities. In addition it must cope with rapidly accelerating technological change. (5-207)

The Founex Report stressed the importance of bringing the environmental issue within the overall planning and decision-making machinery. (34-81) Environmental management requires an institutional structure to provide for comprehensive planning and coordination. Better planning and accountability will permit development to proceed at lower ecological cost. Institutional mechanisms are needed to ensure that potential impacts will be systematically identified before programmes begin and ecological costs will not be ignored for political advantage.

The Founex Report recommends a number of institutional arrangements for developing countries to implement more effective environmental control. These include environmental ministries, setting up standards for monitoring by special institutions, establishing assessment boards and management services, passing legislation for norms and assigning liability, and assigning property rights to hitherto unprotected resources. (7-26) The Rockefeller Foundation recommends the creation of a Planning Board which would be independent, with full subpoena powers, and whose members would be elected to serve terms of 25 years or more. This Board would be forced to argue its case before the public and its elected, accountable leadership and thus serve as an advocate for the long-term interests of present generations and generations yet unborn. (13-137) Robertson suggests creating a Bureau of Ecological Standards charged with determining appropriate environmental practices to maintain ecological integrity. (127-12) Hanks advocates establishing an Organization for Regional Co-operation and Development for southern African countries. Such an organization could undertake a more rational approach to land-use planning because it would have more options and flexibility; valuable natural and near-natural areas could be maintained if development pressure could be shifted to more suitable areas. (64-14) These and other institutional mechanisms should be carefully examined for their potential in overcoming the present failings of political and bureaucratic organizations in planning and managing the development process.

ECONOMICS

The science of economics has not developed a method for assessing the true value of natural goods.

> <u>Natural ecosystems are scarce resources</u>. In a modern industrial society, however, social institutions such as the market system often fail to establish "economic values" for natural ecosystems and to allocate them to their socially optimal uses. (46-136)

Economics has also failed to develop a procedure for making decisions concerning the natural environment which will result in optimal sustained yield to maximize welfare over the long-term. The marginal approach to making economic decisions, like the reductionist approach to investigating natural phenomena, results in a failure to perceive certain realities - there is a failure of perspective when phenomena are examined in isolation, narrowly circumscribed in space, and frozen in time. Decisions cannot be based on a fragmented commodity conception of the world when the world is in fact an integrated living system. (75-177) Cumulative effects over significant periods of time and larger regions of space tend to be ignored by business and bureaucratic institutions with limited concerns and responsibilities. Unfortunately, social institutions are usually designed to respond to limited efficiency criteria. Baumol and Oates cite an example of this bias in institutional structures. In response to water conservation appeals in northern California, consumption fell past the 25% goal to a 40% reduction, whereupon water officials, finding themselves facing a large drop in revenues, threatened to increase rates if consumption did not increase. This demonstrates the insidious institutional bias favouring high levels of production and consumption - the response to low consumption is to stimulate more consumption, while the response to high consumption (assuming absolute limits have not been reached) is to provide for even higher levels of consumption. Society has been tyrannized by the concept of profits - social goals are reduced to this one criterion,

which does not necessarily improve welfare. Man needs new measuring sticks to gauge the success of economic actions in meeting the real needs of man. (16-299)

A pattern of development based on ever-increasing levels of consumption holds special dangers for developing countries. As demand grows while the resource base shrinks, prices will rise. Poorer nations may not be able to afford higher prices just at the time when new social patterns based on greater consumption become well-established. Higher prices may then have such a disruptive effect on consumption patterns that social and political institutions could be thrown into chaos. If rising expectations cannot be met because of higher prices, the potential for economic, social, and political breakdowns is as great as if resources were suddenly depleted - demand may prove immutable and beyond the reach of institutional influences. Of central importance is the timing and extent of price rises as global resources become increasingly scarce and costly - general and rapid price rises may not dampen demand but only fan discontent. This of course could lead to anarchy or revolution.

Past experience is not a good guide to the present economic climate; global demand and resource exploitation are increasing at an unprecedented rate. The prospects for substitution and adjustment to market forces are not encouraging - there may simply be insufficient time to effect a smooth and rational social response to growing scarcities. A safer course would be to instigate a different pattern of development and direct demand to other resources which can be provided on a sustained-yield basis. Boulding has suggested that the traditional village economy, especially of Asia, may be more of a prototype of the world to come than the economies of the great age of expansion. (22-148) This is because the village economy is cyclical. Perhaps decision-makers of developing countries should seek to pattern development after the cyclical economy, maintaining resource independence and high renewability to avoid dangerous dependencies on uncertain or non-renewable resources.

Economics has particular relevance to the policy alternatives, and it may be fruitful to consider how certain economic concepts can be related to the evaluation process. The following three chapters will examine in greater detail the fundamental assumptions of economics, and the policy choices will be analyzed in terms of key economic concepts.

SUMMARY AND CONCLUSIONS

Man's institutions governing development have limited potential for preventing or ameliorating social and ecological problems which result from modifying natural environments. It is therefore advisable to establish institutional safeguards limiting the influence of man's activities on the natural environment.

Science has been more successful at reductionist analysis than at creative synthesis, and has not yet developed predictive or corrective powers with regard to large-scale environmental systems; some natural phenomena are characterized by such overwhelming complexity or occur on such vast space and time scales that it is unlikely man will ever understand or control them. Decision-makers are by nature inclined to give greater credence to the more exact sciences, which produce fast, visible results, and discount the vague warnings of ecologists. But there is no guarantee that tomorrow's science will be able to solve problems arising from today's actions. Since man may never have effective control over his instruments of power, he should exercise great caution and restraint in their application.

Modern technology is rapidly transforming the world by means which have not been adequately tested; it is not certain whether this approach to development really improves total human welfare. Technological innovations seem to *ipso facto* create environmental problems, and this suggests that they may not be relied upon to improve the overall con-

dition of man. Natural goods can be destroyed but cannot be replaced by technology, and so "technological fixes" are limited by nature and cannot be applied *ad infinitum*.

The effective operation of governments is limited by their structure and their networks of communication: all governments are far from being omniscient, and they should therefore use their considerable organizing power with great care and seek to limit their influence on the natural environment. Most governments have overestimated the efficacy of legislation and the potential of well-intentioned development programmes, and underestimated the social, economic, and ecological costs of improving welfare. Decision-makers tend to respond to crises rather than undertake long-term, comprehensive planning. Sequential decision-making is not likely to result in an optimum pattern of development.

There are many inherent dangers in political and bureaucratic processes, such as failures of accountability and accessibility, and perceptual and conceptual differences between the governors and the governed. It is necessary to design institutions in such a way that the effect of human failings is minimized. Institutions should not control man, but rather serve to release him from false appetites and guide him to self-fulfilment. New institutional mechanisms are needed to ensure that development will proceed with minimum social and ecological costs.

Economics offers little guidance for long-term development action affecting natural environments since economic decisions are made by reference to the margin and fail to account for the full value of natural goods and services. Economics has a narrow frame of reference, employs limited efficiency criteria, and is based on implicit value judgments which are of questionable validity (e.g., the assumption that consumption of economic goods is a principal indicator of welfare). A development programme designed to increase consumption is dangerous unless achieved levels can be sustained, and there is a high probability that political or ecological failures will someday dramatically reduce all production based on imported or non-renewable resources.

CHAPTER 10

EXTENDING THE HORIZONS OF ECONOMICS

"I believe that many of the economic forces inside the modern body-politic are pathogenic in respect to harmony with the land... we should seek some organic remedy - something that works from the inside of the economic structure."
(93-153)

INTRODUCTION

In this chapter the concerns and objectives of Economics will be briefly examined with a view to assessing their relevance and validity given the present human condition. Conventional economic criteria may no longer be acceptable now that man's activities are having global impacts. To determine the true efficiency or utility of development programmes, it may be necessary to extend economic analysis to ecological phenomena over longer time horizons. Such analysis may indicate that programmes which serve equity and environmental quality goals are to be preferred over programmes which improve short-term efficiency or stimulate higher economic growth rates.

THE SCIENCE OF ECONOMICS

The art of making political and social decisions to improve human welfare has long been heavily influenced by the science of economics, which has unquestionably been most useful in describing how certain aspects of human welfare can be improved. The science of economics has developed a way of thinking about and dealing with problems of human welfare, with the ultimate object of maximizing well-being in society as a whole. This science has been largely concerned with improving material welfare, partly because of the primacy of certain material needs, and partly because goods and services which contribute to physical well-being more readily lend themselves to quantification and manipulation than do other elements which contribute to man's well-being.

Economics is concerned with two fundamentally different problems: (1) how can more goods and services be created for a given cost (or how can the ratio of benefits to costs be improved), and (2) how can the distribution of goods, services, and costs throughout society be made more equitable? Metaphorically, the concern of economics is to increase the size of the cake and give everyone a fairer slice. Given a rather restricted definition as to what constitutes the cake, so-called "developed" countries have been remarkably successful in increasing the size of the cake (the efficiency criterion) but somewhat less successful in giving everyone a roughly equal share (the equity criterion). Less developed countries have not been particularly successful on either count. While concern for equity is widespread and appears to be growing, the prevailing (and sometimes overwhelming) concern in most countries is to improve efficiency and increase economic growth, with the idea that benefits can always be redistributed (so that an increase in total benefits can be made to improve the condition of everyone).

This nearly universal focus on the efficiency criterion and preoccupation with achieving increased production of industrial goods and related services has perhaps had some unfortunate results. It has resulted in

an overabundance of some goods and services - production surplus to needs at a given level in the hierarchy of needs, and therefore of questionable benefit in improving well-being - while there has been inadequate production (or inadequate distribution) of other goods and services essential to meeting the most basic needs of substantial numbers of people. Even now, in drought-ravaged Africa, for example, some population sectors are enjoying increasing prosperity while others are suffering the effects of starvation. The idea that economic growth through technological innovation is a good in itself (since "more" can always be made "better" through redistribution and increasing consumption levels) may not be correct. Perhaps the goals and concerns of economics should be re-examined to see whether priorities should be re-ordered, and whether the concepts and methods of economics can be applied to fundamentally different needs of men and societies.

Economics is a sophisticated social science which, more broadly defined and interpreted, can perhaps be applied to traditionally "non-economic" aspects of total human welfare. The science of economics offers a way of thinking about choices which need not be narrowly circumscribed by considerations of quantification and confined to problems of production and consumption of that class of goods and services which contribute to what is traditionally called "economic welfare". Economics has evolved considerably from the days when Adam Smith first drew attention to the presence of an "invisible hand" in the free market which allocated goods and services in a manner which (given the existing distribution of income) could be considered more efficient than would be the decisions of any political body. Later, attention was drawn to certain failings in the free market and the need for institutional mechanisms to correct for these failings. There may well be failings in the present concepts and general approach of economics, just as there were found to be "real-world" failings in the operation of the free market. Of growing importance are the ecological and spiritual costs of development, and the concomitant threats to the sustainability of social progress and the quality of life. These considerations must be brought into the

economic calculus if decisions about further economic development are to be rational. Recent investigations into environmental and "psychic" costs (133) indicate that economists may have a most significant contribution to make in developing criteria and evaluation techniques for making choices pertaining to total human welfare.

The science of economics is concerned with bringing about improvements in man's well-being through a systematic analysis of the choices available to man. However the scope of this analysis has been limited by the difficulty of determining precisely what constitutes well-being, and by the even greater difficulty of measuring improvements in well-being. For these reasons, the science of economics has been largely confined to considerations of material or physical well-being and to those goods, services, and conditions which can be readily measured in terms of money.

If it can be admitted that precision is not necessary to accuracy, it may be possible to extend the concepts of economics to embrace the totality of well-being and apply the methods of economics to assist in making choices pertaining to the higher needs and aspirations of man, including those for which no market is conceivable. For the important thing is to systematically evaluate choices which bear on man's welfare, and to determine the direction, if not the distance, which a given choice will carry us.

The general concepts and methods of economics seem eminently suitable for assessing difficult decisions concerning man's relationship with his environment. Already the problems of pollution have been brought into the economic calculus and been shown to be amenable to economic analysis. It would seem reasonable to extend this treatment to that other category of environmental problems: the loss or disruption of natural goods, services, and conditions.

Economics is based on the notion of commensurability: goods and services can be measured in terms of their utility, which forms the basis of exchange. While individual assessments of utility are largely

subjective, in the market there emerges, through the interactions between individuals, an objective measure of utility which is called an exchange value. This value is rather easily quantified or monetized, which serves to facilitate transactions and provides the basic units of measurement deemed necessary for a scientific analysis of choice. There are at least two problems with this approach as a guide to making decisions which affect human welfare: (1) the exchange value may bear little resemblance to use value (i.e., the notion of utility can be distorted by various influences - such as advertising - on tastes and preferences, or faulty perceptions due to limited time and spatial horizons, or simply poor judgment); and (2) there are categories of needs the satisfaction of which depends on the existence of conditions too subtle and complex to be traded in the market place.

It is suggested, therefore, that strict adherence to the use of monetary measurements in determining commensurability may be grossly misleading and unnecessary to the calculation of what constitutes well-being, and this reliance on precise quantification has constrained the application of the economic method and overemphasized the significance of those categories of human needs which more readily lend themselves to quantification.

The difficulty of course is to determine satisfactory standards of comparison so as to deal with incommensurables in a reasonably objective manner. It is proposed that, in spite of this difficulty, the general approach of economics can be applied to decisions affecting total - and not just "economic" - welfare. If the subject matter of economics can be re-defined to include all goods, services, and conditions which impinge on man's well-being, and which can be manipulated ("chosen") by man, then the potential contribution of certain economic concepts and methods might be greatly enhanced. What is lost in precision may be offset by what is gained in relevance.

The question remains as to whether this proposal is a legitimate extension of the science of economics. Economics has evolved from the

art of bartering to a relatively precise science of valuation. But this accomplishment may obscure the fact that what is being measured with such precision is not quite the right thing. The fact that two farmers can agree on the number of race horses that will be exchanged for a piece of land, or the amount of money that will change hands when either is sold, does not indicate that an "accurate" valuation has been placed on horses or land - some values will be perceived, and some will not. The fact that both men are satisfied, that a bargain has been struck or a price fixed, indicates only that neither suspects a failure of perception on <u>his</u> part. Yet it is almost certain that one has had the better of the bargain - perhaps the one who receives the land has underestimated its grazing potential, or failed to consider the aesthetic value that his children will see, and the other has failed to consider the costs of catching runaway horses, or getting involved in gambling disputes. The point is that the exchange value is not necessarily an accurate reflection of the <u>true use value</u>.

The problem of how many race horses <u>should</u> be traded for a piece of land (i.e., based on the <u>intrinsic</u> value of each, if this could be perceived), is essentially as intractable and unanswerable as it ever was, and while the "invention" of money greatly facilitated the exchange of such goods it did not greatly contribute to (and in fact may have made more difficult) solving the basic problem of the fundamental incommensurability of unlike goods. (Perhaps pricing has made it too easy to "assess" trade-offs and this has compounded errors in judgment.)

This problem has many aspects, but perhaps chief among these is the questionable <u>competence</u> of the individual to correctly perceive the relative utility of two goods, particularly over longer time horizons.

From the point of view of society (and future generations) another problem emerges: the highly questionable <u>willingness</u> of the individual to take decisions (based on value judgments) which are in the <u>general</u> interest, if this entails some sacrifice on the part of the individual. This more general difficulty can be partially resolved through institu-

tional mechanisms, but the problem is then transferred to a different level and becomes one concerning the competence and willingness of institutions to take the right decisions.

There are many potential sources of error in making decisions affecting welfare, and perhaps the inability to use money to measure the true utility of some amenities is not the most serious of these. More serious is the possibility that certain vital or inestimable goods will be given inadequate consideration, or left out of the decision-making process altogether, because of the difficulty inherent in evaluating them, or because they are simply not perceived.

ECONOMICS AS A GUIDE

Positive economics is concerned with certain activities of man which can be observed and measured accurately enough to result in a plausible science of explanation and prediction. No assumptions are made regarding the needs of man, what sort of world this should be, or what people should value. Human behaviour is explained in terms of wants. All "wants" are regarded as being inherently neutral; no qualitative distinctions are made. Value judgments have been rejected in order to retain an objective position in describing how economic systems work. (99-3) Since all wants are equal, it is assumed that consumers maximize welfare by selecting that mix of goods which best satisfies their wants.

Decision-makers generally place great credence in the science of economics, and uneconomic behaviour is considered anathema. However, positive economics may well be a poor guide for action because it examines behaviour without reference to needs or values, and perhaps "economic behaviour" is motivated by base desires and has nothing to do with higher values (such as spiritual, aesthetic, and cognitive

satisfactions, or even survival). Conventional economic analysis is therefore limited in usefulness, but given certain assumptions about the human condition from other disciplines (such as psychology, ecology, and philosophy), a set of objectives can be formulated which provides the basis for normative economics. The "economic man" need not be materialistic; economics provides rules for making optimal choices, and these can be applied to any set of objectives. The problem is to agree on objectives.

If it is agreed that man has certain needs, and that these needs are qualitatively different, then a framework of values is provided for the concepts of economics. Just as man's needs range from the material to the spiritual, economics can be applied to the mundane or the sublime.

How does one objectively rank the relative values of man's needs? Lutz and Lux suggest that the more necessary for life, or life-supporting, a particular good, service, or experience is, the more important it is. (99-18) This would imply that ecological needs are most important of all, even though they are not "wants" to most people. Mainstream economics is not equipped to consider the ecological reality in which man must live, and is therefore not a reliable guide for planning activities in the real world.

While lower needs (i.e., physiological and security needs) are more important in the sense of being more fundamental, or necessary to well-being, higher needs cannot be disregarded if well-being is to be maximized. When a prepotent need is satisfied, the next need in the hierarchy emerges more clearly and acquires greater value. When a prepotent need is not satisfied, the path to higher needs is blocked and the individual becomes fixated on a lower need. (99-22) This has perhaps resulted in an unfortunate exaggeration of the value of consumer commodities (and a concomitant undervaluing of natural amenities and their more ethereal satisfactions) which has given rise to the Age of Materialism.

> Few of us would be willing to say that material goods are the only real goods and that increase in wealth and comfort is the only end worth pursuing. But just because we have learned effective methods of increasing both, we practice those methods with so much enthusiasm that we begin to act as though what they get us were the only things worth getting. (86-77)

Our conception of man has been so influenced by his material appetites that we have come to regard man as a producer-consumer-schemer and have completely forgotten about his social and spiritual sides. That is why most forms of consciousness are neglected or considered a burden. We need to consider the <u>whole</u> man, and the full potentialities of the human being.

It is vitally important to clearly establish the objectives of society and then apply economic analysis to man's activities. Perhaps many of the products of nature should be considered "ends" rather than "means", and perhaps acquiring more comforts and conveniences are "means" which serve very limited "ends". If economics is applied only to the production and consumption of material wants then GNP becomes the criterion, the object of study becomes the "means" (to ill-defined "ends"), and the <u>proper</u> "ends" (human needs and potentialities) are ignored or given short shrift.

> Economics, which has long been the science of materialistic values, has now to move beyond materialism. The growth that we need to seek now... is in the realm of the fully human, i.e., the non-material or spiritual. Spiritual growth is called for, not material growth. This is the meaning of self-actualization.... The great and beautiful answer to the problem of rapidly dwindling resources is to direct growth along the lines of human development, not further material development. (99-301, 304)

In dealing with large magnitude options which can result in major environmental modifications, conventional economic analysis is not adequate. Techniques for marginal or incremental analysis cannot cope with the

bewildering array of costs and benefits associated with vast complexes of actions over significantly long time horizons. The value of many facets of natural environments are inaccurately assessed at the margin, producing a grossly unreliable evaluation of alternatives. There is little point in attempting a detailed quantitative assessment in these instances. Also, economic measurements of innovations are primarily concerned with improvements in present consumer satisfaction. But the long-term effects of these innovations on natural amenities may be vastly more significant since they lead to irreversibilities which cumulate and persist, affecting untold future generations (whose preferences are poorly represented, since the preferences revealed in the market are a reflection of present tastes due to present income and income distribution). Finally, there is no satisfactory way of ascribing values to the use of natural amenities. There are many uses which are non-convertible into monetary terms.

There is no reason to confine the application of economics to activities that can be measured in monetary terms. While the absence of a "measuring rod" precludes precise quantitative comparisons of costs and benefits of alternative activities, the use of general economic concepts and methods may indicate the desired direction of policy, and the exact magnitude of the trade-offs involved may not be essential to making correct policy decisions. The application of economic concepts to policy options which are normally regarded as purely political problems may be a useful way to visualize and consider the choices - one can think of "goods" in other than monetary terms, and a qualitative analysis may still be attempted. In fact, perhaps economists should first define goods in a qualitative manner since there is a basic incommensurability between, for example, natural amenities and manufactured commodities, and the concept of "cost" should be different for different types of goods.

Economics stands between the "hard" and the "soft" sciences. Perhaps the economist's concern with emulating the powers of exact explanation

and prediction characteristic of the natural sciences has inadvertently led to a shift in focus from human to material considerations, and a concern with quantitative rather than qualitative calculations. Perhaps economics should expand its horizons into what Kohr has called "meta-economics" (85-168) and become, as Schumacher has suggested, not an exact science but something much greater: a branch of wisdom. (129-223)

EFFICIENCY AND EQUITY

The "Big Trade-Off"

What is called the "economic problem" - the problem of scarcity - is in essence a moral problem and cannot be considered without reference to moral principles. The most significant thing about the concept of scarcity is not than an individual must choose to have less of one thing in order to have more of another, but that he must choose how much he is to have relative to what others may have. The individual must choose what degree of deprivation on the part of others he is willing to accept in return for a given level of consumption for himself.

The world is divided into two worlds: the developed and the underdeveloped. Those who occupy the developed world have the power to choose how the world's resources will be used and distributed. The U.S. Council on Environmental Quality forecasts that if present trends continue, the developed world will enjoy a per capita income of $8 000 in the year 2000 while the underdeveloped world will have a per capita income of only $600. (77-3) There are two distinct problems regarding underdeveloped countries: (1) the material standard

of living is low, which affects health and welfare in a direct, physical sense; and (2) the gap between developed and developing countries, perceived to be unjust and widening, gives rise to discontent, unrealistic levels of expectation, and potential for conflict between nations. There is thus an "absolute problem" and a "relative problem", and the latter poses the greater threat to natural environments and political systems.

The "poverty problem" is perhaps even more serious than is generally realized. Per capita income is often used to describe an underdeveloped country but this may be greatly misleading because (1) not all income may be available for consumption, and (2) there may be grossly unequal distribution of income masking the poverty of the masses. The latter appears to be worsening, causing greater pressures for development. (112-202, 203)

Few would argue that rises in output and more equitable distribution are not desirable in developing countries. The former tends to be considered an economic problem and the latter a political problem, and it is commonly assumed that satisfactory progress can be made on both fronts simultaneously. But perhaps there is some inherent incompatability in these two objectives and they cannot be jointly pursued: emphasis on maximizing output might <u>cause</u> a maldistribution of income. If this is so, it might be preferable to concentrate on equity even if it means reduced output.

There may well be a fundamental conflict between these two basic economic objectives, and if so it is necessary to decide which should be given priority. Two key characteristics of the efficiency objective are: (1) benefits are distributed to those who can pay for them, and (2) benefits and costs are summed and compared without considering how they may be distributed. (46-143) It is important to remember that the potential Pareto improvement test takes no account of

change in the distribution of incomes. Therefore one welfare criterion may easily contradict the other. A commonly offered solution to this impasse is to pursue potential Pareto improvement and then take redistributive measures in the hope of bringing about an actual Pareto improvement. There is thus a tendency for governments to apply the efficiency criterion to a proposal, such as doing a cost-benefit analysis (which is not concerned with questions of distributional significance), and then try to make adjustments to correct for the disparity in resulting income distribution. If the equity criterion were given a truly equal footing with the efficiency criterion, development would follow a radically different course.

It appears that equity can be achieved only with some loss in efficiency. Meeting the vertical equity criterion reduces efficiency since it affects incentives, which results in a loss of potential output. The question is: how significant are such losses in comparison to improvements in equity? Seneca and Tausig suggest that the government must determine the magnitude of net gains and losses among various groups and individuals and then somehow balance the desirability of the distributional effects against the pure economic efficiency effects revealed through straightforward cost-benefit analysis. (133-20) The government must first decide what its priorities are, and then assess alternative programmes in accordance with the weighting it decides to give to income distribution tests and cost-benefit tests. International bodies such as the United Nations and the World Bank must also decide whether developing countries will benefit more by emphasizing efficiency or equity tests.

Growth and Redistribution

Some economists argue that if "efficient" programmes fail equity tests they should proceed anyway because in the long run the poor will

benefit from large total output, and in the short run tax and transfer programmes can substantially rectify maldistribution of income. (133-130) One sometimes gains the impression that this argument is a great subterfuge to enhance the political feasibility of programmes designed to aggravate the existing maldistribution of income and wealth, but perhaps in more developed countries there is some merit in it, and techniques such as adjustment assistance have served to alleviate equity problems of a local or transitory nature. (15-211) For underdeveloped countries, however, experience has shown that "trickle-down" economics does not work. In Iran, for example, phenomenal increases in GNP failed to improve the condition of the large majority of Iranians in both urban and rural areas, and this circumstance contributed to the eventual overthrow of the Shah in early 1979. Even in the most developed countries poverty is widespread, and in less developed countries (after years of economic growth) it remains rampant - it has been estimated that two-thirds of mankind will have an annual per capita income under R500 in the year 2000. (77-3) Economic growth apparently does not help the poor.

Ul Haq stresses that redistribution cannot be counted on to solve equity problems brought on by uneven economic growth which results from the almost exclusive concern with efficiency criteria, and he cites three reasons for this: (1) Poor societies have often very poor means of redistributing incomes. (2) Income flows are not financial: they are in the form of physical goods and services. (How does one convert luxury housing into low-cost housing, or cars into buses?) (3) The institutions which create growth are not neutral as to its distribution. (145-186) It appears that redistribution will also prove ineffectual in alleviating the plight of the poor.

Is Growth Always Good?

Distribution is a problem in both the growth and no-growth cases, but there are some who feel that "zero-economic growth" and equity are not compatible goals, and environmental quality and equity are also not compatible goals. This argument contends that equity goals depend on growth. Baumol and Oates quote Solow as saying:

> The only prospect of a decent life for Asia, Africa, and Latin America is more total output.... Thus, there is indeed a trade-off between progress toward a more equitable income distribution and that toward a quieter, cleaner world of zero growth. (16-142)

There is an assumption here that there are no insurmountable political or ecological barriers to growth, and this could be a profound error. There may well be unavoidable and unsolvable social and environmental problems along the growth path which would be disastrous for the poor as well as the rich. Given finite resources, ecological imperatives, and the vagaries of social and political forces, it must be recognized that there are real, incontrovertible constraints on growth.

This raises the question of risk. As developed countries grow more concerned about the quality of their environment, the risks and burdens of pollution and disruption will be increasingly transferred to the poorer populations of the world. Higher production may raise GNP and per capita income, but this implies greater resource destruction and environmental damage. The situation is exacerbated by inequitable income distribution within a developing country since more production per capita is needed to satisfy the minimum needs of the entire society if the income structure is inequitable. Risks

can therefore presumably be reduced by pursuing equity goals within a society.

Global risks may also be reduced by new production strategies designed to advance equity between nations and thereby partially restore environmental balance. For example, a shift from the use of ecologically costly synthetics produced in developed countries to the use of ecologically safe natural products produced in developing countries would further the cause of both environmental quality and international equity.

However there are some who feel that the cause of equity constitutes a threat to survival. Human Ecologist Garrett Hardin feels justice is unattainable and its pursuit is dangerous - he maintains that the choice is between imperfect distribution with enhanced prospects of survival and marginally improved distribution with seriously imperilled prospects of survival:

> ...distributional justice is a luxury that cannot be afforded by a country in which population overwhelms the resource base. In a poor country, if all people are equally poor - if there is no special privilege - the future will be universally discounted at so high a rate that it will practically vanish. Posterity will be cheated; and being cheated it will, in its turn, be still poorer and will discount the future at an even higher rate. Thus a vicious cycle is established. (70-81)

Perhaps the world has not yet reached the point where distributional justice would so impoverish society; but the population explosion indicates the world may be rushing towards such a point. Rather than discourage equity, it might be preferable to encourage new, non-materialistic goals - a new life-style based on and inculcating a new ethic. Can the science of economics contribute to such a solution?

Dohan points out that while we cannot estimate the economic gain from ethical behaviour, or some decision which favours non-monetized benefits, we can determine the costs - this is simply the difference in net present discounted value between the economic benefits foregone by not undertaking the project and those of the most profitable alternative. (46-167) This suggests a policy to balance efficiency and equity considerations, and reduce global risk: a careful cost-benefit analysis of project proposals could reveal the opportunity cost of foregoing a development (in order to maintain nonmonetized benefits) and this cost could be paid as compensation to the (poor) country foregoing the project. This provides a rational basis for aid since it promotes distributional goals while observing efficiency criteria, and it has the effect of reducing adverse ecological impacts.

Whatever the merits of this suggestion, most economists in this era of industrial expansion feel that rapid economic growth is absolutely necessary and that man's economic problems are not really due to growth itself but the misallocation of resources. (18-18) However growth may lead to more serious allocation problems rather than solving them. Schumacher has suggested that modern industry seems to be inefficient to a degree that surpasses one's ordinary powers of imagination. Its inefficiency therefore remains unnoticed. (129-108) Another writer (Morris) asks: Is it efficient to use a half a glass of oil to produce a glass of milk? And is it efficient to mass produce goods if all the workers are thereby frustrated? (111-328) Efficiency criteria must be related to specific goals to be meaningful.

This raises the question as to whether maximum economic growth is truly related to efficiency and welfare improvements. Perhaps gross inefficiency and inequity can produce rapid economic growth which only _appears_ to improve welfare. Is growth then good? The problem is to establish appropriate criteria: perhaps the industrial state's efficiency and welfare criteria are unsatisfactory. It is suggested

that ecological and equity criteria should be pre-eminent, and it is further suggested that these dictate the desirability of lower industrial growth rates. The predominant concerns should be not how much is produced and at what gross level of efficiency, but rather how production affects ecological balances and how goods are distributed. Measures of ecological efficiency and social satisfaction should replace GNP and per capita income measurements.

Since poor societies have limited capital, they should not pursue maximum efficiency (which would benefit only a few) but rather full employment, to get more equitable income distribution and permit sustained economic development along a broad front. This would mean accepting lower average productivity and per capita income, but it would provide a more realistic approach to curing chronic poverty and increasing overall social satisfaction.

It will be difficult to convince developing countries that maximum growth and efficient production are not suitable goals when there exists such an enormous gap between the developed and underdeveloped countries. The idea of progress still conjures up favourable images from scientism, technocracy, and utilitarianism which have preached the virtues of efficiency, growth and consumption so successfully for so long. But there are other, perhaps now more appropriate, forms of progress, and the science of ecology may be able to point the way. While this science and this situation are recent developments, history provides ample illustrations of what happens when man in his greed neglects environmental realities.

> In Syria 400'000 hectares of man-made deserts have buried a hundred ancient cities. Egyptologists are digging through peripheral Saharan sands to probe the secrets of once well-watered towns and villages. The Babylonians once grew two wheat crops a year and grazed sheep in between. Today their land is barren. The timber that helped make the Phoenicians a great naval power has been replaced by dunes.... (29-68) The Hellenic epoch

> and the greatness of Greece were based on natural resources and persisted as long as the forests produced timber and the equilibrium of nature was preserved. When the balance was disturbed by ruthless exploitation of the forests and overproduction of cattle and goats, the power of Greece declined. The same destructive course followed in the Roman Empire, though it took longer... (37-111)

Dubos warns that the land tends to deteriorate when it is exploited to serve gross selfish interests or when economic efficiency and productivity are the sole criteria. (50-147) What then should man be seeking, and what criterion should he apply to development? Dubos sums it up well:

> Efficiency may be an essential criterion of modern technology, but man is not a machine. Diversity, not efficiency, is the *sine qua non* of a rich and creative human life. (50-287)

The Pre-Eminence of Equity

Although growth and efficiency may be dubious goals in themselves, the equity goal seems central to the concept of welfare. Perhaps the principal concern of developing countries is that past patterns of development have led to unacceptable distributional consequences. Equity considerations are at the heart of the matter - economic growth and efficiency are seen as ways to bring about social and economic justice. Developing countries are therefore suspicious when lower growth rates and alternative technologies are proposed to achieve environmental quality or nature conservation objectives since it seems apparent that the costs will be distributed differently to the benefits. For example, benefits derived from game parks in Kenya are certainly not going to the poor pastoralists and farmers, who are not only suffering direct agricultural losses caused by wild animals but are also bearing heavy opportunity costs in foregoing the use of potential pastures and cropland. (35-470) Instead, cash benefits flow to wealthier

Kenyans in government and the tourist industry, and to overseas tour operators, airline companies, international hotel chains, and other interests outside the country - while recreational and aesthetic benefits flow to affluent visitors from developed countries.

Decision-makers in developing countries resent this situation, and it is widely assumed that pursuing environmental quality objectives is not desirable because of these distributional problems. However there is no intrinsic difficulty if institutional arrangements can be forged to ensure benefits flow to those who bear the costs. In fact, development of recreational and aesthetic resources would tend to be inherently more equitable than development of some other economic sectors, and may be useful in achieving a global redistribution of income, employment, and wealth through international tourism and trophy hunting. Undeveloped countries rich in natural attractions would perhaps be well-advised to develop these "non-exhaustible" resources, which can bring wealth to a country indefinitely, in preference to developing depletable resources which can drain wealth from a country rapidly. It will, however, be necessary to charge the appropriate prices and ensure that the appropriate people benefit.

The choice between efficiency and equity is of paramount importance. In striving for economic efficiency, it is advantageous to make the already good better and neglect the already weak. (99-276) This is unethical and inhumane. The efficiency criterion is of limited applicability in human affairs. Evolution may favour efficiency rather than effort or justice, but mankind has generally chosen to be guided by ethical considerations as well. If one recognizes ethical constraints to human behaviour, the efficiency criterion is not relevant unless it is tied to the equity criterion. Developing countries are trying to become more efficient without sufficient regard for the effects a given pattern of development (the urban-industrial model) has on distribution and general well-being. Given humanistic principles, it would be better to adopt a model which stresses equitable development first and efficient development second.

The problem of equity has perhaps not been taken seriously enough in economic planning. Economists have devised five criteria for measuring economic performance, of which four relate to efficiency (Pareto optimality, social welfare, broad productivity, and GNP), and one relates to equity (distribution of welfare). (47-xx) It may be, however, that the distributional consequences of a policy are the most important measure of economic performance. Ignoring equity can be dangerous in today's politically volatile world, and the equity-efficiency trade-off has profound implications for the welfare of future generations. Future users, as well as the present poor, are under-represented in the market and political arenas. Political economy must be guided by considerations of equity as this may prove over time to be the most truly "efficient criterion" (in the most meaningful sense of the term).

ECONOMICS, GROWTH, AND DEVELOPMENT

The Present Formula

A major goal of developing countries has been to promote economic growth in order to bring about improvements in welfare, particularly for the poorer sectors of society. The formula has generally been to increase the factors of production by importing sophisticated technology so that the level of output can be greatly increased, to the presumed benefit of all. However it appears that this formula has not been particularly successful in "curing" underdevelopment or improving the welfare of the poor.

One problem is that the gap between developed and underdeveloped countries is so great that the latter can hardly expect to achieve a rate of growth that can close this gap, so that even with growth, underdevelopment can be a permanent state. Lutz and Lux calculate

that to close the gap poor countries need to grow at about 10% or get aid about 10 times above present (1979) levels. (99-273) Given resource limitations and political obstacles, such rates must be considered unrealistic. Another problem is that the poor do not necessarily benefit from economic growth. In free market economies, the poor lack the purchasing power to share in the benefits of growth. Surprisingly little is known about the poor but perhaps satisfaction of their needs should be the principal goal of economic development, rather than achieving the maximum rate of growth, particularly since it would appear virtually impossible to break out of underdevelopment by growth alone. Emphasis on the advantages of impersonal allocation of resources by the market results in suffering the disadvantage of impersonal distribution of welfare. Perhaps there is no satisfactory, objective way for the science of economics to deal with welfare questions, but it would appear that distribution of welfare considerations should take precedence over those concerned with efficient allocation of resources.

To this end, a new set of indicators of successful development should replace present measurements of GNP or per capita income. These indicators should include elements relating to natural environments as they affect human welfare. At present, essential ecological functions and other significant benefits accorded by nature are excluded from GNP while wasteful depletion of resources and environmental pollution are included. (13-148) Economic health need not be defined in these traditional terms; what is valuable economically is not limited to what is produced by man. Economic development should be related directly to improvements in man's well-being and not simply to the production of consumer commodities and capital goods. Natural amenities and ecological benefits serve important welfare functions and should be counted as part of GNP.

The Population Problem

Developing countries tend to disregard such considerations because of their very real and very pressing physical needs. Economic growth is seen in terms of industrial production because of its presumed efficacy in satisfying man's most elemental wants. Many observers are convinced that industrial development will eventually result in a solution to the most basic economic problem - meeting physiological and security needs - and this in turn will lead to a reduction in family size, thus defusing the "population bomb". But if population is not soon contained, the economics of the situation will quickly result in even greater weakness: there is less surplus to trade for needed goods, which further reduces the supply of needed goods, which further weakens the country. This logical progression is not altered by aid (which does not really confer strength), and the situation is only ameliorated by reducing population growth. Even if economic growth surpasses population growth, welfare improvements will proceed at a slower pace than would be the case if population were not growing. Population control can only strengthen a country and speed its development.

It appears that the present pattern of economic growth will not generate the negative feedback necessary to control population growth because of simple space and time constraints. Ecologists might suggest the situation is somewhat analagous to that which resulted in the collapse of the elephant population in Tsavo National Park: the elephants had the reproductive and destructive power to destroy their closely circumscribed environment in a relatively short time. Ecological feedbacks require a certain amount of time and space to be effective.

Perhaps the lesson for man - particularly the point about time - should be pursued and examined in economic terms. Mankind's growing numbers create greater demands for consumer goods which are purchased at the expense of natural goods which are in finite supply. Trade-offs between consumer goods and natural goods usually take the form of a deferred exchange in an imperfect market. Only part of the costs are

paid immediately on receipt of the benefits (costs to natural systems are deferred) and there is a great danger that the point in the discontinuity in the exchange opportunity where the price of some natural good becomes virtually infinite will not be foreseen. This possibility of deferred exchange in combination with the existence of an imperfect market poses a great risk for society. Discounting should take account of deferred costs, but since ecological costs are so hard to predict and impossible to quantify, they tend to be ignored; yet these costs (such as are associated with lost gene pools or ecosystem destabilization) are potentially far greater than any present or near-term costs. In addition to the problem of cumulative impacts, there is the problem of inertia. As debts mount up, response time shortens.

There is little doubt that options are rapidly being foreclosed as the stock of biological and ecological capital (in the form of species and ecosystems) is diminished, but due to the scale and nature of the effects the growing risk has remained substantially unnoticeable. The economic system appears to be afflicted with myopia, and this inattention to the ecological costs of economic growth may prove fatal. Those who maintain that developing countries cannot afford to be concerned abouut environmental degradation should recognize that when the costs of economic growth are ultimately paid, all will suffer but the costs will be borne primarily by the poorer elements of society.

Economic "Success"

Developed countries are considered economically successful and so are faithfully imitated by lesser developed countries. But by what standard are we to judge success? The criteria for economic success must be based on an understanding of human nature and human needs. If "economizing" means making more effective use of scarce resources to improve human welfare, then much of what passes for successful economic development really constitutes economic failure. Because GNP and per capita income criteria are limited, an economic system is judged

in terms of what it produces and not in terms of what it destroys or throws away. This has fostered a callous disregard for the integrity of nature and encouraged a "throwaway society" based on reckless exploitation and characterized by a growing insensitivity to natural amenities. In an urban setting, where buildings are plentiful and parks are scarce, it would seem more truly economic to preserve a small park rather than erect another building. But there is a subtle process of erosion at the margin, because of restricted criteria, so that an additional building is perceived to confer greater utility than the existence of a park. (Using GNP or per capita income criteria, the choice is a foregone conclusion and a cost-benefit study would be a sham.) It is easy to calculate the benefits of a building; more difficult to judge the opportunity costs of losing another park.

Other criteria for economic success, and a new approach for making resource allocation decisions, are needed. A first step might be to recognize the fundamental differences between different categories of resources. At the moment the products of nature are treated as income rather than capital, and this has led man to believe the "problem of production" has been solved. But perhaps limited resources should be considered as capital, and their use deducted from net national income (unless there are clearly substitutes in the offing which are ecologically acceptable). Natural goods appear to lie beyond the pale of economic thought, and certain effects of their loss are now ignored, just as pollution effects were ignored previously. The fact that economic incentives do not bring about a truly efficient allocation of natural goods is a form of market failure. This significant source of environmental problems, unlike pollution problems, has not yet been the subject of much significant theoretical and applied work in economics. (84-13)

Pollution is not the only problem of environmental economics. There is a critical difference between activities which do not substantially impair the substance of a resource and those which consume, pre-empt, or destroy a resource. For this latter category, choices among different

alternatives must take account of special costs resulting from profound modifications of the environment, and the ability and willingness of society to incur these costs.

ECONOMICS AND ECOLOGY

The words "economics" and "ecology" derive from the Greek word *oikos*, meaning "house". These disciplines are both concerned with the management of man's "house", but economics has been applied primarily to the functioning of man-dominated systems and ecology to the functioning of nature-dominated systems. The interaction between these two classes of systems is all-important. Odum has stated that there must be some optimal proportion between the natural and developed environments. (117-180) Environmental management is concerned with incorporating ecological principles into economic systems and forging linkages between the rules of nature and man's rules of production and consumption. Environmental management thus seeks to create an "economic ecology" which will serve as a more holistic and reliable paradigm of the reality in which man is embedded.

There is, however, an inherent dichotomy in these two systems which arises from different perspectives of time - economics is moved by short-term considerations (the ephemeral forces governing political and market institutions), whereas ecology operates on a time scale that encompasses cycles spanning aeons. If the perspective of economics is extended sufficiently, the differences become illusory since ecologically sound actions will be considered economically sound as well.

The existing dichotomy is dangerous. For example, economists tend to be more concerned with farmers' incomes and the production of cash crops than with the needs and the workings of the land (from which these goods flow) because the land is often simply regarded as a tool of

production and a tax base. It is vitally important to point out the economic value of soil stability, vegetation cover, and water quality - and the ecological mechanisms on which these depend - since such "goods" are the underpinnings for the whole economic edifice. At the same time, ecologists often fail to perceive the economic character of ecological values, thereby forfeiting forceful arguments for conservation, and very often remain aloof from the difficult question of how decision-makers are to meet the growing needs of humanity for greater economic welfare. Ecologists might find economic concepts useful in prescribing values for ecological assets. The all-too-common presumption that benefits deriving from natural ecosystems, being free and often indirect, have no economic value should be vigorously refuted, and knowledge of economic concepts and methods may assist in formulating some acceptable approximation of their economic value which could be decisive.

A better understanding of economic concepts might also help ecologists appreciate the precise nature of threats to species and natural ecosystems. For example, Konrad Lorenz has concluded that whales will not be hunted to extinction, and his reasoning is based on an analogy between the density-dependent relationship of prey and predator and that of whale and whaler. (98-10) The reasoning is that whales will survive because as the number of whales declines past some critical point, whalers will be forced to switch to some other prey. This is an example of applying an ecological concept where an economic concept would be more appropriate. As Clark has shown, it is conceivable that a highly capitalized and efficient industry may have the resources, technology, and motivation to administer the *coup de grace* if the social rate of discount is high enough and the marginal private cost is low relative to the marginal private benefit from the last whale needed to maintain a viable population. (28-632)

Clark's analysis of the exploitation of whales might be extended to the exploitation of natural ecosystems, since the basic causes of private overexploitation of the resource - high economic value, high rate of discount, and low rate of reproductive (or reconstructive) potential -

would all seem to apply. The widespread belief that private ownership results in socially desirable behaviour (assuming obvious externalities are internalized) may be ill-founded.

The existing urban-industrial paradigm, to which so many developing countries aspire, envisions man as a consumer with a nearly infinite capacity for goods and services contrived by man. Given this paradigm, it makes sense to consider rapid industrialization and economic growth (and maximization of profits to raise capital for more growth) as supreme goals. But this view of reality differs greatly from the view held by ecologists, who see definite limits (imposed by finite supplies of space and other resources) to the production and consumption of economic goods and an urgent necessity to maintain equilibrium (due to rigid constraints imposed by ecological cycles and other imperatives of nature). The present economic system appears to have been dictated by a model of reality which is incomplete.

Attempts to broaden the frame of reference of economics so as to include the subject matter of ecology may result in a better model of reality to which the various concepts of both sciences could be applied. Such a synthesis may be at least partly possible since both are concerned with choice and interaction between human beings and the natural environment, and the demand for and supply of various goods. Where these two disciplines cannot be integrated, their juxtaposition will serve to illuminate how they conflict with regard to reality and help determine which might make the better guide for solving a particular problem. Government policy should take full cognizance of both economics and ecology, and attempt to recognize and objectively weigh all the relevant parameters of each.

Economic systems are subsystems of the natural environment. The developed environment receives inputs from the natural environment which can be processed and exchanged. Economics focuses on the activities of these open subsystems, which are normally studied in isolation over short time horizons (human life spans or shorter), and whose efficiency

can be expressed in monetary terms. However, the system which encompasses economic systems and makes all economic activity possible must be studied on a different time scale, and its efficient operation cannot be understood in monetary terms. The laws of nature transcend and ultimately regulate economic laws. If the operation of the natural environment is impaired, the developed environment is debilitated. An inefficient environment will result in an inefficient economy.

For example, one point that the ecologist would make is that the economic process if fuelled by solar energy (stored and direct) which flows in a linear progression from low to high entropy. The whole of economic life feeds on low entropy and produces high entropy. (82-20) A second point is that there are certain elements and cycles in nature which are absolutely essential to human life and well-being. These must be considered priceless and their value must be reflected in non-market terms, such as self-preservation and the enjoyment of life (the ultimate criteria of value?).

Economic life thus depends on certain elementary conditions, such as the availability of high quality energy, the efficient cycling of vital elements, the assimilative capacity of the environment, and the continued existence of certain biological organisms and the ecosystems on which they depend. Decision-makers should remember that not all values can be reflected by prices, and economic activities can destroy these unpriced but indispensible goods of nature.

Economists are inclined to regard throughputs of the physical system as benefits rather than costs, but these "benefits" can also be thought of as costs to the system. (23-77) Transformation of natural goods into consumer goods is achieved at the cost of higher entropy in the system. Ecologists recognize these costs to the system and consider system costs as fundamentally more important than costs to the individual since the system sustains the individual. Advocates of greater growth must realize that these extra benefits will be purchased at some cost to the system which supports them, and that they (or their progeny) may

ultimately pay more than they reckoned. These "entropy costs" may be relatively insignificant for a time and easily supportable, but it seems probable that there are significant discontinuities in the trade-off between natural and consumer goods so that at some point an infinite price would suddenly appear for the natural good. It would be prudent to anticipate this deterioration in the exchange opportunity process and ensure that growth does not reach this point.

The challenge for decision-makers is to calculate the hidden ecological costs for every economic benefit. The danger lies in the temptation to ignore these costs and simply defer payment. Economists would surely agree with ecologists that environmental protection is "economic" in the long run, at least to the extent which would guarantee the continued healthy functioning of the ecosphere (which "houses" the economy which "houses" man). The big and unanswerable question remains: which parts are essential? Perhaps the best answer is that all parts should be considered potentially essential until proved otherwise - man needs more time and research to be clear about this. Until we are more certain about which species and natural ecosystems we can "afford" to lose, it would be eminently desirable to adopt a global shadow-project policy, with wealthier nations compensating poorer nations, to insure against ecological collapse.

Perhaps as human activity approaches biophysical limits there will emerge a new theory of value reflecting ecological utility, and allocation will be directly influenced by ecological principles so that prices and decision rules will ensure ample ecological safety. Such a theory of value would more accurately reflect the true biological and psychological benefits to man, and the full costs of all inadvertent or wilful damage to man and the natural goods on which he depends.

Economists might do well to study ecology, and seek to develop a model of economic equilibrium similar to models of ecological equilibrium. The two systems may be sufficiently analagous to stimulate new insights. For example, ecosystem models can be analyzed in terms of price-profit

mechanisms. An ecosystem goes through a process of succession because it generates a "biological profit" which is re-invested to expand production. When a climax condition is reached, costs equal benefits and no further profits are generated -- i.e., the value of inputs catches up to the value of outputs, which results in equilibrium. Ecological imperatives govern productive processes in ecosystems so that an ecosystem evolves a strategy which is appropriate to the availability and reliability of inputs (of energy and nutrients) for further development or homeostasis. If the system is physically unstable, particularly if energy and nutrients are abundant, the strategy may be to maximize throughput. If the system is stable, the strategy may be to minimize throughput and maximize structure. Both strategies will result in a state of equilibrium which produces the optimum level of development consistent with the requirements of long-term survival in that particular environment. Economic systems should strive for the same result and seek the level of production which yields the highest sustainable state of social development, defined as the optimum level of satisfaction of man's basic needs in perpetuity which can be obtained with available energy and nutrients from physical and cultural systems. In an economic model with limited inputs to a stable system, the level of outputs should be governed by social thrift to permit optimum production over long time horizons. In such a system there is a limit to profits, and pursuit of private gain may conflict with ultimate social goals.

Hooker has suggested that if coherent principles for maximizing collective welfare could be identified, then a new approach to economic analysis could be possible: you continue to assume cost-benefit analysis, but you replace commodities with deviation from optimal design; it is now an economics of design deviance. (75-182) Hooker feels this could be a systems economics that will match ecology. Perhaps totally new approaches such as this are urgently needed to solve totally new problems as we reach the limits of production.

SUMMARY AND CONCLUSIONS

The science of Economics has been primarily concerned with efficiency improvements in the production of goods and services, and economic growth and increased levels of consumption have come to be regarded as supreme social goals. Comparatively little attention has been paid to equity improvements or those aspects of well-being which do not stem from economic goods. However, economic concepts can be applied to choices regarding total human welfare, and account can be taken of ecological and spiritual costs and benefits, as long as it is accepted that these cannot be quantified.

Economics would be a better guide to improving welfare if the concept of "wants" were replaced with that of "needs". The emphasis on wants has led to widespread fixations on consumer commodities which can only satisfy lower needs or "neurotic" needs. The higher needs then fail to emerge, and so are neglected.

Two of the most urgent challenges facing decision-makers today are to improve the distribution of the world's goods and services, and to arrest the decline of environmental quality. These challenges represent great political and ecological dangers and must be given priority. However, there appears to be an inherent conflict between efficiency and equity objectives, and economic growth may lead to poorer environmental quality rather than to greater equity. Accordingly, future development should be more concerned with the distributional and ecological consequences of a proposal and less concerned with the effects on efficiency and growth. Development programmes should be committed to providing full employment, eradicating poverty, and maintaining environmental quality.

The adoption of modern industrial technology may not sufficiently benefit the poor or serve to contain population growth in time to prevent widespread disasters due to social and ecological breakdowns.

New patterns of economic development and new criteria for economic success are needed to encourage the truly efficient use of natural goods to improve well-being.

The horizons of economics should be broadened to consider the effects of economic activity on the structure and functioning of natural systems (on which all economic activity ultimately depends). Economic systems are open-ended; they receive inputs from the natural environment and all outputs are eventually returned to the natural environment. Economic systems thus have two types of impacts on sustaining ecological systems: depletion impacts, and pollution impacts. Knowledge of the effects of economic activities on natural ecosystems over time, and knowledge of the true extent and nature of all benefits from the natural environment (nature's "free" goods and services), are of paramount importance in determining what is truly efficient for sustainable development. Ecological costs should be calculated for every economic benefit. Since these costs can only be approximated, estimates should be conservative and shadow-project policies should be adopted until more ecological knowledge is gained.

CHAPTER 11

APPLYING ECONOMIC CONCEPTS TO THE POLICY CHOICES

"Only economists mistake physical opulence for riches.... We can all see profit in conservation practice, but the profit accrues to society rather than to the individual." (93-31, 156)

INTRODUCTION

Turning to the question of how to determine which of two policy choices might be more reasonable to adopt, given the five social goals based on Maslow's hierarchy of needs (see pp. 79 and 83), it is suggested that economic concepts and methods can be applied to a general analysis of social and ecological trade-offs inherent in the policy choices, including those which are clearly not monetizable, or even quantifiable. A discussion of how economic terms might be interpreted and used in such an analysis, and an overall rationale for this approach to evaluating alternative policies, will follow. At the same time, an attempt will be made to explain how traditional interpretation and usage of economic

terms, concepts, and methods may fail to result in selection of the policy option which can be considered optimal in terms of total human welfare over longer time horizons.

ECONOMICS AND ENVIRONMENTAL DECISIONS

Economics is the science of choice in the presence of scarcity. The first thing that might be said regarding the choice between the two policy options is that unconstrained development does not allow consideration of the fact that natural and near-natural areas are becoming increasingly scarce, and are therefore increasing in value. Instead, there is an implicit assumption that more goods, obtainable through further development, will always be more highly valued than any (reduced) amount of natural or near-natural areas. This quite common assumption may be due to the wide-spread feeling that natural and near-natural areas are infinitely abundant, free, or of no value. In fact these areas are becoming alarmingly scarce, can be maintained only at some increasing opportunity cost, and certainly have some, perhaps incalculable, value.

The concept of scarcity implies choice, and choice depends on the relative utility of two goods, which in turn depends, in part, on previous consumption levels of each good by the consumer. This is due to the law of diminishing marginal utility: as one obtains more units of a given good, the relative utility of each additional unit will diminish. The choice between any two goods therefore depends not simply on relative availability or on some intrinsic value but on previous levels of consumption of these goods since this affects the present utility function of further increments of each. Choice therefore takes place at the margin - one weighs the marginal benefit of obtaining an additional unit of one good against the marginal opportunity cost of foregoing the benefit that would result from obtaining an

additional unit of the other good. This choice may be said to be rational if it is assumed that the consumer is a competent judge as to what constitutes utility, and his perceptions of the marginal utility of each good (towards enhancing his well-being over some relevant time period) are fundamentally correct.

The notion of "consumer sovereignty" - that the consumer knows what is in his best interests - is absolutely central to positive economics. It is assumed that, given sufficient information and freedom to choose, the consumer will act in such a way as to maximize his own welfare. It is also assumed that, for society as a whole, if an action results in a net improvement in the level of well-being in a society - that is, if the "gainers" gain more than the "losers" lose - then society is better off and, on efficiency grounds at least, the action is justified. However, it is conceivable that consumer tastes and preferences may be so distorted by various external influences, and assessments of utility may be so complex, and conceptions of welfare may be so nebulous, that consumer choices may not result in welfare gains and may actually diminish welfare. This is particularly true of the higher needs of man, and it seems reasonable to surmise that those mechanisms which appear to result in the efficient satisfaction of the lower needs of man may actually inhibit the efficient attainment of higher levels in the hierarchy of needs. It may thus transpire that the free market institution is eminently suited to efficiency improvements at one level of man's hierarchy of needs and utterly obstructive to efficiency improvements at another level.

In fact, there are substantial grounds for believing that consumers are <u>not</u> competent judges as to what constitutes advances in their own welfare (much less that of society as a whole) and if this is even roughly true, much of present economic theory (e.g., welfare economics) must be considered largely irrelevant or potentially misleading as a guide for improving total human welfare. For example, consumers may not be able to make accurate utility comparisons between economic goods

and natural goods at the margin. The concept of exchange value as a measure of relative utility works well for certain categories of goods (for which markets can be created) because this value reflects the scarcity condition of a commodity whose need is easily perceived and readily appreciated; increases in this value signal producers that there is a growing scarcity of this commodity. However the actual use value of the commodity at a particular point in time may be quite different to its exchange value - for example, under certain easily imagined circumstances, a glass of water may have a high use value and a low exchange value while a glass of diamonds may have a low use value and a high exchange value. This paradox of value has been resolved in the case of goods for which markets can be created; for these goods, it is the marginal utility which determines the value. A man who is desperately thirsty and prepared to pay any price for the first glass of water may find the marginal utility of a glass of water rapidly declines relative to that of a glass of diamonds as his thirst is quenched and future supplies of water are assured.

However, for goods, services, and conditions necessary to the attainment of higher needs, use value may be high but poorly perceived, particularly at the margin, and exchange value may always remain indeterminable. The consumer may not be competent to assess utility at the margin for such goods, or make rational trade-offs with other goods which have established exchange values. Consumption decisions pertaining to non-marketable goods with high use value should be based on evaluations of total utility, rather than marginal utility. But use value is difficult to determine if the consumer has no (or little) previous experience of the good, and an appropriate exchange value is hardly determinable in the absence of a market.

There is thus a propensity to substitute goods useful only in satisfying lower level needs for goods that are necessary to meeting higher level needs. Consumers display a tendency to confine their attention to that array of goods whose value is more easily ascertained - one is naturally attracted to what one most readily perceives and understands,

and inclined to neglect other, more elusive (but potentially more welfare-enhancing) goods, to the ultimate detriment of one's total welfare. Natural goods which confer spiritual, aesthetic, cognitive, or ecological benefits have high use value but low or nil exchange value due to the impracticality of setting up a market. The true (use) value of these goods is not obvious to the uninitiated or the unenlightened, and therefore they are often traded for a mess of pottage, as Thoreau noted in 1861:

> But most men, it seems to me, do not care for Nature and would sell their share in all her beauty, as long as they may live, for a stated sum - many for a glass of rum. Thank God, men cannot as yet fly, and lay waste the sky as well as the earth.... It is for the very reason that some do not care for those things that we need to continue to protect all from the vandalism of a few. (134-217)

The concept of externalities has greatly enhanced the usefulness of economics in investigating environmental problems. To date this concept has been largely confined to the problem of pollution - the unnatural accumulation of materials in the biosphere which adversely affects man's well-being - but it is equally relevant to the other environmental problem, that of resource destruction - the depletion of or disruption to natural materials, organisms, and systems, the loss of which adversely affects man's well-being. The reason for the attention given pollution, and the relative neglect of resource destruction, is presumably because the former is more immediate and obvious in its effects while the latter has not yet made a striking appearance and is far more subtle and insidious in its impacts on man's well-being.

The principal idea of the externality concept is that an individual fails to take into account all the costs and benefits of a proposed action because he will not have to bear all of the costs or will not be able to reap all of the benefits of that action. His decision is therefore not optimum for society as a whole. For example, modern industrial systems do not normally include in the cost of what they

produce such diseconomies of production and distribution as the spewing off of effluents into the air or the overloading of the land with solid waste, but the citizens of the community must pay these costs either as taxpayers or as victims. (154-49) This problem applies particularly to public goods, which cannot be owned by anyone because of their indivisable or diffuse nature, and the high transaction costs of establishing a market for them. One widely acclaimed solution to the problem is to find mechanisms which lead producers to make more efficient decisions by "internalizing the externality". One way to achieve this is through the intervention of a central authority in the free market, forcing producers (in the case of external diseconomies) to bear costs approximating those imposed on society and permitting them (in the case of external economies) to accrue benefits approximating those bestowed on society. The principal difficulty lies in determining the magnitude (the degree of utility or disutility) of the external effects, and in the case of resource destruction this difficulty may prove well-nigh insoluble. However the concept of externalities is extremely relevant and useful in considering these general environmental problems and is essential to any logical approach to making environmental decisions.

Another useful concept to environmental decision-making is that of cost-benefit analysis. The idea of weighing costs against benefits constitutes a logical, systematic approach to decision-making. Three major impediments to this approach are: (1) the difficulty in measuring costs and benefits, (2) the difficulty in expressing costs and benefits in monetary terms, and (3) the problem of determining relevant time horizons. However the general framework of cost-benefit analysis seems eminently suitable for presenting and analyzing mutually exclusive policy choices in terms of selected goals.

A more detailed discussion of economic terms and the relevance of economic concepts in making environmental policy choices, follows.

SCARCITY

Scarcity can be attributed partially to the niggardliness of nature and partially to the insatiability of man. After the possibilities of trade have been exhausted, there are two possible solutions to the problem of scarcity: by making nature more productive, or by reducing the demands man makes on nature. The decision as to what strategy to adopt must take account of the relative feasibility and risk attached to these two "solutions". Perhaps the most sensible approach to dealing with scarcity would be to first emphasize waste reduction and the conservation of stocks, and only then consider ways to increase production. However the latter option is usually given greatest emphasis, since historically the possibilities of production have seemed without limit, and there has always been a "consumption race" (motivated largely by a fear of forfeiting one's share of the resource base to someone else). But now resources essential to industrial processes - and, more alarmingly, to ecological processes - are becoming more scarce. Granted that supplies may not be abruptly exhausted, and that technological solutions may be theoretically possible for alleviating most or even all supply shortages eventually, the transition to new sources or technologies may involve significant time lags. This may result in the appearance of insurmountable social and political obstacles, since rising prices of resources due to scarcity and increased costs associated with lower grade deposits may impose intolerable economic burdens, particularly on poorer countries. These constraints could put many "solutions" beyond the reach of society.

Scarcity may be said to both derive from and create "wants". Satisfying wants does not necessarily reduce scarcity but does increase scarcity if stocks are reduced, thereby exacerbating the problem, like scratching an itch. There may emerge a destructive cycle: satisfying want leads to greater scarcity, which may lead to greater want, etc. There is both a physical and a psychological aspect to the problem of scarcity, and technology can be applied only to the physical aspect. Instead of

increasing production to alleviate want in a world of scarcity (and thereby increasing scarcity and compounding the problem), perhaps ways should be found to decrease want directly; the "psychological" solution would appear viable and far less dangerous than the "technological" solution. A policy of maintaining natural and near-natural areas would be consistent with this approach.

CHOICE AND THE MARGIN

It is unrealistic to think there is anything sacrosanct about natural areas. The benefits to be derived from maintaining natural or near-natural areas must be compared to the sacrifices which such a policy entails. Economic theory posits that the rational basis for choice between further economic growth and greater protection of natural areas is by reference to the margin: there is a point where the benefits derived from one is outweighed by the costs of losing the other. There is no absolute imperative associated with either environmental protection or economic growth. The question is not one of either-or, but whether the point of optimum trade-off is determinable.

In practice, the problem of choice is a difficult matter. For example, choosing a house involves non-quantitative comparisons between attributes which are designed to meet physiological, safety, belongingness, esteem, and aesthetic needs. Multidimensional choice cannot be rigorously assessed. In addition to its inherent complexity, choice takes place in a limited framework which normally consists of a partial set of indicators of man's well-being. These tend to be items which confer utility directly and almost immediately. Goals which are somewhat abstract or remote, and intermediate goals (which do not in themselves confer utility), tend to be undervalued and underselected. Ecological goals for example are not likely to be regarded in the same light as more conventional goals, and in fact may not even be considered

as serious choices. The problems of consumer competence and the welfare of future generations are extremely relevant here. If society's present preferences are known, and these favour additional present consumption at the cost of (1) present environmental quality and (2) future consumption, risk, and environmental quality (even if all are discounted to present value equivalents), would the resulting choice necessarily be either optimum or legitimate? It seems likely that current consumption will tend to be disproportionately favoured in such calculations because of the natural bias of present generations toward present consumption and the difficulty in forecasting future preferences (which may result in a tendency to systematically underestimate the significance of risk and environmental amenities to future generations).

Even if the "means to ends" are considered in the same way as the ends themselves, and future generations are given adequate attention, there remains a serious metric problem: how much better (or worse) is one thing compared to another? This problem appears insoluble - there are simply no socially acceptable criteria or standards to apply. Decision-makers are faced with the impossible task of making "interpersonal utility comparisons", which involves assessing how individuals feel about trade-offs and then adding up these feelings to arrive at a net social value. (46-139) This difficult process may be somewhat circumvented by seeking a "potential Pareto improvement", but this still requires difficult judgments as to what will leave at least one person better off after compensating others who might be made worse off. In any case, the efficiency objective is thwarted by the need to consider multiple objectives for society which cannot be valued at all (equity, stability, security, etc.) and which often dictate the choice to be made. It seems highly unlikely that the point of optimum trade-off may be determined with any degree of confidence. It may therefore be prudent to systematically err on the side of safety, and choose the most conservative estimate of the optimum level of protection for natural and near-natural areas.

Some economists suggest that maximizing choice is the most important objective of economic development and the most useful criterion of success. But economic growth does not necessarily increase the range of vital or meaningful choice since advanced technology and commerce bring with them their own imperatives and impose certain constraints on an individual's freedom. For example, an individual's choice of work and place of domicile are restricted to what is made available by the current technology and pattern of settlement. In industrial societies it may no longer be very feasible for many people to choose to be a certain kind of artisan or live in the country. In the same way, an individual's choice of natural amenities may be lost in the process of industrial growth and development, and it may be that these losses are not compensated by the acquisition of economic goods. The degree of "meaningful choice" available may be a better indicator of social welfare than is economic growth. With rapid industrial development, trivial choices may abound and multiply (particularly those concerning material goods) while the choice of natural amenities (which can lend greater enjoyment to life) may be diminished and effectively denied to most individuals. Maintaining natural amenities increases the range of meaningful choice, which is important to welfare.

An interesting illustration of the difficulty in defining where true choice lies is the generally accepted statement that members of modern developed economies are "choosing" to limit family size because they are relatively free from the disease, deprivation, and insecurity that "forced" their ancestors to have lots of children. A plausible alternative explanation is that these people simply cannot "afford" to have more children because they are "forced" to consume high cost commodities by the industrial-urban system they find themselves in, and the value of children and the extended family has been appreciably diminished by the transition from a rural to an urban milieu. The question as to who has the greater choice and who is better off is perhaps not easily resolved and depends to some extent on whether one is inclined to emphasize family values or material and status values. The assumption that rising affluence brings about a reduced desire for large families,

and that this "decision" involves completely free choice and is a wholly rational trade-off, is misleading; if a modern urban resident chooses a large family, he is assigning himself and his family to a purgatory of poverty unlike his rural grandfather's condition. There is a qualitative difference that is not reflected in income comparisons.

One major problem is that present generations have no way to accurately compare the choices that have been gained and lost over time because "former users are invisible": former generations may have attached great value to choices which are not available to present generations. This suggests another interesting problem, perhaps equally intractable but more significant: if choice is made at the margin, and assuming that Maslow's hierarchy of needs (in which the satisfaction of one need is a pre-condition for the recognition of another need) is an accurate description of reality, then choice can be applied to only one need at a time and not to the trade-offs involved in man's whole "need set". That is, the incremental nature of choice, and the progressive succession of needs for which choices are made, may make optimal decisions impossible. For example, a decision-maker in a poor country has a narrow framework in which to exercise choice: the trade-off is between the most immediate, essential needs on the one hand and environmental quality on the other. Constrained by considerations of time and an almost exclusive preoccupation with the most pressing needs of man, the decision-maker is inclined to neglect other categories of needs for which there is no urgent demand but the inclusion of which would profoundly influence the choice as to how much environmental quality (or how many of the products of nature) should be sacrificed. Thus, it may be that choice at the margin will always produce sub-optimal trade-offs by the very nature of the process.

In any case, if a major goal of society is to maximize the range of choices open to an individual, it would appear necessary to maintain special environments, such as wilderness areas and regions for nomadic pastoralists, even though these can only be utilized by minority groups. In addition, the loss of special environments may represent

a cost (to a few groups) which is totally out of proportion to the few benefits (spread thinly over the masses) to be derived from any development. This is clearly uneconomic.

THE LAW OF DIMINISHING MARGINAL RETURNS

It would seem that there must be some point in the industrialization process when the law of diminishing returns will result in diminishing living standards, and that this might constitute an unambiguous way to determine when industrial growth should be curtailed. However this reasoning assumes some ultimate limit on material wants, as if these could ever be satisfied, and neglects the prodigious ability of industry to find infinite ways of stimulating wants. In fact, industry has capitalized on the law of diminishing marginal utility - largely through the power of advertising - by promoting dissatisfaction with one thing while furnishing another to take its place. The question is whether this plethora of goods and services is adversely affecting the capacity to enjoy life (might not gluttons become jaded but remain insensible to their condition?) and whether the value of lost amenities can be known or appreciated so there is some reasonable basis for choice at the margin. It is possible that the diminishing marginal utility of consumer commodities will go unrecognized.

Another potential problem is the effect of population growth on the trade-off between natural amenities and improvements in the standard of living. Population growth results in disproportionate increases in per capita production costs due to the law of diminishing marginal productivity. If the standard of living is held constant (or allowed to rise), then providing for one extra person will involve a proportionately greater usage of energy and other resources than for the last person, which implies correspondingly greater losses in natural amenities available to the remaining population. An examination of the present

global situation would indicate that decision-makers everywhere have incorrectly forecast the costs of improving material welfare, and have made social commitments that we cannot really afford, because of a general failure to perceive the true diminishing marginal productivity of natural resources. (5-205)

The theoretical optimum population would be that in which the utility accruing to the last member joining the population just equals the disutility imposed on all other members by his presence. Even if one could measure and aggregate disutilities, changing utility functions (due to the effects of congestion, isolation from the natural environment, and environmental modifications on tastes and preferences) would make such calculations essentially meaningless since one could not be compared with another and the condition of "greatest utility per capita" could not be unambiguously determined.

The concept of diminishing marginal utility also applies to natural amenities. One cannot appreciate wilderness if there is too much of it in one's life, anymore than if there is too little. The utility function depends on one's perceptions, which may be influenced by education but depend largely on the degree of contact with the utility-conferring object. Since experience determines the level of maximum utility (and alters it), and since there is no substitute for experience (which is unique, incredibly complex, involves unidirectional time, and is limited to small samples of potential space and experience sets), there is no method for accurately fixing this optimum level. The utility of natural amenities cannot be objectively estimated in any meaningful way, and therefore one must rely on evidence from the past and on intuitive judgments in seeking the optimum level of exposure to natural environments.

PUBLIC GOODS AND COMMON POOL RESOURCES

Public goods cannot be privately owned (and potential users cannot be excluded from using them) because they are either too large, diffuse, indivisible, or intangible. Examples are oceans, rain, air, and nutrient cycling. Public goods are sometimes defined as "undepletable" since it would appear that an individual can increase his consumption of such a good without diminishing the supply available to others. (15-19) The logical extension of this thought is that public goods, once provided, cannot become scarce and therefore can present no economic problems. However this is misleading since, for example, my presence in a wilderness can in fact reduce the availability of wilderness to others, and most public goods can become scarce through the combined actions of individuals and hence are, in an important sense, "depletable".

Certain public goods, such as wild animals, soil organisms, ecological processes, and untamed wilderness are particularly vulnerable to abuse since they are not associated directly with private goods (unlike air or water, which are used in one's home and known to be important to health and welfare) and therefore tend to be regarded as unrestricted common property which can be violated with impunity. Hence while there is concern about air and water pollution, little attention is paid to the loss of natural ecosystems, even though the former may always be purified if disutilities become significant, while the latter may not be restorable by the time disutilities are recognized.

It is useful to distinguish between public goods which cannot be exhausted and those which can be depleted to zero and lost forever. Baden calls this second category of goods "common pool resources" - such goods have multiple owners (or people with rights to use the pool) and are potentially destructible. (9-144) This latter circumstance presents an especially serious externality problem: whereas many public goods can at worst only be undersupplied (and can always be provided in increased

amounts later), common pool resources can be completely eradicated.

Problems associated with common pool resources arise from the following circumstances: (1) ownership of the resource is held in common; (2) users have independent rights to the use of the resource; (3) no one user can control the activities of other users; and (4) total use or demand upon the resource exceeds the supply. (119-157) The "invisible hand" cannot be applied to common pool resources because if individuals try to maximize their self-interest, all will eventually become worse off. It is therefore desirable to transform common pool resources into public property, and so convert free goods into goods which are costed and allocated in the public interest.

Some common pool resources can be invested with private property rights to a limited extent - such as wildlife species on enclosed farms - but this solution is unsatisfactory because it is subject to the vagaries of the market, which seems to have a built-in bias for goods which have the greatest short-term utility to one individual. The market systematically favours individual, gross, or short-term needs over social, sublime, or long-term needs. While the shrinking commons has produced incentives to invest private property rights in some resources (such as wild game), this is likely to prove a futile holding action because the full social benefits of these resources will never be captured by the titular owners - some of the benefits are intangible and dispersed, and are therefore distributed in a different way to the costs. The increasing opportunity cost of maintaining such resources will render the market solution inadequate, since definition and enforcement costs are insuperable.

The dwindling supply of natural ecosystems cannot be arrested by a market solution because these systems and the functions they serve are common pool resources. It is not practical to institute a system of private ownership in the case of asset-units which are very large (such as large natural areas) or diffuse or intangible (such as the functions of natural ecosystems). Ecological benefits are undervalued in a

market because the special characteristics of these goods preclude pricing and payment - property rights cannot be specified, transaction costs are high, knowledge of the goods is grossly imperfect, and at least some of the benefits are collectively enjoyed. A prudent man will not freely give up some other good to enjoy these benefits, since they fall to him just as readily if he gives up nothing. No technical solution to this problem is feasible, therefore a social solution is required: public ownership is necessary.

Small ecosystems can be privately owned but a competitive market is not likely to emerge for their most significant values. If goods of a public character are put under private ownership, the resulting net social benefit is likely to be less than if managed by an enlightened public agency. The Cape of Good Hope Nature Reserve in South Africa was established because private farmers were not motivated to preserve the flora and fauna of the tip of the Cape Peninsula. However, while private ownership does not necessarily protect natural areas and their values, common ownership is far more likely to result in their destruction. In a finite world of increasing scarcity due to increasing population and technological growth, there is a great danger that common pool resources not entrusted to and actively managed by some public body concerned for the social interest will be abused by individuals bent on pursuing their self-interest. Garrett Hardin, who calls this the "tragedy of the commons", suggests mutual coercion mutually agreed on because injustice is preferable to total ruin. (65-60,62)

Baden has made an interesting suggestion which seems intuitively correct. If management is not imposed, the outcome of competition for a common pool resource will be a *de facto* monopoly of the resource by the group generating the largest negative externality. (10-244) It seems logical to assume that the most ruthless and efficient exploiters will reduce the utility of a common pool resource to other users, and so ultimately drive other users away from the resource. The process itself may be far from obvious, however, as when birdwatchers find less to watch and turn to other pursuits, perhaps even to ones which contributed (through

second or third order interactions) to the disutility which drove them from their avocation. Thus externality effects may favour recruitment to the externality-imposing activity, a positive feed-back mechanism that is ecologically unsound. This insidious phenomenon could be pervasive and of extreme significance since many higher-order needs are satisfied with common pool resources. (This may account for the degradation of cultural as well as natural environments - perhaps widespread "poor taste" is a reflection of the power of large negative externalities, and the failure to create institutional mechanisms to counteract this power.)

EXTERNALITIES AND THE PROVISION OF NATURAL GOODS

Private markets cannot be established for certain recreational, aesthetic, and ecological values associated with natural areas. The market cannot save the special values of natural ecosystems for two reasons: first, it fails to generate information about social values. Second, it fails to provide incentives to allocate resources to confer the greatest social benefit. It may be in the best interests of society if landowners leave some ecosystems in their natural state, but the problem of externalities precludes a market solution. This is due to the inability of parties who would incur opportunity costs in maintaining these natural systems to exclude "free riders" and appropriate to themselves the full benefits of their actions. Assigning private property rights to the products of nature would not solve the problem since the costs of setting up a market would be prohibitive; this would involve obtaining information on the activities and welfare functions of innumerable individuals, effecting and enforcing contracts, and other high transaction costs. It is the "public good" character of natural areas which dictates the control and management of natural amenities by a central authority.

Unfortunately many governments do not manage these public goods effectively. The price system tends to exert an inordinate influence on how resources are used, even though these goods are removed from the market and it may be recognized that many of them have value but simply cannot be priced. Public preferences are not clearly revealed in the case of public goods, and because the influence of the price system is pervasive and looms large as a mover of men, natural areas and their associated amenities are undervalued and often consumed at a (near) zero cost to produce goods for which a price is more easily determined and from which benefits can be more readily appropriated.

This pattern may become even more pronounced as population increases, demand for material goods increases, and an economy's activities expand. The actual rate of increase in external environmental costs resulting from this situation is difficult to estimate, but it may be substantial (Krutilla conjectures it is at least equivalent to the observed decline in private production costs). (90-19) These external environmental costs comprise two types: those which result from pollution effects, and those which result from the loss of some natural good. An example of this last type of externality is the inefficient allocation of wetlands because farmers must bear the costs of maintaining unproductive land but cannot reap the benefits, such as harvesting the total production of ducks. If an agency acquires and assumes management of these wetlands, or undertakes to compensate the farmer, the obvious question might be: what valuation should be placed on duck production relative to alternative uses (such as building sites, agricultural production, etc.)? The not-so-obvious (but increasingly important) question is: what valuation should be placed on <u>other</u> productions and functions of the wetlands, in light of the growing scarcity of wetlands, relative to these same alternative uses? Here the agency or central authority is even more likely to fall down - it is easier to estimate the value of ducks than the value of detritus production.

How effective is the agency likely to be in externality accounting and

making decisions which yield maximum net social benefit? The agency has a mandate or a mission to provide for the more obvious and immediate needs of an expanding population with increasing per capita demands. There is an incentive to go for maximum sustained yield and set quantitative goals, but this objective does not consider certain qualitative goals and does not even ensure economic efficiency (since not all costs to the land and other resources are considered, which would give <u>optimum</u> sustained yield or best net economic yield).

Dohan has suggested four ways to track down externalities and determine their economic value with "shadow prices": (1) trace the effects of an externality to its interface with an economic activity; (2) use proxies which are closely related and have market-based values; (3) use a questionnaire to determine willingness to pay; and (4) construct "contingency prices" (prices necessary to change the decision) and evaluate for reasonableness. (46-154) These methods may produce better decisions at the margin, but all have serious deficiencies or limitations.

Externalities pose even more subtle and difficult problems: the sum of a whole series of decisions by farmers or agencies, each decision apparently rational in itself, could result in making everyone in society worse off. Externalities that in isolation appear insignificant have cumulative effects and at some point these may become significant. These are hidden social costs with a time dimension. Perhaps the concept of externalities needs to be given a broader interpretation and ways must be found to reduce their incidence - not only firms, but central authorities and households, are not considering the full costs (in time as well as space) their actions impose on society (defined as all men, present and future). The externality concept has been narrowly applied to the way firms in present society impose monetary, and sometimes "psychic", costs, but the concept should be extended to all parties for all time to come, and allow the consideration of all costs - including cumulating ecological costs and risks to survival. Mishan has said:

> The introduction of an adverse external effect into the economy is a bad thing no matter how the economy adapts to it. By internalizing the bad, or by optimizing the output that produces the bad, we are doing no more than making the best of a bad job. (109-118)

And Coase has suggested:

> When an economist is comparing alternative social arrangements, the proper procedure is to compare the total social product yielded by these different arrangements. The comparison of private and social products is neither here nor there... the problem is to devise practical arrangements which will correct defects in one part of the system without causing more serious harm in other parts. (30-123)

It may be that, in addition to doing a better job of discovering and accounting for externalities, the economic planner must suggest that some acceptable method of coercion or enforced cooperation be adopted to escape the harmful effects of externalities.

SUMMARY AND CONCLUSIONS

Natural and near-natural areas are becoming scarce and are increasing in value relative to consumer commodities. However this may not be obvious to the individual making consumption decisions because the connection between these two categories of goods appears most tenuous from his limited perspective. Economic institutions designed to satisfy lower needs may systematically obstruct the emergence of higher needs and the perception of how they might best be satisfied. The concept of "exchange value" may obscure the relative utility of goods for which no market can be created, so that material goods (for example) may be preferred to other goods which actually have higher

"use value". Two other economic concepts of particular relevance to environmental problems, the externality concept and the cost-benefit concept, have serious practical limitations with regard to assessing depletion and disruption costs.

The traditional response to scarcity - improving nature's productivity - is less appropriate now that environmental limits are being approached. Man should attempt to reduce his demands on the natural environment. The conventional practice of making choices by reference to conditions at the margin is also questionable because it favours satisfaction of lower needs over short time horizons (which implies that higher needs and future generations will be neglected). Choices pertaining to the natural environment should be based on long-term, conservative planning estimates.

The law of increasing marginal opportunity cost indicates that providing for more people or improving their standard of living results in proportionately greater losses of natural goods. Common pool resources can be completely exhausted by unregulated exploitation - "the tragedy of the commons" - and so institutional safeguards must be adopted to avoid externality effects. However, government provision of public goods is complicated by the difficulty in determining true costs and benefits and by consumer biases favouring short-term, direct benefits.

CHAPTER 12

PROBLEMS OF EVALUATION

"That land yields a cultural harvest is a fact long known, but latterly often forgotten.... Have we made any headway in developing 'a refined taste in natural objects?'.... The basic issue transcends economics." (94-xix; 93-149)

INTRODUCTION

The various products of nature have value for man. These goods are provided by nature without cost - no toil or other payment is exacted. Man is therefore inclined to take such goods for granted and, when pressed, finds it strangely difficult to count up these blessings. Perhaps the first step is simply to list some of the goods arising from the natural environment which may be said to have value for man. Natural areas provide wild plants and animals for a host of uses: medicine, food, clothing, still undiscovered resources, recreational and tourism uses, aesthetic uses, watershed protection, landscape stability,

environmental baseline and monitoring uses, educational uses, rehabilitation models, outdoor scientific research laboratories, and mechanisms which protect man from known and unknown dangers. In short, natural areas provide man with security and enhance the quality of his life. What value can be placed on such goods?

THE PROBLEM OF VALUATION

What becomes of man will depend less on what machines he invents or what governments are imposed upon him than on what values he creates. (86-172) It is commonly assumed that the science of economics has developed acceptable methods of determining the relative value of things, and that the decision-maker can be confident that valuations used in cost-benefit analysis, willingness to pay comparisons, and other procedures are rational and reliable. However the two major economic theories of value cannot be applied to natural goods which cannot be exchanged, and therefore economics offers little guidance on decisions involving this vital and ubiquitous category of goods.

The labour theory of value holds that a thing's value is determined by the labour involved in its production. By this criterion, natural goods have no value at all. The utility theory of value, which is based on subjective preferences which give rise to market prices, is restricted to exchangeable goods. This measure of value necessarily excludes all common pool resources. Many natural goods thus elude economic valuation techniques and other ways of estimating value must be sought. The law recognizes that normative judgments of value must sometimes replace market evaluations:

> Where the article or thing is so unusual in its character that market value cannot be predicated of it, its value, or plaintiff's damages, must be

> ascertained in some other rational way and
> from such elements as are attainable. (140-32)

Economists have tried to find ways of assigning values to natural goods, such as asking people what they would pay for given quantities, but such estimates are unrealistic since they involve attaching exchange values to things which will never be exchanged. Environmental quality may thus be incommensurable. However it is obvious that people will trade some environmental quality (or natural goods) for other benefits or goods, and some attempt must be made to estimate the terms of trade. The danger is that numerate-minded economists will be inclined to favour methods which produce precise results but may involve irrelevant concepts (such as willingness to pay estimates), rather than methods which produce rough estimates which more accurately reflect the reality (such as might be obtained through literature and historical surveys, or properly constructed questionnaires). There is no point in being guided by findings whose sole merit is that they were easy to obtain and quantify.

EXCHANGE VALUE vs. USE VALUE

The value of a thing can be conceived either in terms of its total utility or in terms of its marginal utility through what it can bring in exchange. Even for consumer commodities, the two are rarely equal (the difference is called the consumer surplus). The market price is the measure of the exchange value, and this may be much lower than the utility value (except in the unusual case when there is a horizontal demand curve). (44-346) Since the allocation of scarce resources is based on estimates of exchange values, consumer goods which happen to have low exchange value but high utility value, and natural goods which have no exchange value at all but extremely high utility value, may be grossly

misallocated. Because natural amenities have high use value but low exchange value (due to their public goods nature), this class of goods will tend to be displaced by consumer commodities with higher exchange value and lower use value. The widespread assumption that the use of exchange values in making allocative decisions necessarily leads to efficient results and improves welfare may be erroneous.

The utility value of a thing cannot be easily measured, which is why exchange value has become the standard. Utilitarianism has had to ascribe monetary value to goods (even to time) and therefore money, which is only a means of exchanging goods, has appeared to acquire an absolute value, so that it is often mistaken for an end rather than a means. The language of prices has become so universally canonized that price seems to have the power to confer value and, concomitantly, unpriced things seem to be valueless. Man-made goods (which are easily priced) are therefore accorded unreasonable value, and the products of nature are undervalued.

The problem of valuation is a serious one. Things of incalculable value are devalued when given a price. And ascribing monetary value to a natural good, such as a natural ecosystem, implies that all its values are accounted for and that a competing good with higher monetary value is a superior choice. Cost-benefit studies systematically undervalue natural goods by assigning exchange values (an imperfect mechanism which is grossly misleading) or neglecting them altogether. The true utility of such goods must be recognized but not priced - some other method of weighing their value must be attempted which will more accurately reflect the degree of satisfaction the good confers. If a good is thought to have great or inestimable value, then that judgment must accordingly find expression in the economic calculus. This sounds a messy procedure, full of pitfalls and subject to bias and manipulation. But present procedures for economic analysis are hardly more satisfactory if vital goods cannot be valued properly, or even considered; in fact, these procedures have a built-in bias and allow inadvertent manipulation, since opportunity costs of providing natural goods are

allowed to rise so that demand falls off, even though the intrinsic value remains unchanged.

Krutilla and others have attempted to value the opportunity costs of lost natural goods, relate the values of amenity and commodity resources, and discern the transformation value of natural goods into man-made goods at the margin. (91-3, 8) Elaborate procedures have been devised to apply welfare maximizing criteria to specific projects, but these studies are costly and likely to be rejected in developing countries where natural goods seem abundant and manufactured goods are scarce.

PERCEPTION AND CHOICE

A major difficulty confronting the conservationist is to get decision-makers to perceive the economic value of organisms and processes which literally cannot be seen. A thing tends to be appreciated in direct proportion to the visibility of its utility. Nitrogen-fixing bacteria are likely to be undervalued because they are invisible to the eye and their beneficent function is only remotely and imperfectly conceived. Their priority at the margin (where decisions are made) is therefore unrealistically low, or completely unrecognized.

There is no satisfactory way to determine which natural amenities have greatest utility, or the level at which certain ecological processes must be maintained, since there is no standard unit of measurement. It is therefore necessary to rely on experience or the judgment of specialists. The decision-maker who has not learned the value of trout fishing or nutrient cycling must listen to the fisherman or the ecologist. This does not solve the problem of valuation since information bits are not interchangeable or commensurable, like monetary bits, and communication failures compound the difficulties in evaluating the reliability of the data. The fundamental problem facing the decision-maker

attempting to maximize social welfare is the difficulty in conceptualizing the value of dissimilar goods, services, or conditions in order to make meaningful comparisons permitting a rational choice among mutually exclusive alternatives. The danger inherent in this situation is that goods, services, and conditions which can be readily valued in terms of money will be inordinately favoured when trade-offs are made, and this will result in a general decline in welfare.

To illustrate the difficulties involved in making such choices it may be useful to examine one particular problem, such as what level of wilderness to maintain. Krutilla has developed methods of evaluating trade-offs of wilderness benefits against benefits of specific developments (91-133) but these are not useful in developing countries where benefits associated with wilderness are not yet appreciated sufficiently to offset even trivial benefits from development. By the time natural amenities come to assume values equivalent to those of consumer commodities, the environmental resources necessary to their provision may well have been destroyed. The question here is how much importance can be attached to present value structures which are based on temporally limited perceptions and habituation patterns. The point is that the value of a resource is associated with the perceptions of the user rather than external criteria, but perceptions may be faulty or can change over time as conditions change: what is considered a dismal swamp today may be considered a high quality wilderness tomorrow.

The value of wilderness can thus range from near-zero to near-invaluable, depending upon ever-shifting circumstances which alter man's condition and therefore his relation to wilderness. Wilderness may appear forbidding and empty to a starving savage who has little appreciation of aesthetic matters (or little need for adventure and contemplation), but his descendents may feel differently (and have different needs). It is not really wilderness itself, but the satisfactions it makes possible which can be said to have value, and man's perception of its utility is wholly determined by the nature of his relationship to it and all other aspects of his environment. There are certain sights, sounds, and

other experiences which have no counterparts outside wilderness. These will, in time, possibly lead to an increased appreciation of wilderness in presently underdeveloped countries, stemming from a fundamentally different relationship (when wilderness is no longer a threat, or the prevailing condition).

However there are other possibilities. Perhaps in the process of development, wilderness will become so diminished or vitiated that it will lose its value. Or perhaps future generations will become so thoroughly urbanized and their value systems so altered that the wilderness will not hold any attractions or provide any satisfactions. Some conservation economists seem to assume that tastes and preferences will change in favour of natural amenities due to the "learn-by-doing phenomenon" (as evidenced by the recent surge of interest in camping and back-packing in more affluent countries), and that the bequest motivation will increase as natural amenities decrease, (88-783) but this ignores the possible effects of congestion and insulation from natural influences.

There is a propensity among conservation economists to equate rarity with scarcity, and this can lead to erroneous assumptions and lull the conservationist into a false sense of security that wilderness will be preserved. For example Baden assumes that because natural amenities are becoming more rare, their value must increase: he suggests that as a country becomes increasingly wealthy and accumulates an even greater volume of "stuff", the value of an additional unit of "stuff" declines. Concurrently, natural amenities are more rare and, hence, more valuable. (10-243) This is a fundamental error - rarity has nothing to do with value. Scarcity implies value because the term suggests something is in short supply, and therefore presumably is being sought for some purpose, and hence has value. We do not value the smallpox virus, although it is exceedingly rare, just as the rarity of the snail darter says nothing about its value (and perhaps the environmental movement is losing credibility by going to exaggerated lengths in attaching value to a natural object just because it is rare). Natural amenities may

well become both more rare and less valuable at the same time. Valuation is in the mind of the beholder, and it seems quite possible that future generations may become so completely divorced from natural influences as to lose all respect and appreciation for natural phenomena. In this case, natural goods might be rare but not scarce, and the quality of life may be substantially impaired but this fact might remain unnoticed.

AN APPROACH TO VALUATION

The decision-maker is thus in a bit of a quandry. He must consider the welfare of future as well as present generations, and he cannot trust the value judgments of either. Perhaps conventional methods for estimating value and making trade-offs are spurious, and the decision-maker should not give them much credence, but rather come to an informed value judgment based on a careful reading of history and literature, and an examination of the findings of the social sciences. A comprehensive, interdisciplinary approach - with particular emphasis on the evidence provided by the past (the experiences and intuitions of our more perspicacious ancestors) - may prove far superior to the incremental, *ad hoc* approach, no matter how impressive the latter's number-crunching, or how neat and tidy the results.

It would seem desirable to integrate economic concepts with ecological, ethical, and philosophical concepts, and perhaps the first step should consist of comparing the various meanings of the term "value". Economic values in their first intent are quantities of money, while ethical or human values are qualities of life. (99-41) There are some types of ecological, ethical, and philosophical goods which have such high social value that if they were priced, the consumer surplus could not be defined. It is possible for a demand curve to become infinitely steep, and at that point the supply of the good is minimal by any criteria. For some goods, like water, it is relatively easy to define

this point. For others, like natural ecosystems, it may be beyond our competence. But it is important to remember that at some point, the normal (economic) meaning of value is transcended, and value comparisons with any number of other goods becomes meaningless (as when a kingdom is gladly traded for a horse or diamonds for a glass of water). Economic analysis seems incapable of dealing with such sharp discontinuities in valuation because the focus is on man's works, and the works of nature (where these singularities commonly occur) are generally taken for granted. Nature appears, from the economist's limited perspective, as a cornucopia overflowing with energy and materials. The underlying network of supporting life processes, and the spiritual, aesthetic, and ethical values associated with natural goods, often remain unseen and unvalued.

When the ecologist sits down to enumerate the valuable functions of the natural environment he tends to compile a long list. However he cannot simply hand this list to the economist as a guide for making decisions at the margin because the functions are not quantified and there is no way to determine the exact contribution of any one good. A natural ecosystem is clearly limited in value, but the whole is more than the sum of its parts and one ecosystem may have greater value than is apparent. Unfortunately there is no mechanism for apportioning the value of the whole to the component parts, and the greater good can be eroded away in a series of cost-benefit analyses. It is important to remember the interconnected nature of ecological systems (and the fact that individual services are almost certain to be undervalued) when one compares costs and benefits and attempts to determine the ultimate social value of a project. There are always unseen costs, since it is not possible to identify some functions of nature until they are lost, and some losses are felt only after some time (or only when losses cumulate). Once lost, many natural goods cannot be replaced or their loss compensated because only nature can provide them and this takes time (which may not be available).

Past experience, when nature was relatively abundant, is not an appropriate

guide for today's decisions. The demand for natural goods appears to be increasing while the supply is decreasing. Some goods may be quite scarce on a global level, but still abundant on the national level (where they are treated as free goods, with unregulated use). Economic analyses should take the broadest and longest view, and provide ample margin for unknown values and cumulative effects.

The concept of value should not be limited to the degree of utility obtainable. There should be some mechanism for valuing goods which ensures that those which are useful but fragile (or can be easily exhausted) receive a much higher valuation than those which are hardy or can be readily renewed or replenished. Many useful natural goods are unique and irreplaceable - these characteristics should be considered to greatly enhance their value (in addition to any other considerations). The concept of irreversibility is important to valuation because demand may become infinite as a good becomes unavailable. If this is foreseen, use of alternative goods at higher costs can be accepted so that supply of the good will not be reduced to this point.

While many natural goods cannot be recovered once lost, some damaged natural systems can be repaired and put back in their original condition, or ways can be found to compensate for some of their lost functions. Dohan suggests shadow prices may be determined for "the public service benefits" of natural ecosystems by using the concept of <u>public opportunity costs</u>. This involves calculating present and anticipated expenditures to replace or recover public-service functions once provided by natural ecosystems. (46-161) The loss of benefits in moving to a situation of lower environmental quality is added to the extra costs of economic resources to maintain the lower state of environmental quality. It is interesting to note that the shift of the cost curve results in a <u>new optimum</u> level of environmental quality, so that there remains a permanent penalty to be paid for forfeiting the original benefits. This lower level is optimal in the sense that under the new circumstances no other level could now yield larger net benefits - but of course the new level of environmental quality is a less satisfactory level. This

procedure therefore gives some indication of the costs of losing natural goods in monetary terms, and demonstrates that trading natural goods for a few million dollars is not always economically sound.

Dohan suggests that it is futile to go further and attempt to assign monetary values to benefits that are distantly related to economic aspects of life and without close economic substitutes. (46-163) However he stresses that nonmonetizable benefits and costs should be boldly listed along with the monetizable benefits and costs. (46-164) There are enormous difficulties in giving an accurate impression of the extent of such costs and benefits due to (1) uncertainties (one cannot even roughly predict many consequences, particularly second and third order interactions) and (2) ambiguities in communication (in the absence of a language of quantification, one must rely on imprecise and potentially misleading terms). For example, nebulous values such as option demand, non-participant demand, and bequest demand should be included in cost-benefit calculations, although it is not clear to what extent these contribute to welfare or how one can estimate welfare loss in terms of these values when natural areas are altered. The danger is that the nonmonetizable costs of losing natural goods will be clouded in confusion and systematically underestimated, while the monetized benefits of a development project are more likely to be clearly perceived and fully recorded. Undertaking a cost-benefit analysis which seeks to estimate the quantities and probabilities of <u>all</u> values, not just marketable ones, is a daunting task. However this is no reason to abandon such an approach in favour of conventional cost-benefit analysis. Taking refuge in the simplicity of numbers provides no escape from the complexities of reality.

WILLINGNESS TO PAY AND COMPENSATION

All attempts to price unmarketable goods are unsatisfactory because

informed value judgments are thereby distorted. Exchange values simply cannot be determined for use values, and so attempts to define the consumer surplus cannot be achieved by simulating an equilibrium market price. Some economists maintain that exchange values can be approximated since consumers reveal (or can be made to reveal) their willingness to pay for diffuse public goods in various ways. The reasoning is that people would be willing to pay for these goods if there was a market for them, and that this willingness to pay can be estimated by various techniques. In fact, it is posited that as alternative supplies of the good are reduced, the willingness to pay may increase to the point where private markets will emerge (as the cost of setting up a market becomes feasible). Some economists have even suggested that valuation and allocation problems might best be resolved by distributing property rights to nature, but it is difficult to see how (and by what criterion) all natural goods could be distributed, or how definition and enforcement problems could be resolved. (133-68; 91-33)

Willingness to pay can be estimated directly or indirectly. A person can be interviewed with the object of determining the maximum price he would pay to avoid being deprived of some good, or the costs which he incurs to experience some benefit can be measured (the presumption being that the benefits are equal or superior to these costs). However such interviews produce spurious results (for several reasons) and cost estimates can grossly understate the benefits. It is difficult to persuade people to reveal their preferences, which may be unfathomable even to themselves, and people are often observed to say one thing and do another. The cost estimate approach can be somewhat improved by asking how much an individual's costs would have to increase before he would forgo the item in question, but this is still a very arbitrary calculation. And in fact perhaps the most sensible answer to an inquiry as to what constitutes the maximum price that can be attached to a wilderness experience, for example, is that it is priceless (in the original sense of the term): it is worth any amount, from nothing to everything, depending on circumstances. If a price is put on wilderness (such as a use fee) it might suddenly lose _all_ value. (Whether a woman

<u>offers</u> her affections or charges a price can greatly affect the value of the experience. Any theoretical price for love is purely arbitrary and meaningless.) The "cost" of pricing may thus be exceedingly great. It might not be so surprising if an old outdoorsman indicates a low willingness to pay for fishing his favourite stream. This may only mean that paying would ruin the experience. In fact, those who feel most strongly about this (which usually includes those who value the resource the greatest) are apt to indicate a low willingness to pay. The object of the exercise is thus defeated (unless we are willing to invert the analysis, and consider the lowest price to indicate the highest valuation).

Willingness to pay estimates are further complicated by the inability to perceive the past or future utility of a good. This means that the <u>potential</u> utility of a good (which may be far greater than its apparent present utility) is completely ignored. It may be more profitable to investigate welfare functions of former users (through literature and history) than to base decisions on the estimates of present (perhaps ignorant or incompetent) users.

One of the problems with using willingness to pay measures of value is the bias stemming from a person's <u>ability</u> to pay. If a man is poor, he cannot attach a price corresponding to the true value of the good if that price exceeds his income. Even a rich man cannot put a price on a priceless good. Is it reasonable to bound valuation of higher order goods by income constraints? Such a procedure ensures inaccurate valuation. Perhaps willingness to <u>sell</u> would constitute a better measure of the value of such goods. Willingness to sell would give a <u>maximum</u> estimate of the value while willingness to pay would give a minimum estimate - the difference may be considerable, and the level of environmental quality will be determined by which measure is used. As an illustration, if an individual is asked what he is willing to <u>pay</u> to save some wilderness area from destruction, his answer will vary greatly from the one he would give if asked what he is willing to <u>accept</u> to allow this wilderness to be destroyed. In the latter case, assuming

wilderness is in short supply, there are likely to be some people who will put a very high premium on maintaining the wilderness while (given a certain level of general prosperity) the rest of society will put a comparatively small premium on the per capita share of benefits from exploitation. It is quite possible that the sum of exploitation benefits will not equal the sum of preservation benefits, in which case a potential Pareto improvement is not possible because those who gain from development could not compensate those who would lose. Since property rights in wilderness are not defined, the situation is ambiguous: potential losers may not be able to stop a wilderness development by their aggregate willingness to pay yet the developer may not be able to compensate the losers if the project is undertaken and still show a gain from the development. The question of who owns the goods of nature is therefore pivotal. If firms own the natural environment, households must be willing to pay for maintaining a given level of environmental quality; if households are the owners, firms must compensate households for any deterioration in environmental quality. The initial state of ownership determines whether a move to another situation is a Pareto improvement.

It is suggested that households (or some surrogate, such as a central authority) rather than firms should be considered the rightful "owners" of natural goods on logical and ethical grounds. The household is the firm's *raison d'etre*, and it is the individual as consumer which should be regarded as the ultimate economic entity. If individuals can be considered to have "certain inalienable rights" it is only reasonable to include the rights to environmental quality and certain essential products of nature among these. There are no logical or ethical grounds for distributing the property rights to nature among firms which are, after all, only specialized legal entities serving an economic function.

Therefore the willingness to sell measure should become the criterion, and minimum compensatory payments should be calculated for projects which destroy or damage natural goods. Since cost-benefit analysis is concerned with potential Pareto improvement, assessments should be based

on estimates of the compensating variation, which Mishan defines as the sum of money which, if received or paid after the economic change in question, would make the individual no better or worse off than before the change. (109-391) If the compensating variation of gainers exceeds that of losers, there is a potential Pareto improvement - sufferers must be (potentially) compensated for loss of welfare, after which there must be benefits remaining to provide a net gain. In the case of large potential loss to a few people (as when highly-valued natural goods are destroyed) it may prove impossible to compensate the victims and still show a net gain, particularly if the benefits to the remainder of society are relatively trivial and if the change is under conditions of certainty.

While still imperfect, the compensation principle might be the best way to bridge the gap between exchange values and use values. Though prices would still be inferred, higher goods are less likely to be undervalued in a trade-off with priced goods. Being unconstrained by income, natural goods will be traded more in accordance with one's perception of their true use value. Where this becomes infinitely large, development should not proceed. If more pressing needs subsequently come to the fore, development can resume.

There are still some serious conceptual problems with this method of calculating trade-offs, and these might invalidate all the sophisticated sampling techniques, careful data collection, and advanced statistical analyses used in such an approach. The whole mathematical edifice rests upon a very fragile complex of assumptions: individual choices and behaviour concerning highly abstract goods are rational, amenable to direct scrutiny or introspection, and are comparable in monetary terms. This seems untenable. Perhaps it is unrealistic to expect individuals to arrive, after a few minutes (or even hours) of thought, at a value for higher order goods, as if this procedure could be equated with choosing between various cuts of meat, or setting an upper limit on the price of a stick of biltong. Individuals may not be competent to determine <u>any</u> price for higher order goods. It may be just as well to let informed decision-makers calculate the compensation variation utilizing other sources and techniques.

THE SHADOW PROJECT CONCEPT

The shadow project concept has strong advantages over the compensation principle for cost-benefit analysis. It is based on the assumption that nature must not be degraded any further and any proposed project must be accompanied by a "shadow project" to ensure no loss in environmental quality. The cost-benefit analysis need not be concerned with the incalculable values of natural goods, and is largely freed from the difficult task of foreseeing what impacts will result (and estimating their costs), but need only be concerned with the monetary costs to maintain the environment as it is now. The concept of replacement value clearly reduces the problem of converting use values to exchange values, as many non-quantifiable effects are avoided.

The shadow project concept follows logically from investing all individuals with rights in the products of nature, and is analagous to concepts for solving pollution problems, wherein a producer is required to pay for the use of public goods. Developers would have to pay for all the externalities they impose - they have no "rights" to damage or exhaust nature, and must therefore either internalize the externality, obtain aid, or cancel the project.

Stone has suggested that the objectives of welfare economics would be furthered if natural objects were themselves given legal rights. Legal disputes would then involve consideration of the full environmental costs to society rather than the partial costs now borne by litigants: we in effect make the natural object, through its guardian, a jural entity competent to gather up fragmented and otherwise unrepresented damage claims, and press them before the court. (140-28) These would include nonmonetizable damages and have the effect of institutionalizing their value - it would make the violation of rights a cost by declaring the "pirating" of them to be the invasion of a property interest. Stone feels that wherever it carves out "property" rights, the legal system is engaged in the process of creating monetary worth. (140-29)

The obvious difficulty with this approach is the high cost of implementing the shadow project. For developing countries such costs are not likely to be acceptable, but perhaps developed countries will be prepared to partially defray these costs in the form of aid because, taking a global perspective, they may feel that natural goods are already in short supply and their demand for these goods might warrant such expenditures.

Shadow projects are not likely to be accepted in a world of increasing want ruled by short-term political expediency. Decision-makers must be unusually long-sighted to accept such costs or insist that developers cannot use up natural goods without paying for them. In addition, shadow projects are limited in scope. Natural amenities will be lost with <u>any</u> development, and many cannot be replaced or their loss compensated because only nature can provide them (and we may not even know what they are until we feel the effects of their absence). The best shadow projects would avoid as much damage as possible (and not just restore damaged areas, or pay for their destruction), but the high cost could be perceived to be totally unrealistic. In addition, the structure of relative prices today may bear little relation to those of the future. Shadow prices are likely to shift upwards as future scarcities become more severe. Should these be anticipated? This would only increase the costs (and decrease the likelihood) of implementing shadow projects.

Other attempts to determine values for natural goods include the functional component approach and the energetic valuation procedure. (114-5, 7) These involve assessments of natural functions and primary production respectively, and attempt to relate these to monetary values. It is doubtful whether decision-makers will accept the premises on which such calculations are based, although these exercises serve to give a more thorough understanding of the kinds of values natural goods have. Unfortunately, most decisions affecting natural goods still tend to be based on highly questionable comparisons with economic goods whose current monetary values derive largely from fortuitous and

transitory conditions. The guidance value of such judgments is nullified by the inability of "man the consumer" to make decisions which will improve social welfare.

THE COMPETENCE OF "MAN THE CONSUMER"

Rationality and Competence

According to Seneca and Tausig, sustained economic growth is necessary to solve the basic economic problem of man - scarcity. (133-347) But to what extent should specific needs and desires be satisfied? At what point does satisfaction and gratification become satiation and glut? It is easy to get fixated at a low level in the hierarchy of needs. If fixation is on material needs, the result is materialism. If fixation is on the social needs, the result is egotism. (99-14)

Economic growth can be the _cause_ of scarcity for some goods by creating a superfluity of other goods. Natural amenities are becoming scarce partly because of growing materialism. Consumers are choosing material goods at the cost of foregone natural goods. The question is, are consumers competent to make these trade-offs; are their decisions likely to improve their welfare? Keynes regarded economic growth as a way to free man of material wants so that man could realize his higher potential - not as a good in itself, but rather as a _prerequisite_ for the good life. Keynes felt that materialism would die an unmourned death. (133-347) The evidence to date does not support this view. Leopold said the ultimate issue, in conservation as in other social problems, is whether the mass-mind _wants_ to extend its powers of comprehending the world in which it lives, or, granted the desire, _has the capacity to do so_. (95-55) Most men have not had sufficient exposure to ecological realities to accurately judge their significance:

> There are two spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from the furnace. (94-6)

Urbanized man is poorly placed to perceive his ultimate relation to the natural environment, or recognize the potential of natural amenities to satisfy his higher needs. One cannot readily appreciate what one has not experienced.

Welfare economics and democratic political theory are both based on a value judgment: that the personal wants of the individuals in the society should guide the use of society's resources. (84-19) This judgment is of the most profound significance since some wants may be insatiable and ultimately destructive of goods which are necessary to satisfying higher needs. Individuals are said to behave rationally when they purposefully attempt to maximize their economic welfare by searching for the largest and best collection of consumption goods and services they can afford. (133-51) However, rational individuals are not necessarily competent to discern which goods and services would maximize their welfare because they may lack information or experience. Tastes and preferences are shaped by complex processes, and the source of consumer wants is not subject to direct scrutiny or introspection. Information is costly, and consumers may regard the costs of additional information as being greater than the potential benefits.

The problem of consumer competence is not simply one of unscrupulous producers moulding the desires of gullible consumers. The problem is far more insidious and intractable. What happens is that the consumer proceeds, by a series of reasonable steps, to occupy an unreasonable position. Rational, self-serving actions can lead ultimately to an irrational, self-damaging result. The consumer may be competent to make decisions to maximize present welfare, and remain incompetent to make long-term, orchestrated decisions to maximize future welfare - he may be able to stay near the centre of the road, but not able to choose the right road.

For example, advances in technology lead to the introduction of new products which may bear hidden, long-term costs. The consumer's evaluation is likely to take cognizance only of immediate monetary and opportunity costs. Long-term, intangible opportunity costs, and cumulative or synergistic costs, tend to remain unperceived or underestimated. Benefits, on the other hand, may depreciate in time. When a consumer buys a television set, the novelty value is particularly high at the time the decision is made, but in time this fades. Opportunity costs - such as foregone exercise, sleep, family activities, etc. - may soon outweigh the entertainment benefits, but these costs may remain unperceived.

Difficulties are compounded when future generations are considered. The decisions of present consumers affect the options and well-being of future consumers whose tastes and preferences are not taken into account. The calculation of discount rates is almost wholly arbitrary and reflects present biases. There is a need to apply some systematic method for determining worthy goals, and consumer decisions should not be regarded as a reliable guide to maximizing welfare.

Greed and Shortsightedness

> The major sources of our ecological disasters - apart from ignorance - are greed and shortsightedness... money-making is the rational norm in comparison with which all other pursuits are irrational and abnormal. (121-20)

Individuals seek to maximize their own personal welfare over short time horizons. Since gross material satisfactions appear to have obvious welfare-enhancing value, and since today is more important than tomorrow, the pursuit of monetary wealth and the creation of economic goods seems rational even if common pool resources are destroyed and life-support systems are impaired. The value of natural amenities and ecological processes is likely to be unperceived or disregarded by most people.

Mishan has developed a procedure for evaluating the welfare effect of risk to life which involves aggregating the valuation of each member of society, but points out the great difficulty in arriving at individual values since people are generally ignorant of the degree or meaning of risk. (109-318) It is therefore highly unlikely that individuals can competently assess the significance or value of far more subtle losses in welfare arising from more complex variables. Fischer points out that willingness to pay measurements may be grossly distorted by advertising and other propaganda designed to manipulate preferences away from a "natural" environment and toward an environment characterized by consumer goods. (58-99) Results of attempts to measure willingness to pay will vary according to a wide variety of circumstances unrelated to the true value of the goods to the user. Consumers do not have stable preferences, are not able to assess relative preferences accurately, and do not clearly perceive how the loss of natural goods affects welfare.

Spiritual and aesthetic values generally seem to compare unfavourably with material values. Part of the problem is the difficulty in making such comparisons; since spiritual and aesthetic satisfactions cannot be expressed in monetary terms, the proponents of such values often say they are "priceless" and dismiss any comparison with "base" material goods. It might be well to stress the ultimate relation of money to all classes of benefits rather than to simply argue that some cannot be priced, in order to dramatize the callousness of many real decisions. For example, people often accept the loss of natural amenities, or separation from family, to take a job which offers only a slightly bigger pay packet. It would perhaps be a useful exercise to carefully evaluate the benefits of the extra money in relation to the foregone opportunity costs of specific "priceless" goods rather than to simply say the latter is incalculable. Few people actually go through such an exercise, and therefore grossly underestimate the value of lost natural or social amenities traded for a few trivial comforts. This irrational behaviour is due to faulty perception and an arbitrary approach to decisions.

Levels of Perception

Modern man perceives his role as a consumer of man-made goods much more readily than he does his role as a consumer of nature's goods. Mishan points out that people willingly give up their choice to experience the goods of nature as if it were unavoidable, but may be expected to take great exception if trivial consumer commodities should be withdrawn from production. (109-128) Beckerman exemplifies this disparity in perception when he ridicules efforts to conserve tigers, salmon, and oysters because they make a negligible contribution to the welfare of the average person. (18-112) Beckerman has a more prosaic notion of utility, and measures welfare in strictly economic terms. This perspective is too narrow; it is necessary to consider the value of beauty and wonder in wild things, and adopt a holistic outlook to perceive emergent values when things are taken together. Such higher spiritual and aesthetic values exist, and can be demonstrated empirically. For example, Litton and Craik have identified objective "factors of recognition" for landscape resources which are used to categorize "compositional types". Litton demonstrated that aesthetic perceptions can be analyzed and explained, and Craik confirmed objective criteria are valid by running comparative perception tests. This interesting collaboration between a landscape architect and a psychologist revealed that people seem to agree on the effects and special values of specific landscape phenomena. (90-265)

Habituation and Sensuality

Urbanized people often display an irrational fear of nature, and feel no empathy with natural or wild surroundings. As the proportion of urban to rural population grows, attitudes toward natural goods may become increasingly indifferent, disparaging, or even hostile. Man is becoming habituated to unnatural environments, and losing his sensitivity to natural influences. This constitutes a most insidious, positive feedback process which could be reducing the quality of life. The

aesthetic and spiritual benefits of regarding awe-inspiring natural beauty in solitude and silence may be lost to experience, and the loss may go unnoticed and unmourned. If decision-makers were to follow popular preferences, fewer and fewer natural areas would be maintained. Even seriously degraded environments seem to eventually become acceptable. Disinterest is all too common among the very people who live amidst the ugliness of industrial wastelands: they are resigned to it, and they are unprepared to pay for rehabilitation. (14-153) When environmental quality is lost, people become insensitive to their surroundings and are not prepared to pay for restoration because they have forgotten (or perhaps never knew) the pleasures of a quality environment; it is important to prevent the erosion of environmental quality, because losses are likely to be permanent.

Passmore says <u>sensuality</u> is necessary to ecological concern, that rising totally above sensuousness is utterly destructive of man-nature relationships. (121-21) But how does one restore sensuality to industrialized man, or to inhabitants of degraded landscapes and members of impoverished societies? Man the consumer has been too malleable to psychologically destructive forces, and has lost his sensibilities. He cannot be regarded as a competent judge, or an effective agent in his own salvation.

Joseph Wood Krutch has said:

> Perhaps when the time comes that there is no more silence and no more aloneness, there will also be no longer anyone who wants to be alone... inevitably the desire for a thing must disappear when it has become no longer attainable. (87-36)

Lamont Cole wonders whether we are selecting for genetic types only those who can satisfy their aesthetic needs in congested cities,(6-43) and Kenneth Allsop believes that a new race of "de-natured" men will emerge and our concepts of quality and beauty and harmony will be obsolescent and doomed to extinction. (3-xiv)

Beckerman mentions the enormous practical and conceptual problems involved in actually estimating the value people would attach to an improved environment, but then disregards the implications of these problems. (18-29) Economic welfare may bear little relation to total welfare, and it is possible that improvements in economic welfare can sometimes reduce total welfare. The notion of "consumer sovereignty", which is central to the logic of welfare economics, may be a dangerously misleading concept. People may not be good judges of the value of maintaining environmental quality relative to the value of other goods.

Personal and Collective Risk

Little is known about how perceptions of hazard, particularly indirect hazards such as those associated with ecosystem damage, affect behaviour. Crucial knowledge is lacking of the processes that link publication and dissemination of information and individual and public actions. (150-54) Lord Ashby has commented on the importance of risk-taking attitudes: unless these are understood, politicians will not be able to restrain pressure for short term benefits at the expense of long term welfare of the environment. (8-9) Ashby's incisive analysis of public attitudes toward hazard suggests:

> These attitudes are a function of three main variables: (a) the frequency with which a hazard, or a nuisance, or a disamenity is likely to occur; (b) the number of people who are simultaneously affected by the event; and (c) the propinquity of the event. Thus 7 000 people killed over a year is not regarded as a problem calling for urgent national enquiry. But 70 people killed at one moment in a plane crash or a railway accident, provided it is in one's own area, is a terrible tragedy... (8-9)

If political response to hazard is determined by public attitudes, there will be insufficient attention paid to remote or uncertain hazards. People do not seem ready to assign resource values on the basis of long-

term considerations or mere statistical probabilities of danger. (54-651) Uncertainty is the key difficulty - people accept risks because (1) they are not fully aware of the potential costs, and (2) they expect to avoid these costs. If the welfare economist accepts such faulty consumer assessments as a guide to decisions, the decisions will be faulty. In seeking a Pareto improvement, the economist engaged in allocative studies traditionally follows the practice of evaluating all social gains and losses solely on the basis of individuals' own evaluations of the relevant effects on their welfare, given the information they have at the time the decision is taken. (109-318) The problem is that the mass of men may be grossly uninformed as to what will contribute to the general welfare; if all members of the public knew the outcome of a risky decision before it was taken, those who would suffer by that decision could not always be compensated by those who would benefit.

In addition to the problem of uncertainty, there is the problem of limited interest. Hardin stresses that freedom to pursue individual self-interest *inevitably* leads to tragedy in a finite world: individuals solely concerned with maximizing their own welfare will ultimately destroy the source of general welfare. (65-52) The decision-maker cannot base his decisions on the limited perspective of materialistic individuals. What is needed is a unitary and harmonious world view as an intermediary to ensure collective survival. (55-192) This suggests the need for institutional solutions.

Need for Imposing Standards

Man is not a wholly rational animal and those who believe in the omnipotence of human reason and learning should be aware that man's control over his impulses is apparently very limited; man's emotional and instinctive drives are not always subject to reason and must be checked by institutional or culturally-conditioned systems. (98-35) It is necessary for decision-makers to lead and direct, rather than acquiese and submit to public demands which entail great ecological risks. The

principal obstacles to the solution of ecological problems are in fact political, to persuade or coerce citizens into actions. (120-57)

Stone feels that education alone is not likely to be effective in protecting the environment. There are an increasing number of humans, with increasing wants, and there has been an increasing technology to satisfy them at "cost" to the rest of nature. Thus, we ought not to place too much hope that a changed environmental consciousness will in and of itself reverse present trends. (140-47) Consumer competence is limited by poor information, lack of foresight, inadequate ability to reason, and the problem of the commons. Thus a consumer need be not only ecologically informed but also compelled to make decisions collectively in the proper institutional framework. (46-138)

To sum up, consumer decisions affecting natural goods (which are common pool resources) cannot be trusted to improve general welfare for two reasons. First, consumers have short time horizons and are incorrigably biased in favour of personal satisfactions immediately obtainable. Second, even if consumers are persuaded to consider the general good, individuals lack information on the benefits of natural goods and cannot estimate their value, so there is no rational basis for making incremental decisions. Competing man-made goods have obvious and measurable utility, so that marginal decisions will always favour these. This "market advantage" leads to cumulative effects which will reduce the quality of life and increase the risk to survival. There are thus insidious mechanisms in the consumer's decision-making process which tend to drive natural goods to exhaustion. There is no point where the most enlightened and best-intentioned consumer will freely choose to forgo material goods for his exclusive consumption to make available more natural goods for general consumption. It is therefore necessary to establish institutional mechanisms to control the trade-off between natural and man-made goods so that some balance can be maintained. This involves making objective, informed value judgments as to the level of natural goods necessary to provide for future quality of life objectives with low risk to survival. Due to the generally low level of

ecological understanding, it may initially be necessary to set rather high standards for maintaining natural goods and this will require considerable political courage, will, and wisdom.

COST-BENEFIT ANALYSIS

Many development projects which damage or exhaust natural amenities appear economic because they are heavily subsidized - examples include preferential tax treatment, understatement of capital costs for public projects, and deficit sales of natural resources. The true costs are thus hidden by fiscal mechanisms as well as a failure to consider environmental degradation, so the developer is able to justify a project by shifting two types of costs onto the public. It is the task of the cost-benefit analyst to correct these anomalies. Krutilla has suggested that an examination of hidden subsidies often reveals that the net value of an apparently profitable development plan is in fact negative. If it remains positive however, then some account can be taken of environmental opportunity costs; or, since this is a daunting task, one could at least state how large these must be to quash the development. (91-91)

Cost-benefit analysis is concerned with identifying and measuring social benefits and opportunity costs arising from alternative proposed actions, and then determining whether one alternative is preferable to another by virtue of an excess of benefits over costs. Conventional cost-benefit analysis is limited to consideration of economic values because these can be expressed in monetary terms and added together algebraically. Natural ecosystems clearly contribute to man's economic well-being but, due to their "public goods" nature, market values cannot be established. A cost-benefit analysis is properly concerned with all changes in man's economic well-being resulting from the alternative actions, including external effects. Since the market ignores some values and distorts others, an important objective in cost-benefit analysis is to provide

correct estimates of all economic effects on social well-being. This would include the effects of pollution (which have been widely recognized in recent years) and the effects of eradication (which have been generally ignored, largely due to the difficulties in perceiving, measuring, and monetizing these effects).

Cost-benefit analysis depends on clearly defined alternatives and the existence of a welfare function which permits quantification of the alternatives. The rationale behind this approach is that monetary measures correctly specify the relative contributions to welfare made by diverse and otherwise completely incommensurable goods, services, and conditions. The procedure is to list all consequences of each alternative and then estimate the benefits and costs of each consequence. The problem is that information for identifying, quantifying, and assigning money values to these benefits and costs is insufficient and the estimates are therefore inaccurate. Some criteria will fail to be considered (because their significance is not foreseen), the measurement of others will be based on guesswork, and money valuations are likely to change rapidly over time due to changing circumstances.

These failures are likely to be most pronounced for benefits and costs resulting from maintaining or destroying natural ecosystems and processes because of the complex and abstract nature of these goods. The problem of measuring such benefits and costs appears to be insoluble. The optimum trade-off of natural goods for other goods could be determined if the value of a marginal unit of resource destruction could be measured but man does not have sufficient knowledge to do this. Attempts to calculate a partial equilibrium solution are impractical since the loss of one area will have some effect on neighbouring areas. Dohan has pointed out that the economic criteria of cost-benefit analysis is assymetrical - it may be used to reject a project proposal, but can never be conclusive about a project's acceptability. (46-166) Acceptance depends on the satisfaction of other social criteria.

The cost-benefit analysis approach thus has serious limitations. It is

important to stress that a single index, no matter how methodically and carefully calculated, cannot provide an adequate appraisal of alternatives. Ultimately one must trust to value judgments not amenable to complex mathematical treatment. There is nothing magic about the numbers in cost-benefit analysis, and the economist has no greater claim to rationality or objectivity than the sociologist who may in fact be better able to discern the true nature and extent of the welfare conflicts involved.

In practice, conventional cost-benefit analysis can hardly be divorced from its bias favouring commercial undertakings - the entire approach is based on assumptions regarding the crucial importance of economic welfare. Other judgments are not incorporated into the formula (such as the specification of environmental quality objectives and equity objectives) which may be more meaningful to total social welfare. There is an unfortunate propensity among decision-makers to consider efficiency objectives as being of paramount importance, and to accept cost-benefit analysis as conclusive (at least on the individual project level). It can be argued that the efficiency objective is a false goal if its attainment results in an inefficient environment. The environment has been underpriced because the value of ecological and social factors are unknown and therefore ignored. If these cannot be reliably estimated, then cost-benefit analysis is not a reliable guide. The true objective of cost-benefit analysis should be to improve the decision-maker's perception of the welfare effects of alternatives, and to this end more information is necessary on the value of the natural environment.

Because cost-benefit analysis is concerned with producing quantitative results, many of the largely imponderable effects of urban and industrial developments are often ignored. Losses of biological entities and disruptions to ecological processes are seldom included in a project evaluation, even though these directly affect man's health and spirits and contribute to the maintenance of socio-cultural assets. Outputs of easily measurable goods are therefore given undue emphasis, and results in what Mishan calls "horse and rabbit stew". (109-160) Mishan counsels

against attempts to quantify the unquantifiable, but would try to correct for gross distortions by stating clearly the area of ignorance, offering a range of guesses of the value of damage to be expected, and making contingency calculations to show how the net social benefits of a project can be offset by the spillovers. Mishan has also suggested constructing "social indicators" for socially desirable goods which are difficult to quantify - these could then serve as proxies to provide some index by which welfare changes could be measured. (109-406)

Dohan agrees that one should not attempt to assign monetary values to benefits that are distantly related to economic aspects of life. (46-163) Where possible he uses shadow prices to provide a minimum estimate of the economic value of certain natural functions which contribute to safety and environmental quality. However, due to the absence of data on socially relevant output of ecosystems, it is not possible to accept as optimum the choice indicated by the cost-benefit analysis and so it is necessary to list and consider nonmonetized social benefits and costs. (46-165)

Krutilla advocates a similar approach and suggests using a model which assesses a whole time path of irreversible investments. (91-40) If, as seems likely for many public projects, the benefits of development decline over time relative to the environmental opportunity costs, the model should use a low discount rate, which would favour preservation of environmental amenities. Alternatively, one could estimate what the initial year's preservation benefits would need to be in order that the present value of preservation is at least equal to that of development. (91-125)

Krutilla assumes that environmental amenities will remain positively income-elastic. Mishan agrees that the terms of trade as between manufactured goods and natural goods will tend to move increasingly in favour of the latter. (109-290) He therefore suggests the cost-benefit analyst calculate the hypothetical rate of growth over time of the value of natural goods relative to manufacturers that would be necessary

to equalize the excess benefit of the two alternative projects. This calculation might be plausible enough to protect natural areas.

Seneca and Tausig have said the cost-benefit framework is indispensable and enables economists to ask the right questions even if they are not yet able to provide the correct answers. (133-20) This tool can strengthen environmental protection arguments beyond the weak "save our heritage" appeal. Dohan says by using cost-benefit analysis we now know more precisely what the real trade-off is between net economic benefits and those many other elements that enter into man's well-being. (46-167) Even if the known costs and benefits are only enumerated, and attention is also drawn to potential costs and benefits, and the appropriate time periods involved for some of these costs and benefits, the analysis will be useful in making decisions. For instance, if a development project's schedule is recognized to be on a much different time scale than that of preservation of natural amenities, perhaps the quantification bias will be largely nullified.

Decision-makers are advised to employ the cost-benefit concept in its most general sense. It is vitally important to take a broad view, to include intangibles and higher order interactions, and to assume a long time horizon. The cost-benefit framework can be used for policy decisions as well as individual project decisions. It is perhaps at this most general level, where precise measures become subservient to directional questions, that the concept is most valuable and least subject to the quantification bias.

A major difficulty, especially for more general studies, is to determine and evaluate future costs and benefits and compare them to today's. Several crucial assumptions are involved in this process, and the cost-benefit analysis can be confounded by attempts to forecast the extent and value of future costs and benefits, and the preferences of future generations. There is a natural intertemporal bias favouring the present and near-term and heavily discounting the long-term. This is rationalized by placing faith (unwarranted by recent developments)

in technology to provide for future needs. The problems of uncertainty and irreversibility seem to have little influence on the process of discounting.

The striking thing about evaluating a future stream of costs and benefits is the arbitrariness of the assumptions on which one bases the analysis. It is possible (indeed likely) to be out by an order of magnitude on forecasts, which completely invalidates the conclusion. The major sources of error are unforeseeable technological developments and socio-psychological developments. Given this great uncertainty, perhaps the major consideration should be the value of risk-aversion. It is desirable to cultivate a conservative cast of mind amongst decision-makers on matters which involve highly uncertain or potentially irreversible effects on the environment and on the supply and demand of amenities.

The traditional cost-benefit approach is dangerous since irreversible actions can be justified. Ehrenfeld has pointed out that extinction of a biological resource can be economically superior to long-term, sustained yield gains of the sort generated by intact marsh, provided that the profits and the discount rate are each sufficiently high. (54-653) Many development projects impose effectively irreversible effects on the natural environment. When dealing with potentially irreversible actions, it is vitally important to carefully consider the role of uncertainty, the meaning of welfare, and the appropriateness of discounting.

DISCOUNTING

The rationale for discounting future costs and benefits is based on two phenomena: (1) the net productivity of capital, which is derived from resources that might otherwise have gone into present consumption but can be used to increase the resources that can be consumed in the future, and (2) the positive rate of time preference, which is based on the fact

that consumers prefer to consume a smaller amount now to a somewhat larger amount later. (46-157) Discounting seems reasonable when applied to the consumption of goods made possible by capital formation, or to the consumption pattern of a given individual. When applied to goods produced by nature, or to consumption by groups placed differently in time, the practice of discounting seems inappropriate. Since many natural goods are not subject to increases in the amounts available for consumption (but only decreases) and since this means consumers cannot choose to consume a smaller amount today in preference to a larger amount tomorrow, discounting should not apply to such natural goods. (The only justification for discounting would be if it were known that future preferences would shift away from these natural goods - this is not foreseeable.)

Lloyd has said that the ordinary source of motives for economy is a foresight of the diminuation in the means of future enjoyment depending on each act of present expenditure. (97-9) Perhaps this outlook is an appropriate way of looking at the future for any category of goods the present consumption of which is likely to result in future deprivation. Since the stock of natural goods cannot be augmented by the net productivity of capital, but can certainly be diminished by present consumption, there would appear to be no prospect for consuming more later and, instead, a very real prospect of having none to consume later if the future is discounted. From the point of view of society in perpetuity, the positive rate of time preference does not apply because time is no longer relevant: it is not logical to say that consumption by earlier generations is to be preferred to that of later generations. Only within an individual's span of time is it reasonable to prefer present to future consumption.

The practice (or habit) of discounting causes man to systematically undervalue the products of nature and their future benefits. The net productivity of capital gives some incentive to invest in the future but this motive is assymetrical - it applies to man-made goods and not to natural goods. The only motive applying to natural goods is the posi-

tive rate of time preference. The result is that when evaluating a future stream of costs and benefits in a cost-benefit analysis there is an inherent incentive to produce man-made goods for the future but no incentive to provide natural goods for the future. While this may be rational for present generations, it does not adequately consider the welfare of future generations. For society as a whole (present and future) time of consumption is irrelevant and the only consideration is whether a good's value can be diminished by time or use. Natural goods do not lose their value in this way, while man-made goods ultimately do. It is therefore rational to discount the future for man-made commodities, since these have utility over short-time horizons (which affect only present individuals), but society should not consider present consumption of natural goods preferable to future consumption, and therefore should not discount this category of benefits. (Costs of lost natural goods should be discounted however - the cost of losing such a resource is the value of that resource less administrative costs discounted into the indefinite future. (9-143) This could be a substantial amount.) Under the present practice of discounting, future generations may bear the costs of development but not share the benefits. Benefits from most projects tend not to persist or aggregate, but are consumed and discarded (or deteriorate), while costs to the environment tend to both persist and aggregate. If the socially relevant time horizon is beyond one generation, discounting would seem unacceptable.

The fact that natural goods are provided free by nature, and are not the result of man's labour, brings up the question of who has just claims on these goods. If it is granted that these goods have utility to any generation, and no generation has "earned" the right to abuse or destroy them, then the present generation has no valid claim, simply by virtue of its place in time, for discounting their future use. An object which cannot be improved by human labour has a certain utility or use-value which is independent of considerations of time. Any generation's position in time is fortuitous and irrelevant to its appreciation of any good, service, or condition which enhances its well-being. Natural goods exist in stocks which cannot be expanded over time, and so their

supply can be regarded as having a static relationship with time. If time is regarded as a frozen continuum, then all experiences of well-being conferred by natural goods take place in an "eternal present". There is no reason to prefer their being concentrated toward one end of the time scale and attenuated toward the other.

On the other hand, the value of natural goods relative to man-made goods can be expected to change over time. Since time is unidirectional and the supply of natural goods can be reduced but not augmented, the relative value of natural goods might be expected to increase over time. As man-made goods proliferate the relative value of natural goods could rapidly appreciate. This suggests that natural goods should have a zero or negative rate of discount and man-made goods a positive rate of discount. It is therefore suggested, on intergenerational efficiency grounds, that in cost-benefit analysis it is necessary to fully account for the effects of a project on all natural goods, and to determine economic values where possible, and to apply some rate of discount to irreversible costs and a zero rate of discount to benefits for natural goods.

Garrett Hardin has calculated that at a discount rate of a half per cent his investment of one dollar in a redwood seedling will not pay because it takes 2 000 years for the tree to mature and yield 14 000 dollars in lumber. (70-75) But perhaps the investment may be considered worth-while to society since the cost-bearer's time horizon is irrelevant and the benefit-receiver will have paid absolutely nothing. If one is sure to be excluded from the benefit, the positive rate of time preference does not apply and discounting is senseless because time is no longer pertinent to the decision. If one is to receive a free benefit, discounting is senseless since there was no cost incurred. From the point of view of society, if one considers the long time span involved, the connection between the original investment and the final payoff is extremely tenuous: it may be that the redwood tree will have a value far greater than the lumber value of 14 000 dollars (particularly if - as is likely to be the case - it has acquired great scarcity value). In any case, many of the costs and benefits of investments concerning natural

goods are nonmonetizable and therefore not properly liable to discounting treatment. Major costs of converting natural goods into man-made goods include the costs of increasing uncertainty and approaching irreversibility. Major benefits of preserving natural goods (like planting a redwood tree) are altruistic satisfaction and hope in the future of man and nature (and not just the value of the lumber).

Preservation policies seem to exact a high opportunity cost, but these are balanced by low investment and operating costs and high benefits over a long life. The benefits of most development projects accrue over short periods of time whereas the benefits of natural ecosystems accrue over periods of time which are, for all intents and purposes, infinitely long. The application of a high social rate of discount has the effect of shortening the socially relevant time horizon, and thus has a marked impact on the valuation of natural ecosystem benefits. The fact that this rate is often determined by the rate of return on private investment seems to introduce a bias against such benefits (which are not related to the current productivity of capital). The practice of applying a discount rate which would seem moderate as a rate of interest on capital has profound effects on valuation in a very short time:

> ... at a 10 per cent interest rate, the future value of forests and oil, among other resources, is discounted by 75 per cent in only fourteen years. With the future so heavily discounted, the market cannot be expected to raise prices sufficiently and soon enough to prompt adequate conservation as scarcities develop. (13-147)

The main problem with discounting is that rates tend to be set _far_ too high due to the present generation's understandable bias toward present preferences and near-term benefits and the difficulties (uncertainty) associated with ascertaining future preferences and long-term benefits. When discounting, one must project demand and scarcity patterns. Superior goods with inelastic supply should be discounted at a low or zero rate since (1) one can logically forecast a demand increasing

disproportionately with income (and presumably income levels can be expected to rise, however slowly, in developing countries), and since (2) natural goods by their nature cannot be augmented by technology and are subject only to decreases in supply. A choice must be made as to the level at which society will provide for the needs and desires of present generations relative to those of future generations. If decision-makers are committed to a sustainable society, some degree of suffering and injustice now (from a slower development rate) may be preferable to leaving future populations without the means for a secure and satisfying existence.

SUMMARY AND CONCLUSIONS

Economics has not developed a theory of value which can be applied to common pool resources, and attempts to ascribe monetary value to them have not been satisfactory. A particular problem is to assess the significance of cumulative and irreversible losses. Thus there is a danger that natural goods with high use value may be allowed to disappear because their intrinsic value is not perceived. It is therefore necessary to rely on the informed value judgments of specialists for estimates of present and future use values for natural goods.

Valuation based on "willingness to pay" estimates are highly suspect and in any case are theoretically inferior to a "willingness to sell" measure of utility. The shadow project concept largely avoids the incommensurability problem but is costly. One possible approach to making trade-offs is to allow informed and responsible decision-makers to calculate the compensation variation by means of a variety of techniques (including ecological, historical, and literature surveys).

Urban-industrial man is losing contact with nature and may not be competent to judge the relative value of economic and natural goods.

Consumers often fail to discriminate between wants and needs, have little appreciation of the nature of ecological risks, and are inherently selfish. Consumer preferences do not constitute a reliable guide to social welfare improvements.

Conventional cost-benefit analysis fails to account for social and ecological costs which cannot be expressed in monetary terms and therefore the special values of common pool resources are excluded from consideration. No single index can be considered an adequate appraisal of alternatives; ultimately one must rely on the informed value judgments of responsible investigators. However, the cost-benefit concept is useful, particularly for decisions at the policy level, and techniques can be devised to mitigate the quantification bias which favours economic goods.

Another difficulty is the intertemporal bias favouring present and near-term needs. The practice of discounting can provide justification for irreversible actions and should not be applied to intergenerational consumption of natural goods. Since the stock of common pool resources can only be diminished by economic activity, it would be logical to apply a zero or even negative rate of discount to the benefits of natural goods.

CHAPTER 13

THE POLICY ALTERNATIVES EXAMINED

"The 'key-log' which must be moved to release the evolutionary process for an ethic is simply this: quit thinking about decent land-use as solely an economic problem. Examine each question in terms of what is ethically and esthetically right, as well as what is economically expedient." (94-262)

INTRODUCTION

There are many methods of analyzing the policy alternatives. For example, utility analysis techniques (137-27ff) could be applied to the policy choices to determine their utility in satisfying the basic needs of man. Or a cost-benefit framework could be utilized and the specific costs and benefits of each alternative could be weighted and scored using the Battelle method. (45-523ff) It is beyond the scope of this dissertation to attempt an exhaustive analysis of the two policy alternatives; the only objective here is simply to give some indication of how the alternatives might be examined. The following sections are

intended to explore in more detail some of the implications of the policy alternatives and illustrate how these might be more systematically considered.

THE POLICY ALTERNATIVES RATED

The two alternative policy options can be rated in terms of their potential for satisfying the five goals which contribute to social well-being (see pp. 83 and 109). The five goals are to provide for (1) health and physical well-being, (2) protection from violence and insecurity, (3) social stability and economic justice, (4) aesthetic, cognitive, and spiritual satisfactions, and (5) the ability to satisfy the needs of future generations. The two policy options under consideration are (1) a policy of rapid and unconstrained development based on industrial growth and economic expansion, and (2) a policy of development which does not rely on modern industrial technology and is constrained by a provision for maintaining some significant proportion of the land as natural and near-natural areas.

The first policy option would promote rapid material advancement through the introduction of modern technologies. Production achievements would be limited by: scientific and technological constraints; the availability of raw materials, capital, and skilled manpower; the adaptability of present populations and institutions; competition with other societies; and the tolerance levels of ecological systems which contribute vital life-support functions. There are thus technological, economic, sociological, political and environmental constraints to exercising this option. The second policy option places less emphasis on material production and more restrictions on the pace and extent of development. It would bring about advancement which is balanced and wide-based, through the use of traditional and intermediate technologies. Production achievements would be constrained by <u>self-imposed</u> limits to:

reduce dependency on resources which are not abundant; prevent social upheaval and the breakdown of traditional institutions; lessen competition and confrontation with other societies; and ensure that ecological equilibrium and potentially valuable genetic resources are maintained. For convenience the first policy will be referred to as the "industrial option" and the second policy as the "conservation option". The two policies will be briefly compared for each goal in turn to provide an illustration of how these policy options might be evaluated in general terms.

Goal 1: Provide for improved health and physical well-being

The industrial option has had considerable success in developed countries in improving the health and physical well-being of most members of society, but the distribution of welfare has not been equitable: some sectors of the population have benefited far more than others, and poverty has not been eliminated. In developing countries, the industrial option has had mixed success in satisfying the basic nutritional and material needs of the people, and although it has had little success in reducing poverty, it has improved survival rates and general health conditions throughout much of the world. Perhaps the most striking result of this policy has been the production of a great variety of material goods in considerable abundance. However comforts, conveniences, and amusements appear to improve well-being only up to a point, beyond which the law of diminishing marginal utility has great effect.

The conservation option does not in itself contribute to the satisfaction of this goal, and (due to the reservation on land-use) may result in a degree of material deprivation for some peoples. However, the supply of essential goods, such as food, clothing, and shelter, would seem within the capabilities of traditional and intermediate technologies so long as the population does not grow out of balance with the renewable resources available, and so long as resources are not wasted in the production of superfluous goods.

Goal 2: Provide for protection from violence and insecurity

The industrial option has led to greater individual security in many parts of the world, but while personal security may be generally improved, collective security may be at greater risk. Security from the threat of physical violence is conferred by the proper functioning of socializing elements, as well as by police and military protection. Environmental security depends on the degree of ecological equilibrium that a society maintains. There are indications that the industrial option leads to higher risk of sociological and environmental breakdowns. Rapid growth and change threatens the stability of social institutions, advances in police and military technology may ultimately result in greater violence, and increasing productivity through more relentless exploitation of the environment may degrade and diminish the resource base and so lead to greater environmental insecurity.

The conservation option may have some low, negative impact on the provision of security in remote areas to which police and military protection may not be extended effectively. (These areas could even become sanctuaries for criminals and terrorists.) However maintaining traditional social institutions may reduce the need for police protection, and the adoption of certain political strategies can reduce the requirement for military protection. The adoption of environmentally appropriate technologies would avoid the environmental hazards which are associated with modern technology. These hazards constitute a source of social insecurity in themselves, and also weaken a country, making it more vulnerable or dependent on other countries, which results in greater political and economic insecurity.

Goal 3: Provide for social stability and economic justice

The industrial option has not been successful in balancing equity considerations against those of efficiency. Absolute poverty has not been

eliminated through economic growth or redistribution, and relative poverty has even increased. While this policy option might in theory be capable of providing social stability and economic justice, in practice the gap between the rich and poor continues to widen and this has increased the potential for social strife. It is unlikely that the more affluent sectors of society will ever be so well satisfied or so generous that adequate progress will be made in rectifying social and economic disparities. If economic policy is geared to a system which is designed to produce material benefits, then the social needs of man may be widely frustrated.

The conservation option could make some positive contribution toward meeting this goal. This is because excessive exploitation of the natural environment primarily benefits the rich while depriving the poor of traditional livelihoods and social security. Maintaining natural and near-natural areas might slow the widening gap between rich and poor, and strengthen rural development by making rural areas more attractive places in which to live and work, where social needs might be more easily met.

<u>Goal 4: Provide for aesthetic, cognitive, and spiritual satisfactions</u>

The industrial option has great potential for enhancing satisfactions from creative and cultural activities through technological achievements. However the Western experience indicates that the mass of men remain untouched by the most notable aesthetic, cognitive, and spiritual accomplishments of an industrial civilization because they are subjected to a host of lesser influences, isolated from higher influences by social and economic barriers which are part of the system, and insulated from the healthy influence of nature by the urban environment and modern modes of conveyance. The promise of industrial civilization has been largely unfulfilled - individuals appear to have little prospect of attaining self-actualization because their lives are consumed by trivial activities. The necessity to provide an abundance of

goods and services to enhance well-being has been questioned by a great number of philosophers and social scientists who feel that the physical accoutrements of a society and the range of amusements available do not necessarily lend vitality to a civilization. The citizens of modern cities appear to be materially prosperous but aesthetically and spiritually impoverished. The industrial option is not necessary to the pursuit of self-actualization, and may hinder its attainment.

The conservation option affords greater opportunities for direct contact with nature, which constitutes a primary source of aesthetic, cognitive, and spiritual satisfaction. Once physiological and safety needs are reasonably satisfied, perception of natural goods can be a most significant source of pleasure, instruction, and inspiration. Maintaining natural and near-natural areas permits all men - regardless of social or economic standing - to experience the special satisfactions attainable only through direct association with nature.

Goal 5: Provide for the needs of future generations

The industrial option is concerned with satisfying present and near-term needs; long-term needs are heavily discounted. This policy has a built-in bias against future generations because certain inescapable costs and great risks to future well-being are deemed acceptable. Industrial development entails the irreversible destruction of many species, ecosystems, unique objects, and special qualities of nature (which might be of great value to future generations) and increases the risk of disrupting vital life-support processes. Future quality of life, and the very existence of future generations is threatened so that present generations may prosper.

The conservation option would leave a greater legacy to future generations, and help maintain ecological equilibrium so that risks to survival will be reduced. This policy offers far greater prospects for sustained social progress, and promises a world of greater variety, integrity, and

beauty to enhance the quality of life and lend stability and security to the lives of untold generations.

Conclusion:

The two policy options might be rated according to their potential for realizing each of the five goals, and a final assessment made of their overall acceptability based on this potential and the relative significance of the goals. For example, a subjective analysis of the foregoing might indicate the following, very approximate, ratings. (These ratings are obviously disputable but are here intended to illustrate the process of policy evaluation.)

Goal	Industrial Option	Conservation Option
Provide for:		
Health and physical well-being	High	Low to Medium
Protection from violence and insecurity	Medium	Medium
Social stability and economic justice	Medium	Medium
Aesthetic, cognitive, and spiritual satisfactions	Low to Medium	High
The needs of future generations	Very Low	Very High

It can be seen that the lowest and most prepotent need is best satisfied by the industrial option. The two options have similar potential for satisfying the next two needs. However the conservation option is much to be preferred in meeting the final two needs; there is a significant variance in potential for satisfying the supreme goal for the individual (self-actualization), and a most striking difference in the prospects for ensuring that social progress will be sustainable. As long as the

conservation option can reasonably satisfy the lower needs, which can be achieved with intermediate technologies, then this option is to be preferred. There is no point in overgratifying the lower needs or satisfying them more quickly if it means sacrificing the attainment of self-actualization and the prospects of future generations. If decision-makers are committed to providing for a high quality of life over long time horizons, a policy which provides for maintaining substantial portions of the natural environment in the form of natural and near-natural areas should be adopted, and appropriate technologies and appealing alternatives to urban-industrial life styles should be made available.

Rapid and unconstrained industrial development may reduce poverty and provide greater security for today's populations, and may possibly result in greater social stability and economic justice, depending on the society's political, social and economic institutions. However these goals can also be realized by other methods which involve less ecological risk and allow more options to be maintained. A policy of rapid and unconstrained development would appear to adversely affect the prospects of achieving two important social goals: providing opportunities for individual self-fulfilment, and ensuring that social progress is sustainable. This is because the natural environment provides natural amenities and essential life-support services which could be destroyed or seriously impaired by the process of industrial development.

The costs of maintaining natural and near-natural areas may be regarded as foregone opportunities to provide the maximum goods and services which could be produced (given the present state of technology) to satisfy culturally-induced needs and the lowest basic needs of present generations. The benefits of maintaining natural and near-natural areas may be regarded as providing future generations with greater prospects for survival and more opportunities to satisfy the higher basic needs. The principal conclusion of this analysis is that the exploitation and conversion of all remaining natural and near-natural areas, most of which have little potential for increased productivity,

would not contribute significantly or for long to providing for man's culturally-induced and lowest basic needs, but would increase risks to survival and reduce the prospects of satisfying higher basic needs. If decision-makers are committed to the survival of mankind and to providing for the highest quality of life that society might enjoy, then a policy of maintaining natural and near-natural areas should be adopted in spite of short-term opportunity costs.

THE POLICY ALTERNATIVES EVALUATED

The two policy alternatives differ significantly in their potential for satisfying the five social goals. A policy of rapid and unconstrained industrial development might be expected to satisfy basic physiological needs rather quickly and thoroughly, but a commitment to this policy is likely to result in a system of production and consumption which goes far beyond man's requirements to maintain health and physical well-being. An important point in Maslow's theory of motivation is that once a true need is satisfied, the organism is "released" to the next need in the hierarchy - there is thus no object in providing more goods and services than are required to satisfy a need. In the case of physiological needs, only a few goods and services would suffice to keep these needs satisfied. But industrial societies stimulate new, "unnatural" needs which may inhibit the emergence of higher instinctoid needs or interfere with their satisfaction. There are certain conditions necessary for the satisfaction of each basic need, and it is the task of political and social leaders to bring about these conditions and provide individuals with abundant opportunities for satisfying all of their true biological needs. Failure to do so on any level will result in some degree of inanition and social disintegration. Natural and near-natural areas comprise a wide range of satisfiers, particularly for higher needs - they represent sources of aesthetic and spiritual nourishment - and should therefore be provided in some abundance. Culturally derived "substitutes"

for natural goods are not really substitutes at all, and therefore satisfy neurotic needs rather than basic needs.

One great danger of industrial development is that it destroys primary sources of basic need gratifiers - natural and near-natural areas - and fosters a system of production and consumption that is directed at lower and culturally-induced needs rather than at the higher biological needs. The need for self-actualization may then never clearly emerge, or attempts to satisfy it may be frustrated by the confusing plethora of goods and services which demand the individual's time, attention, and energy. The notion that the health and material benefits to be conferred by the urban-industrial complex outweigh all possible adverse impacts is a dangerous delusion since this system could destroy the spirit and reason for living of the people to be provided for. (42-134)

The other major difficulty with a policy of rapid and unconstrained industrial development is that it is destructive of resources on which man's very existence depends. It is often argued that environmental protection involves a cost to the welfare of poorer peoples, and that developing nations must look after their own interests, just as the more developed nations did in the past. This ignores the perils of the new reality: failure to protect the environment may ultimately result in welfare reductions and a threat to the very survival of these same peoples. There is a very real possibility that gaining admission to the ranks of the affluent involves a cost that is unacceptable. A policy which destroys genetic resources and natural ecosystems as a matter of course must be regarded as extremely hazardous. There are no clear rules for risk-taking, but considering the present scale of environmental degradation and the importance of maintaining equilibrium in life-support processes, one might conclude that this policy is already at high risk. An examination of recent major development projects and environmental problems indicates that technological innovation is advancing at a much faster rate than ecological understanding. It seems likely that following a policy of rapid and unconstrained industrial development could eventually result in an environmental disaster of major proportions.

The second policy, which provides for maintaining substantial portions of the natural environment in the form of natural areas and near-natural areas, would involve acceptance of self-imposed constraints on modification of the natural environment and on the production of goods and services. This is of course not to suggest that goods and services which are absolutely essential to the satisfaction of physiological needs should be restricted; rather, production of superfluous goods and services, particularly those intended for the satisfaction of culturally-induced needs, would be greatly curtailed. Appropriate technologies could be designed to satisfy man's physiological and security needs within the limitations of the resource base.

This policy has one disadvantage and two very great advantages. The disadvantage is that resource utilization is necessarily limited to some extent so that total output is somewhat reduced. The advantages are that many natural goods which have special utility in meeting the need for self-actualization are maintained, and greater resource reserves for the needs of future generations are assured. The seriousness of the disadvantage depends on how great the population pressure is and whether resources are to be used to meet basic needs or culturally-induced needs. If only basic needs are met, the resource base can - with appropriate technology and adequate distribution - probably support more people. In any case, population growth will ultimately reach some quantitative or qualitative limit, and it seems prudent to confine population growth and resource utilization to selected areas rather than to commit all global resources to the risks associated with over-development. The latter course would only allow more people to live at a lower level of existence and at greater risk.

SELF-ACTUALIZATION AND THE NATURAL ENVIRONMENT

Maslow says the "Big Problems" are how to make the "Good Person" and how to make the "Good Society". (102-732) Technological goods lose their

value, and all good works come to nothing, if these problems are not solved. Maslow suggests that modern man suffers from "deficiency diseases" brought about by failures in the environment. He calls these "sociosomatic" diseases and "metapathologies" - they are the spiritual or philosophical or existential ailments. (102-733) Perhaps many of these ailments result from the deprivation of certain natural goods; many natural goods should be regarded as balm to the spirit and mind, or a kind of preventative medicine, or fortifiers which can restore psychological health and lead to the development of the Good Person and the Good Society.

Maintaining natural and near-natural areas ministers to cognitive needs (the need to know and to understand) and aesthetic needs (the need to avoid ugliness and contemplate beauty). Naturalists exclaim on the endless variety in nature, the multitudinous assemblage of marvellous objects and mysterious phenomena for investigation and speculation; and aestheticians find natural beauty a great source of inspiration and satisfaction - in fact, all art reflects nature and is an attempt to capture and convey the beauty nature inspires, whether through humanized landscapes or some wilder, more primal source. If the capacity for knowledge and aesthetic appreciation may be acknowledged as among man's highest and most distinguishing attributes, then this vast repository of information and fountainhead of all beauty should be treasured and made safe.

McFarland, speaking for the preservation of a scenic valley, defended the ideal of maintaining natural areas in general:

> The true ideal of their maintenance does not run parallel to the making of the most timber, or the most pasturage, or the most waterpower, but to maintain in healthful efficiency the lives of the people who must use that lumber and other resources. (113-166)

This statement points to the limitations of utilitarian considerations, and the need to consider higher order values when evaluating any proposal. Man's most obvious needs may be physical, but the cognitive, aesthetic, and spiritual needs are no less important if man is to be whole and healthy. Nature provides abundant sources of satisfaction for man's higher needs. Acceptable substitutes cannot be found in the developed environment, nor could their loss be compensated by indulging culturally-induced needs:

> The requiredness of basic need gratifiers differentiates them from all other need gratifiers. The organism itself, out of its own nature, points to an intrinsic range of satisfiers for which no substitute is possible... (103-92)

Man's intimate relation to nature is an evolutionary fact, and natural objects constitute basic need gratifiers which lead to self-actualization.

The Transcendentalists of early 19th century New England in America sought self-actualization through direct contact with nature. Natural objects and scenes were regarded as symbols of a higher reality, as keys to a spiritual and intellectual liberation, and so direct contact with nature was regarded as fundamental to the advancement of mankind. Henry David Thoreau, a most eloquent Transcendentalist, spent much of his life walking alone in the woods consciously seeking the inspirations and insights which lead to self-fulfilment. The following selections from his journals give some indication of the special relationship one may have with nature, and the value of that relationship.

> This stillness, solitude, wildness of nature is a kind of thoroughwort, or boneset, to my intellect. This is what I go out to seek. It is as if I always met in those places some grand, serene, immortal, infinitely encouraging, though invisible, companion, and walked with him. (134-170) ...Ah, dear nature, the mere remembrance, after a short forgetfulness, of the pine woods! I come to it as a hungry man to a crust of bread. (134-68) ...My desire for knowledge is intermittent; but my desire to commune with the spirit of the universe, to be intoxicated with the

> fumes, call it, of that divine nectar, to bear my head through atmospheres and over heights unknown to my feet, is perennial and constant. (134-41) ...I long for wildness, a nature which I cannot put my foot through, woods where the wood thrush forever sings, where the hours are early morning ones, and there is dew on the grass, and the day is forever unproved, where I might have a fertile unknown for a soil about me. (134-118)

But Thoreau observed that most men fail to perceive the wonders of nature:

> I suspect that the child plucks its first flower with an insight into its beauty and significance which the subsequent botanist never retains. (134-77) ...Men talk about Bible miracles because there is no miracle in their lives. Cease to gnaw that crust. There is ripe fruit over your head. (134-36)

Man's insensitivity has resulted in great depredations of nature which has further diminished man and reduced his potential for self-actualization:

> ...when I consider that the nobler animals have been exterminated here... I cannot but feel as if I lived in a tamed, and, as it were, emasculated country.... I am reminded that this my life in nature, this particular round of natural phenomena which I call a year, is lamentably incomplete. I listen to a concert in which so many parts are wanting.... I should not like to think that some demigod had come before me and picked out some of the best stars. I wish to know an entire heaven and an entire earth. All the great trees and beasts, fishes and fowl are gone. The streams, perchance, are somewhat shrunk. (134-157)

Thoreau believed that to the extent a culture, or an individual, lost contact with wildness it became weak and dull. (113-88) Thoreau regarded wild places as sources of intellectual and spiritual nourishment, as important to man as sources of physical nourishment, and believed wildness should continue to exist if only to suggest that earth has higher uses than we put her to. (113-103)

Most "defenders of wilderness" (Thoreau included) recognize the value of pastoral scenes and rustic settlements as well, and could not abide an endless wilderness - what is wanted is a balance in the countryside, so that one can move from city to hamlet to farm to wild woods and back again. Variety does add spice to life, and no one "good" is so good that it can supplant all others. Dubos prefers the rural landscapes of France, and points out that the landscapes which provide the most lasting pleasure for the largest number of persons are still those in which man has tamed the wilderness. (50-140) Krutilla stresses the need to protect these living landscapes which add so much to the quality of the total environment:

> Landscapes should be compared and evaluated as representing a resource in their own right.... Visual end-products need to be anticipated.... (90-290)

Sir Frank Fraser Darling comments on the importance of beautiful landscapes, and the fact that beauty is correlated with ecological equilibrium:

> Perpetuation of a derelict landscape as a background to children's lives is like rearing them to some extent in lovelessness.... Human tastes vary, but all in all the most general consensus of beautiful landscape would be found to be that which is in ecological repose or near to it. (40-112)

The seemingly endless exigencies of today, and the fear of some impending ecological catastrophe tomorrow, should not eclipse more complex issues and subtle dangers. These concern the availability of solitude, of peace and beauty, and of rewarding recreational activity. (2-14) While these things may now seem relatively inconsequential, and hardly relevant to the present needs and aspirations of developing countries, it must be remembered that these considerations will become increasingly important as development continues. In a world of frenzied activity and change, the parks and reserves of the world assume increasingly greater values as places of relative stability and peace. (149-15)

Such psychological benefits are real and significant to our concept of well-being, even though they are largely incalculable. Certain forms of recreation and relaxation require natural environments, and their value may easily be underestimated. Cultural and historical values associated with natural environments stem from man's inseperable ties to nature and his earlier relationships with nature. Future generations will require some physical reminders of truly natural environments to fully appreciate man's present and past traditions and value systems. To enhance such understanding, it seems desirable to establish reserves not only for natural areas, but for near-natural areas where a whole way of life can be protected - where man, in fact, is accepted as an integral part of the ecosystem receiving protection. (149-15)

Near-natural areas can to some degree be reconstituted or created on demand, but natural areas are absolutely unique and not replaceable. Fisher stresses the importance of authenticity as an attribute in the demand for undisturbed natural areas and compares the value of original art against reproductions to certain outdoor activities which have no recreational substitutes. (59-100) Those who appreciate natural environments with the greatest intensity are urban dwellers with higher levels of income and education. (59-101) The demand for pristine environments may be expected to increase dramatically as the supply is diminished and human populations grow in both numbers and sophistication.

PROVIDING FOR FUTURE GENERATIONS

A decision-maker's limited time horizon is of fundamental importance because present perceptions of utility may be unrelated to the needs of posterity. For example, species of current economic value might pale in significance if compared to species which will become valuable in the future, but the latter are presently unneeded or unknown and may therefore be unprotected. In a world of rapidly diminishing resources

and increasing demand, modern technology may not be trusted to provide for the future - there should be a substantial effort to conserve species and ecosystems of no current economic significance on the grounds that some may prove to be of inestimable value to future generations.

It is difficult to gauge one's responsibility to future generations: for example, do they have a right to enjoy wilderness, the products of nature, the myriad perceptions and experiences made possible by a biologically diverse world? How do their rights to such things stack up against our rights to have large families, and consume and destroy what we will? What is truly economic? Even in national parks, there is a dangerous tendency towards wrong or overexploitation of the present at the expense of the future. (26-44) In deciding how to manage an ecosystem, perhaps one should ensure that for those ecosystems having a range of potential uses, the final choice is determined by the long term needs of the community. (48-53) Evaluations change over time, and there is no way for the generations to get together and negotiate a binding contract. (59-106) Environmental quality is highly income-elastic, but more affluent future generations cannot pay present generations to forgo irreversible destruction. Our whole society is burdened in every corner by investments in which posterity had no say. (150-49) Seneca and Tausig say it is necessary to regulate economic behaviour in order to provide for posterity:

> It becomes difficult even to specify the meaning of social welfare in an uncertain, dynamic world (which) must include not just the present consumption of existing households but also the consumption of future households.... In such a world, government intervention... may be necessary to achieve a socially desirable time configuration of production and consumption... (133-46)

Krutilla points out that for cases in which irreversible losses are sustained, it will generally be optimal to refrain from investment warranted by current benefits and costs, i.e., to take short-term losses,

if in the not too distant future a lesser level of development would be desired. (91-55) Too much development can result in greater future losses, and therefore one must anticipate the effect of irreversible losses. Since technical change can be expected to extend the opportunities of extractive industries (mining, forestry, and agriculture) and cannot be expected to improve the amenity services of a natural environment, present conflicts should be resolved in favour of the latter: the relative value of the alternative uses is likely to change, tending to favour the retention of the area in its "unimproved" state. (91-13)

The International Union for the Conservation of Nature has advocated the establishment of "Resource Reserves" which would be held in trust to prevent overexploitation and preserve options. The principal idea is to prevent unplanned, single use and short-term economic exploitation in regions which are under considerable pressure for colonization and greater utilization, but for which there has been inadequate research and planning. (78-19) It is advisable to adopt a generally conservative policy with regard to developments which are irreversible since the optimal plan for a future generation cannot be implemented if it is in a direction which has been foreclosed by earlier activity. In addition, option values increase with uncertainty about costs and benefits since better and safer decisions can be made later. Some natural areas should be maintained so that future discoveries can lead to wiser development patterns. Jackson feels that the tsetse fly may be a blessing in disguise because it has kept large tracts of the African continent free from the adverse effects of deforestation and overgrazing so that modern resource management practices can now be applied in these areas. (81-199)

Edwards feels that the indigenous vegetation in most of southern Africa is needed for maintaining life and achieving environmental stability over the short- and long-term. (52-156) Environmental stability lends security to man's activities and also promotes species diversity because it permits the evolution of community complexity (and diversity begets more diversity). (158-53) Leopold points out that plants and

animals are connected by chains of dependency for a maze of services. (93-162) Activities which destabilize ecosystems retard community complexity, create special hazards, and reduce diversity. Goodman says that even if species diversity does not in itself contribute to ecosystem stability, the loss of genetic resources can be destabilizing for man: the disruption of the patterns of evolved interaction in natural communities will have untoward, and occasionally catastrophic consequences. (54-651) Maintaining species diversity and environmental stability serves to reduce hazard and keep management options open.

The cost of maintaining stability and options in managed ecosystems is lower economic yield because the highest biological productivity is attained in some successional stage, rather than the climax. However it may be desirable to stay near the climax to reduce the need for inputs and reduce risk, especially since energy is becoming more costly and risks are becoming potentially more serious. The energy available for productivity in a successional stage would be used for maintenance near the climax, thus reducing the need for economic inputs to maintain productivity over the long-term. (147-187)

The value of untapped genetic resources is difficult to estimate because man has long relied on a very few species and has not properly evaluated many potentially useful plants and animals.

> Of an estimated 80 000 edible plants in the world, only about 50 have been cultivated on a significant scale, and 90 percent of the world's food comes from only 12 species.... Nearly one-half of all prescription medicine contains a drug of natural origin as an active ingredient.... Yet only 5 percent of all plants have been studied for their medicinal value. (124-9)

In the animal kingdom, new uses are being found for species at an increasing rate. Polar bear hairs have recently provided researchers with a clue that may help them produce materials for better cold-weather clothing and solar energy collectors, and armadillos are proving

to have inestimable value in the search for a cure for leprosy. (80-3/9) Decision-makers should be alert to the possibility that a seemingly useless organism might one day be thought priceless. Ehrenfeld has noted several examples of erstwhile useless species which have special value, or have been used as pollution indicators or general environmental indicators. (54-650) The United Nations Conference on the Human Environment has called for governments to agree to an international programme to preserve the world's genetic resources. (146-13) Gene banks, zoos, and small nature parks cannot maintain genetic resources in a dynamic and evolutionary state, so it is necessary to set aside large, unmodified landscapes for this purpose. (79-12) It is important that such reserves be large enough to contain viable populations with adequate gene pools to continue the evolutionary process of adapting to environmental variation. (104-8; 135-25)

Reserves are also needed for other purposes. Aldo Leopold valued natural areas for their instructive value as a base-datum of normality, a picture of how healthy land maintains itself as an organism. (113-198) Protected reserves can serve as baseline and monitoring areas to help in predicting, preventing, and solving environmental problems. "Controlled Reserves" have been proposed for animal breeding and protecting green belts in desert areas; other reserves can serve as seed reservoirs and grazing reserves for times of drought. (147-49) Some biosphere reserves are used in the Global Environmental Monitoring Systems (GEMS) of the United Nations Environmental Programme (UNEP) to help provide an early warning system for significant environmental problems. (151-30) Man-modified reserves can provide examples of long-established and stable patterns of land use and examples of degraded landscapes which can be restored to generate new knowledge for rehabilitating and managing areas subject to deleterious land use practices. (151-22, 23)

Dasmann suggests that maintaining a variety of natural environments will prevent "ethnocide" - cultural diversity is one way of insuring that the human race will continue to survive, as well as a way of providing for a more interesting and colourful existence. (42-131)

Cultural diversity maintains freedom of choice, but cultural alternatives must be vigorously protected in the face of spreading conformity, or else as people die, their ways will be forgotten. (42-132) Developing countries should set aside natural and near-natural areas while land is relatively "cheap" to avoid the predicament in which Holland now finds itself: land is now so expensive that not enough can be bought for research to find out how to manage the rest of the country. (27-98)

Man seems capable of using modern technology to overcome most forms of environmental resistence to his biotic potential. This involves taking dangerous gambles. Some constraints should be imposed for safety's sake, and maintaining natural and near-natural areas seems a sensible insurance measure to protect future generations. Other species are subject to physical and behavioural limiting factors which normally prevent populations from exceeding absolute environmental limits. This is instructive, and serves as a warning. Failure to maintain adequate portions of the natural environment may lead to gradually decreasing productivity and reductions in carrying capacity. This is suggested by the historical evidence of the decrease in carrying capacity of such areas as Iraq and Lebanon and the indications that man's engineering is leading to similar deterioration of the environment in other areas. (136-38) Man must have the foresight to impose limiting factors of his own devising to avoid environmental deterioration on a regional and global scale.

SUMMARY AND CONCLUSIONS

The two policy options vary in their potential to satisfy different social goals. The industrial option has had spectacular success in improving health and material well-being in many parts of the world (although large sectors of society have not shared in these benefits) but has not proved effective in providing for man's higher needs, and

has failed to adequately consider the needs of future generations. The conservation option is capable of satisfying man's most essential material needs through appropriate technology, and would provide for man's higher needs and the needs of future generations by adopting self-imposed limits to maintain valuable common pool resources.

There is no point in over-indulging material needs since this interferes with the satisfaction of other needs. The most desirable policy would be one which provides the greatest prospect of satisfying <u>all</u> of man's true, biological needs in perpetuity. The industrial option caters to culturally-induced or neurotic needs and destroys sources of basic need gratifiers found in nature and traditional forms of social organization. The conservation option would attempt to restrict superfluous production in order to provide for man's higher and future needs.

Natural goods have great potential for satisfying man's highest need - the need for self-actualization - and are also needed to ensure the very survival of mankind. These goods should not be sacrificed to meet lower or culturally-induced needs, particularly since many natural goods are irreplaceable and have no substitutes. Future generations may be expected to place an even higher value on these goods and so it is optimal to limit developments which have irreversible effects on the natural environment. Maintaining natural and near-natural areas would provide for a host of uses which have profound significance for the future of mankind.

CHAPTER 14

A BALANCED APPROACH TO PROGRESS

"The practices we now call conservation are, to a large extent, local alleviations of biotic pain. They are necessary, but they must not be confused with cures." (94-274)

INTRODUCTION

A central postulate of welfare economics is that an expansion of choice represents a welfare gain; reduction of options, a welfare loss. (91-43) Tastes and preferences may be expected to change, and provision should be made to satisfy a wide range of choices. Ecosystem and genetic diversity contribute to social welfare by virtue of options maintained. Since the attitudes and specific requirements of future generations cannot be reasonably predicted, we have a clear responsibility to "keep options open" and to prevent, to the best of our ability, the depletion or destruction of natural areas and of the genetic

diversity of life. (149-5) The prevailing concept of "progress" is destructive of natural ecosystems and genetic resources, and leads to greater social and political tensions, as individuals and nations compete for scarce resources to fuel growth. Odum suggests ecology can serve as a model to reduce world tensions by demonstrating that action based on holistic values and properties is a viable alternative to development on the basis of competitive exclusion alone. (116-1291) There may be more appropriate forms of development than the urban-industrial system. Maintaining natural and near-natural areas buys time for the development of new technologies which are more efficient and less disruptive.

THE CONSUMPTION IDEAL

To an economist, consumption implies satisfaction derived from using goods and services and it is assumed that the well-being of an individual can be improved by increasing consumption. To an ecologist, consumption implies equilibrating activity and it is accepted that the well-being of a system cannot be improved if increasing consumption is non-homeostatic or destabilizing. The idea that welfare is improved with increased consumption might be disputed by ecologists - too much of even a good thing can be bad for an organism. Most economists feel that consumption is a good in itself, and the goal of society is to maximize consumption over some relevant time period, but Mishan points out that there is something inherently self-defeating in the idea of maximizing consumption: eventually we might become increasingly frantic trying to "cut corners" and save time in the endeavour to "enjoy" all our goods. (109-235) The concept of equilibrium would seem more germane to welfare than that of consumption. Schumacher suggests that economies should be geared to maximize human satisfactions by the optimal pattern of consumption rather than to maximize consumption by the optimal pattern of productive effort. (129-53) A simple way of living, based

on minimizing consumption, is rational in a world of diminishing resources. Boulding advocates the "spaceman economy", which is intended to achieve maintenance of a given total stock with a lessened throughput (that is, less production and consumption). (23-78) The production of goods in excess of real needs can lead to welfare losses. Kohr points out that once a community exceeds optimum size, social consumer goods (such as police, health, military, traffic, and safety services) consume a greater proportion of GNP so that little is left to increase personal welfare. Even personal consumer goods can be "substitute burdens". What is gained in one work field is lost by having increased the number of work fields. (85-38) Larger community size also results in cultural estrangement and the loss of convivial social patterns.

The urban-industrial model is based on a conception of man as an acquisitive and competitive creature with unlimited wants and desires. The engine driving an urban-industrial society is competition of the crassest and most negative kind. (55-194) Competition is necessary because resources are scarce relative to desires. The industrial ethic suggests the solution to scarcity is to increase output:

> We have not yet reached a situation in which scarcity has been banished from the face of the earth so that there would no longer be any point in trying to increase output. (18-246)

But it is unlikely that scarcity will ever be banished from the earth and increasing output also increases scarcity. An alternative is to reduce wants, or change the nature of wants so that they can be satisfied in ways which are not socially or environmentally destructive and which do not result in increased scarcity. This is a "costless" way of dealing with scarcity because no resources are destroyed. Institutions can be designed to inculcate values to bring about welfare improvements without depleting the natural resource base. John Stuart Mill felt mankind should settle for one level of output that could be maintained, then go about the process of adjusting humanity to it. (12-162) He also suggested that the best state for human nature is that in which, while

no one is poor, no one desires to be richer. (2-90) Some subsistence societies demonstrate qualities which minimize competitiveness and facilitate group survival. These societies are characterized by strong community bonds, a reasonably even distribution of material goods, and a high regard for social ethics. Although such societies did not consciously adopt these social forms, and the prospect of social engineering presents daunting challenges, these time-honoured societies might serve as more appropriate models of development - they demonstrate that social institutions can keep consumption patterns of natural goods at low levels and so reduce impacts on the natural environment. Greater moderation and a more equitable distribution of goods would significantly reduce the pressure on the natural environment and improve the outlook for mankind.

THE PROBLEM OF CONGESTION

Natural and near-natural areas also represent potential recreational space for human populations. As crowding increases, there arises increased competition for scarce space to be alone. This in turn leads to an increased desire for apartness. (55-194) The loss of privacy and opportunities for experiencing solitude constitute welfare losses.

> It is not good for man to be kept perforce at all times in the presence of his species. A world from which solitude is extirpated, is a very poor ideal. (2-91)

Consideration must be given to the effects of congestion on psychological well-being, as well as on the functioning of fragile ecosystems. Crowding degrades recreational resources in both a psychological and a physical sense, and the ultimate effect is to substitute one group of users for another (callous individuals will replace those who are more sensitive to their surroundings) so that the "outdoor experience"

becomes a mockery of itself. Utilization may be high, but quality will be low; the old precept that it is desirable to provide the greatest good for the greatest number thus becomes a perversion.

The problem of congestion is somewhat deceptive in that there may be a lengthy period of no discernible cost with increased use, then negligible costs, and then catastrophic costs may appear rather suddenly as congestion effects set in. Krutilla says congestion effects are optimized at the point at which the disutility on others by the addition of a party will just cancel the utility gained by the additional party. (91-13) Congestion effects must be anticipated by assessments of carrying capacity, and the adoption of a management policy based on limited access.

THE NEED TO RESTRICT FREEDOMS

There is a great danger that the growth ethic of the urban-industrial system will ultimately result in more poverty rather than more prosperity. Economic growth will require dramatically increased resource consumption in developing countries to attain a very high level of development, and resources might be exhausted before that level is reached. Biologist and Nobel laureate Peter Medawar feels:

> The goal of a happy, high-consumption world cannot be fulfilled even for the 3.5 billion people now alive, much less than for the six billion expected by the year 2000. At the (U.S.) standard of living, the Earth could support only 500 million. (139-19)

Hegel defined freedom as "the recognition of necessity". (55-192) It is not rational to refuse to accept limitations on population growth and economic development. Some freedoms must be sacrificed to keep other freedoms. Hardin points out that man has accepted many

restrictions on the commons in the interests of group survival, but more restrictions are now needed. (65-63) Many natural goods and much greater security may be had for the small opportunity cost of fore-going large families and superfluous material goods.

THE NEED FOR GOALS, PLANNING, AND CONSERVATION

Man cannot expect to have all his desires satisfied. It is necessary to surrender some aspirations to ecological reality, and select only those goals which are essential and achievable. The absence of defined and understood goals has been one of the principal causes of human confusion and environmental degradation. (42-14) Marden suggests five steps for formulating goals and objectives and designing a policy for development: (1) Defining where we are now. (2) Deciding where we want to go. (3) Deciding how to get where we want to go. (4) Defining how much needs to be done in given time periods. (5) Allocating our scarce fiscal and human resources. (100-216)

Social patterns must be ordered according to ecological principles, and conservation must be regarded as being necessary to the attainment of certain social goals and as being supportive of development, rather than in conflict with development.

> The United Nations' definition of conservation is - "the rational use of the earth's resources to achieve the highest quality of living for mankind". This would be an equally good definition of the ideal goal of economic development. (43-17)

If the quality of life is to be sustainable, then conservation is an essential part of development. Leopold would judge any policy of development by two criteria: (1) Does it maintain fertility? (2) Does it maintain a diverse fauna and flora? (93-163) These criteria would

appear both necessary and sufficient to avoid ecological disasters. The advance of civilization should not be seen in terms of conquest, or as man constructing an Alhambra atop some pinnacle of his own devising:

> Civilization is not the enslavement of a stable and constant earth. It is a state of mutual and interdependent cooperation between human animals, other animals, plants, and soils.... The real end is a universal symbiosis with land, economic and esthetic, public and private. (95-45, 50)

Man requires a balanced environment to maximize welfare. Natural and near-natural areas serve uses for which the developed environment offers no substitutes. Odum says the true value of a man's total environment is determined by the diversity interaction between the "developed" and the "natural" environment and not only by the worth of each as a separate component. (117-180) Decision-makers tend not to evaluate the total environment, but only the developed part - yet if some of the natural environment is disrupted and unable to function, a ripple-effect occurs and eventually the developed environment begins to deteriorate. This may not be perceived in time to prevent a collapse of the developed environment. Odum cautions that beyond some point, conversion of natural to developed environment will result in costs which rise percipitously in non-linear, multiplying fashion. Accordingly, there has to be some optimal proportion between the natural and developed environments. (117-180)

Planners should favour decentralized communities because they remove much of the tendency toward destructive exploitation of resources and yet permit a reasonably high standard of living to be maintained. (42-156) There is also value in keeping a closer association between individuals and the natural environment because natural goods can confer benefits directly (without the intervention of a production function) and because people should remain sensible of their dependence on nature. Kohr says that smaller communities are capable of maintaining an internal balance and are self-regulating. Larger communities require

greater control and direction because they are not so responsive to social homeostatic mechanisms. (85-51)

THE NEED FOR TIME TO ADJUST

Rapid development can disrupt communities as well as ecosystems. Time is required to adjust to new conditions. Social stability is the analogue of ecosystem stability; if change is too rapid, the system can collapse. There is psychological value in maintaining time-honoured customs and traditions, but it is difficult to do this when technology steps up the pace of change - there is not enough time to adapt. Individuals and families simply cannot sustain rapid and profound change. (55-199) Changes should occur slowly, over several generations, thus enabling adaptive processes of a biological and social nature to create a new, acceptable relationship between man and environment. (50-194) This may be particularly true of more primitive societies and poorer environments. Traditional societies are often subjected to completely novel stresses for which their institutions and philosophies were not designed. This leads to confusion, dissension, and dissatisfaction instead of improvements in welfare. A classic example of the potentially disastrous effect of rapid and profound change is the breakdown of the Eskimo society, in which the alcoholism rate has reportedly reached 80%.

> Eskimos were once known as the "laughing people" and it was true. We were the happiest people in the world. In the earlier days, they didn't have such problems as alcoholism and drugs, having to worry about a monthly rent, pollution, politics, new diseases... we would like things to slow down a little bit. Give the Eskimo a chance to prepare himself for things to come. (118-312)

A slower rate of development would be socially as well as ecologically more desirable.

Developing countries often have highly localized loyalties. The drive to industrialize and urbanize these countries may lead to fractious political entities and general discontent, whereas these same loyalties can serve to promote a balanced, broad-based growth with a special feeling for the land which supports the community. Traditional societies cannot be transformed too suddenly without ill effects - development should be regarded as an evolutionary process rather than an act of creation. The introduction of sophisticated technology can destroy the cohesion of a society and cause mass unemployment, migrations into cities, and the breakdown of families and communities. Both urban and rural areas can experience great social and environmental disruptions when economies suddenly become too specialized, and peoples can become subject to a new form of colonialism. The hurried development that is being attempted in unindustrialized countries must lead to economic colonialism because the education necessary to make the growth self-supporting cannot take place as quickly as the increase in wealth. (132-46) Perhaps full employment and economic independence are more satisfactory economic criteria than total output and total income.

THE NEED TO WEIGH RISK

> The disappearance of plants and animal species without visible cause, despite efforts to protect them, and the irruption of others as pests despite efforts to control them, must, in the absence of simpler explanations, be regarded as symptoms of sickness in the land organism. Both are occurring too frequently to be dismissed as normal evolutionary events. (94-273)

Man's environmental impacts are increasing in both number and magnitude; this suggests that the conservative outlook is increasing in rationality and requiredness. A conservative approach to development is dictated by the ecologist's view of the environment as a sensitively balanced system. New developments may have dangerous consequences. There is not enough information to accurately assess the effects of spillovers or determine whether they can be effectively controlled. This logically imposes a requirement to exercise the greatest caution in development planning. Any well-meaning action or promising new process could reduce rather than increase welfare, and a series of such actions and new processes could have cumulative effects which might prove catastrophic. Unfortunately, most decision-makers are prepared to accept such risks and proceed with new developments unless they are almost certain to be disastrous.

The argument that environmental concerns can be deferred until a developing country can "afford" to deal with them is specious. It is likely that the rate and scale of environmental degradation will be so great that by the time material prosperity is attained, the cost of environmental restoration will be prohibitive. An intransigent attitude of "development at any cost" may also cause low-cost opportunities of protecting the environment to be missed. Kneese points out that prevention of environmental problems is often much cheaper than cure. (84-103) While reasonable risks are justifiable in meeting physiological and safety needs, risk-reduction must always remain a supreme consideration in the development process, and should be of paramount concern in developments intended to satisfy culturally-induced needs.

Fisher and Krutilla have shown that it pays to be inefficient if a relatively modest investment may forestall much more serious and even catastrophic consequences. (59-103) Baumol and Oates, discussing the need for pollution abatement, point out that a fundamental principle of rational conduct, all too likely to be overlooked in the formulation of policy, asserts that the severity of the policy that should be under-

taken in defence against some peril depends on both the likelihood of the threat <u>and the character of the damage that it threatens</u>. (16-66) This is equally applicable to decisions concerning other environmental hazards. When environmental risk is extremely high, the marginal reasoning underlying cost-benefit analysis cannot legitimately be applied; and in the case of catastrophic disruption of ecological systems, marginal trade-offs between environmental quality and consumption of other goods and services are not meaningful. (133-227) The costs of large-scale ecosystem destruction are potentially very high, while many of the benefits are short-term and crass. Too little is known about ecology to confidentally assess degrees of risk associated with major developments. Schumacher says small developments are preferable because of safety. Activities should be scaled to the recuperative forces of nature. (129-31)

Environmental problems are growing increasingly complex, intertwined, and long-term. However, decision-makers still rely on a generally *ad hoc* approach to problem solving, seeking to maximize returns over short time horizons. In the past, long-term planning and careful timing and balance were not so critical, but now one must be concerned about the cumulative effects of innumerable actions. There is no procedure for forecasting such effects, and so greater caution should be exercised. Commoner's warning that everything is connected to everything else (and we should therefore expect the unexpected) suggests a general approach to action: to refrain from risky enterprises, to cultivate an ecological awareness, to adopt a new set of values, to establish new research and development goals, and to develop new means of measuring welfare. (121-24) No amount of wealth can confer security if the world itself is not secure, as Kierkegaard so eloquently testifies:

> To be rich I must possess something until the morrow... must be secured <u>for</u> the morrow; but to be rich I must also be assured <u>of</u> the morrow. Take away riches, and then no longer can I be called rich; but take away the morrow, and then too, alas, I no longer can be called rich. (83-103)

The potential for disaster is unprecedented. Too many peoples are relying on too few techniques to meet their needs. If any one of these techniques goes wrong, there would be global ramifications. For example, growing demands for food are being met by a handful of high-yielding varieties of plants, and agricultural pests are being controlled all over the world by a few chemical agents which may have unforeseeable side-effects. Production and distribution activities nearly everywhere depend on the continued availability of uncertain supplies of fossil fuels and certain minerals. And traditional skills and knowledge are disappearing as the urban-agro-industrial pattern is adopted by more societies. But there is safety in diversity and isolation. Evolution proceeds by encouraging new processes in an uncertain and dangerous world. Mankind ignores this at its peril. The major reason for maintaining natural and near-natural areas is safety - man's increasingly sophisticated and large-scale environmental modifications are already disrupting regional ecosystems and having globally significant spillover effects. Natural environments, which have passed the test of evolutionary survival, have a stabilizing effect, and offer refuges which could be important centres for renewal.

Decision-makers face a rapidly changing environment with limited information - new opportunities abound, but outcomes are not certain. There are no commensurable units of valuation by which welfare improvements may be measured, and no way to gauge the degree of risk associated with alternative actions. The increasing value of uncertainty calls for a change in strategy - fear of loss should now be given more weight than hope of gain. The relevant decision rule is to move toward gain up to the point at which you can no longer bear the contemplation of the loss you will sustain if you are wrong. (22-64) For some, this point has already been passed; for others it is being neared all the time, and at an ever-increasing rate.

ACCEPTING IMPOSED LIMITS TO GROWTH

Economic growth is the result of (1) population growth, (2) technological growth, and (3) growth in desire for more resource-based goods. (141-4) Even if population growth is curtailed, the other sources of growth constitute a great threat to the environment. In the United States, between 1946 and 1966, population increased 43% but use of fertilizers increased by 700%, of electricity by 400%, and of pesticides by 500%. (136-11) If developing countries with high population densities follow this pattern of growth, the probability of ecological calamity is high. It would seem prudent to adopt self-imposed limits to all three components of economic growth and rely on more appropriate forms of development.

Environmental problems result when tolerance limits are exceeded by man's growing demands on the natural environment. Modern economies are committed to infinite growth on a finite planet. Regional and global limits will most certainly be reached sooner or later. If limits are near, then continued growth may be regarded as suicidal and must be halted. If limits are not yet near, it is still desirable to slow growth because serious environmental problems, which are costly and have no ready solutions, are already being created and these can be expected to soon wipe out the welfare gains of rapid development. The question is not <u>whether</u> any fixed growth rate will ultimately be terminated, but <u>how</u> the change will be achieved. (16-129) If it is terminated abruptly (due to political or technological failure, or the exhaustion of some critical resource), the effect will be catastrophic. There is considerable doubt whether continued economic growth can be expected to improve welfare for much longer. Economic activities are already having many complex and far-reaching impacts on the biosphere (and on social, economic, and political institutions) which could eventually prove destructive.

Décision-makers in developing countries should take cognizance of the

manifold costs of urbanization and industrialization which reduce the quality of life when the standard of living is increased. For example, a country which trades natural amenities and a simple life style for the materialism made possible by polluting industries will bear the increasingly heavy costs of specializing in pollution, and these costs may ultimately outweigh the benefits of material prosperity. Pollution costs affect health and safety, property, agriculture, and countless environmental amenities. There are also significant costs associated with becoming reliant on increasingly scarce and expensive raw materials, particularly special sources of energy. The urban-industrial system was founded on cheap energy, and the increasing costs of energy should now dictate a new type of development. There may soon be no alternative but to develop alternative technologies based on low energy consumption and energy of current issue. Oil is scarce, coal is dirty and not evenly distributed, and nuclear energy is very risky. (129-117) Shortages and prohibitive prices could interrupt the supply of essential fuels and materials after peoples have become accustomed to higher standards of living, and this could precipitate an economic or political collapse. Industrialization reduces options and diminishes the degree of control which decision-makers have over social and economic developments. If investment in modern technology (and supporting resources and land-use patterns) becomes too great, it may prove unfeasible to risk change later. The development of traditional and intermediate technologies based on simple skills and resources which are secure would keep options open and reduce long-term risks.

It is often argued that economic growth is necessary to provide employment and goods and services for an expanding population, but it seems possible that the use of appropriate technology could provide full employment and meet the basic needs of the population with a steady-state economy. Seneca and Tausig appear to agree:

> Society must alter its basic philosophical position toward the meaning of economic growth. The overriding social goal would be maintenance of environmental

> resources and would entail acceptance of a lower rate of growth - even a zero rate - of current output toward this end. (133-352)

The "maintenance of environmental resources" entails the maintenance of natural and near-natural areas. The exploitation of natural and near-natural environments often leads to short-term or minor benefits, and long-term and more serious costs: marginal lands may not be suitable for agriculture and soil fertility or structure may soon be lost; mining may benefit richer countries more than the local population; and clearing forests may result in fuel shortages, flooding, and erosion. (62-124) Some natural and near-natural areas should be maintained for their special values while other, more suitable sites are developed. The conservation of nature can be interwoven into development as conceived by the principles of ecodevelopment. (78-5) Conservation can improve the return from developments, as when river developments make provision for conserving the natural vegetation of upstream catchment areas.

There is no denying that there are few truly "natural" areas left in the world. The few that are left may therefore be regarded as having valued properties which altered environments do not have, and these may be vitally important to maintain for posterity. Maintaining natural areas is a way to provide for minority preferences, in accordance with Mishan's concept of separate facilities. (38-319) Maintaining near-natural areas is a means of retaining humanized landscapes and encouraging appropriate development based on ecological principles in accordance with Dubos's vision of sustainable land-use practices. (51-461) Maintaining significant portions of the natural environment reduces costs to the developed environment because ecological processes contribute many supportive functions. Development efforts may also be made more efficient if restricted to areas more suitable for development rather than being dissipated over vast, relatively unproductive regions.

Sound planning and effective management must be based on surveys under-

taken to identify areas of possible scientific, educational, recreational, and aesthetic value so that these may be given special protection status. Parks and reserves should be established as soon as possible, before population pressure grows worse and more claims to the land are made, and provision should be made for ensuring that local inhabitants benefit from the establishment of parks and reserves.

In order to protect natural and near-natural areas, it will be necessary to remove the economic incentives to exploit them. Appeals to reason and morality are not so effective as economic arguments. Ultimately, it must be persuasively demonstrated that indiscriminate exploitation of the natural environment is not rational, and failure to maintain natural and near-natural areas is uneconomic. An enlightened central government could legislate a system of economic incentives and disincentives which would have the effect of restricting exploitation to certain areas. A system of development permits could be used to control exploitation; these could be auctioned to the highest bidder and revenues could be used to compensate those who would suffer costs but not benefit from development activity. (Such a system would be flexible, relatively invulnerable to inflation, reasonably resistant to population pressures, and would minimize uncertainty about levels of destruction.) Ecologically sound activities could be subsidized and undesirable activities could be curtailed by imposing extraction or discharge fees. Economic manipulation could divert desires and aspirations away from goods which are ecologically costly and toward goods which are inexpensive, safe, and renewable - high prices and high taxes for the former, and generous subsidies for the latter. The gap between developed and developing countries could also be narrowed by pricing policies and transfer payments. Whatever specific methods are used, the guiding principle should be to encourage a form of development which is appropriate to man's needs and ecological condition.

The Founex Report recognized that it is inadvisable to assume that what has worked in developed countries will also work in developing countries - there are simply too many profound differences in their respective situations. (4-42) Many rich countries, for example, got that way by exploitation of labour and abundant raw materials taken from poorer countries. This option is now closed. Dasmann urges that:

> Where preindustrial land-use systems exist, with a long history of successful adaptations to their environments and continuing productivity, they should, if possible, be left alone. This applies to hunter-gatherers, nomadic pastoralists, and traditional agriculturalists.... (42-125)

It is not wise to tamper with a balanced system. Developing countries generally lack financial and other resources, and the ecological knowledge, to increase productivity with modern, sophisticated technologies.

> Where investment is meagre it is better to work with the ecosystem than to fight it. Where investment is available, higher yields can be achieved by making modifications to the ecosystem, but new strategies must then be evolved to counter degradation. (147-234)

Farvar and Milton point out that modern technology often has more serious environmental impacts in developing than in developed countries and suggest the idea that traditional societies can and should be overhauled overnight has not only proved virtually unachievable, but perhaps undesirable. (57-xv) There has been more disaster than development, more ecological costs than economic benefits. Ward and Dubos have recounted how tropical forests in West Africa were cleared for large-scale cultivation of cassavas and peanuts and then, without the protection of the natural vegetation, torrential rains carried away tons of valuable topsoil and the equatorial sun baked the remaining soil into bricklike laterite. In India and Pakistan, extensive irrigation developments led to waterlogging and salinization of soils. Dam-building in the Damodar Valley drove subsistence farmers to practice shifting agri-

culture on steep slopes, degrading the watershed and silting up the reservoirs. (154-159ff) For these projects, long-term costs have greatly exceeded the short-term benefits.

Developing countries are in a good position to plan more appropriate forms of development:

> Many environmental projects... can be implemented by relatively labor-intensive methods which would harmonize environmental concerns with the employment goals that are so important in development planning.... It is a paradox of history that most developing countries can more easily mobilize resources for long-term development than get immediate relief from poverty. (128-77)

Modern technology requires high capitalization, which restricts the satisfaction of venture and work for oneself to a handful of wealthy capitalists. Intermediate technology spreads satisfaction around by providing opportunities at a human scale. In agriculture, intermediate technology is more suitable for smaller farms, and a policy of encouraging smaller farms serves equity goals. Also, small farms need not be inefficient.

> In many countries smaller farms consistently outproduce large farms on a per acre basis, although they do produce less output per man-hour. In other words, they maximize returns to increasingly scarce factors of production, namely land and energy; rather than to an increasingly abundant one - labour. These production methods are capable therefore of producing both increased total output and increased rural employment. (13-45)

The situation in developed countries has differed greatly from that in developing countries. In the United States, for example, land and capital have been abundant while labour has been scarce. American farmers have simply substituted an energy-intensive and materials-demanding technology for labour and careful husbandry. (61-219) In most developing nations, capital and good land are scarce while labour

is abundant. Modern agricultural methods are therefore inappropriate in such countries, particularly since fuel and fertilizers are getting more expensive. Also, the environmental costs of capital-intensive agriculture are becoming more serious. These costs include pesticide residues and increasing pesticide resistence, chemical fertilizer run-off, animal waste pollution, erosion, and sedimentation.

Developing countries should not rely on mechanized agriculture and the Green Revolution, but should adopt intermediate technologies which are both more efficient and more reliable in the long-run. Appropriate development involves technologies which are suited to existing circumstances and available resources. Much more research should be done to develop and promote intermediate technologies, small-scale energy generation systems, and renewable energy sources. The adoption of sophisticated machinery and processes may initially increase production and lower costs but it then becomes necessary to continue increasing production to recoup investments and maintain machinery and activities. The many interactions (e.g., between farmers, tractor manufacturers, pesticide producers, and choosey consumers) promote a self-feeding cycle which is unecological: it is a successional process consisting of positive feedback loops which can only lead to greater growth and greater social and ecological costs. Given limitations on energy and other resources, and high population levels and rates of growth, the developing countries have no hope of achieving the consumption levels of developed nations. The pathways for economic development in these countries must be those that make use of other sources of energy and should not be based on a fossil-fuel technology. (42-55)

The enormous inputs of fossil-fuel energy in modern agriculture have produced a misleading impression: that productivity can be improved all over the world. But this vaunted efficiency is, in a very important sense, a deception - as fossil-fuels become more costly, what must be stressed is <u>input efficiency</u>: the ratio of energy in to energy out. Population and economic growth in developed countries have been "purchased" by accepting unfavourable ratios of energy input to output. Dasmann

reports that in China, 50 calories are gained in food for every one calorie employed in producing it, whereas in the U.S. it takes over 7 calories of energy input to produce 1 calorie of energy output. (42-64) The previously low monetary costs of energy inputs from fossil fuels is a pre-eminent reason why modern technology was so successful in raising production and generally increasing the standard of living in developed countries - great gains were made with great inefficiencies. But the cost is rapidly increasing and some fossil fuels may soon be exhausted. Adopting modern technology may be disastrous if energy or environmental costs suddenly become prohibitive.

Fossil-fuel based technologies should be rejected as too risky and unnecessary. It is not necessary to use dangerous tools just because they are available. For 99,9% of human history, man lived without being dependent on fossil fuels. Odum says fossil fuels constitute the tool with which man accomplished an ingenious uncoupling of man and nature. (115-251) Man previously relied on the solar-powered natural ecosystem but with fossil fuels he was able to escape previous constraints. Fossil fuels power the urban-industrial system and subsidize the agroecosystem, but fuel-powered and fuel-subsidized systems are now unsatisfactory because they depend on resources which may soon be unavailable. Odum suggests new technologies based upon new goals. To recouple man and nature into a more harmonious whole requires that science and technology be integrated with reordered social, economic and political goals - a most difficult task. (115-253) Perhaps the major difficulty will be to stem the tide of rising expectations. The urban-industrial system promises unlimited goods and services, and this has spawned the "technological imperative" (to produce more at a lower private cost), which has become a pervasive and unrestrained force in the world today. The challenge is to create new goals and opportunities which are in accord with ecological imperatives.

For those who think technology can always cope with the forces of nature, the experience of pesticides should be a warning. Agricultural science is largely a race between the emergence of new pests and the emergence

of new techniques for their control. (94-254) The development of integrated pest management, which is largely based on maintaining diversity and high levels of interactions to achieve stability, points to an appropriate strategy for dealing with man's problems: working <u>with</u> nature. The success of agribusiness (and the Green Revolution) is based on costly insecticides, herbicides, fertilizers, fuel and equipment. The efficacy of these tools is diminishing while their cost is increasing (in both economic and ecological terms), but the effect is to make continued production even more dependent on high technology and big operators. Agribusiness is thus driving the small farmer out of production and into the city, which increases social problems. Since these methods are less efficient in the long run, and ultimately destructive, they should be discouraged. Small farmers should be subsidized and provided with more appropriate tools and techniques. Dasmann suggests that one need examine the practicability of a solar-powered, wind-powered, labour-intensive, livestock-fertilized, and live-horse powered farm as representing a more viable model. (42-66) Maintaining the viability of diversified livelihood systems should take precedence over the optimization of any single product system, and land reclamation and rural infrastructure projects which emphasize the use of local materials and local labour should be given priority. (147-310, 311)

It is important to make rural areas appealing and provide employment opportunities for rural populations. Corea says the drift from rural to urban areas conflicts with development and employment objectives in developing countries:

> But if these objectives are to be fulfilled, particularly in respect of the educated youth, the rural habitat itself needs to be transformed. This is more than a matter of raising productivity in agriculture. It is also a question of improving the facilities and amenities in the rural areas. (34-81)

Greater direction and control of rural development and settlement patterns can reduce cityward migrations and distribute population more evenly. In drylands particularly, settlements should be surrounded by protected areas within which grazing, farming and fuel gathering are restricted to prevent degradation and desertification, and urban development should not be carried out to the detriment of adjacent livelihood systems. (147-60) If rural areas can be made more attractive, and basic needs can be satisfied through the use of intermediate technologies, then a more harmonious and sustainable pattern of development will be achieved.

THE NEED FOR AN ECOLOGICAL OUTLOOK

Decision-makers in developing countries naturally wish to emulate the urban-industrial system of the developed countries in order to partially rectify the gross disparity in standards of living around the world. But concern for distributional justice must be tempered by ecological reality. If attempts to "close the gap" are likely to result in ecological catastrophe, then such attempts should be abandoned in favour of a more moderate course. It is rational to recognize limitations and proclaim modest but realistic goals; it is irrational to disregard limitations and attempt to achieve overly ambitious and dangerous goals.

There is agreement between what is rational and what is ecological, truly economic, and ethical. The great ethical systems of mankind all sought to express an underlying moral reality, that we live by moderation, by compassion, by justice, that we die by aggression, by pride, by rapacity and greed. (153-192) Being conservative (and being a conservator) is being ethical and rational, and this behaviour has economic as well as ecological value.

Aldo Leopold saw ethics as a process in ecological evolution:

> An ethic, biologically, is a limitation on freedom of action in the struggle for existence. An ethic, philosophically, is a differentiation of social from antisocial conduct.... An ethic may be regarded as a mode of guidance for meeting ecological situations so new or intricate, or involving such deferred reactions, that the path of social expediency is not discernible to the average individual. (95-44, 45)

Decision-makers should be guided by an ecological ethic rather than a simple desire for human justice, equity, and general prosperity. What is ecologically right or wrong depends on the situation confronting the decision-maker. In situation ethics, the morality of an act is determined by the state of the system at the time the act is performed. (68-114) It was not wrong for 19th century Argentine ranchers to slaughter cattle for their hides and leave the carcasses to rot because the meat was not needed (or could not be transported to where it might be used) and there was no damage to the system; today it is perhaps wrong to even produce beef when it is possible to produce and distribute more food, which is desperately needed, at lower ecological cost. It is perhaps even more wrong to allow production activities to destroy the land's ability to provide; the greatest sin is not against life itself but against the land, which supports and nourishes life.

The major challenge facing decision-makers in this period of impending global disaster is to effect a transformation in human values to what is ecologically expedient. Hardin believes a new system of values must be developed to replace the myths and taboos which so effectively protected nature in many pre-industrial societies: being treated as sacred can protect an object against destruction by impoverished people who might otherwise discount the future in a simplistically rational way. (70-77) A new land ethic and intergenerational ethic is required to protect resources from overexploitation. Passmore suggests that the moral onus should be on anyone who seeks to destroy or modify any part of the natural environment to demonstrate that such an action is justifiable and poses no great short- or long-term risk. (120-121) Leopold's

classic statement of moral criteria by which to judge any action should perhaps be the ultimate guiding principle for decision-makers:

> A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise. (94-262)

SUMMARY AND CONCLUSIONS

The problem of scarcity can best be solved by reducing wants (and thereby minimizing consumption) or changing the nature of wants (so that consumption activities will be less destructive) in order to maintain equilibrium in a complex and finite world. Congestion effects and other impacts must be anticipated, and restrictions on man's activities should be accepted, if the risk of catastrophe is to be minimized. There is some optimal ratio between natural and developed environments and maintaining that ratio should be given the highest priority.

Development planning should be based on reasonable goals, related to man's true needs, and development should proceed at a pace which is not disruptive to social institutions or vital ecological processes. Political and environmental hazards are now so serious that ambitious development programmes should be abandoned in favour of a conservative, balanced approach to development. Decision-makers are advised to develop institutional mechanisms which will impose limits on economic growth so that political, social, and ecological limits will not be reached. Adopting a policy of appropriate development, using alternative technologies which are suited to the special demands of the environment and the society concerned, would allow real needs to be satisfied at low cost and low risk.

The ecological outlook is gaining in relevance and rationality as

environmental impacts grow more serious at the regional and global level. Decision-makers need to adopt an ecological ethic if man is to survive and have a life worth living.

CHAPTER 15

CONCLUSION

"The combined evidence of history and ecology seems to support one general deduction: the less violent the man-made changes, the greater the probability of successful readjustment in the pyramid." (94-257)

The natural environment provides life-support functions and amenities which are important to man's survival and well-being, but their value cannot be precisely measured and is usually underestimated. These natural goods are threatened by the urban-industrial system, which is rapidly converting natural environment into developed environment and increasing the level of impacts on remaining natural and near-natural areas. Because the value of goods and services produced by the urban-industrial system is more readily perceived and appreciated, and the adverse effects of losing natural goods are more subtle and often go unnoticed over long time periods, there is a significant possibility that decision-makers will allow an unfavourable ratio of natural environment to developed environment to occur - a situation which may be irreversible and which poses two distinct dangers: (1) the quality of

life may be substantially reduced, and (2) the costs and risks to survival may be substantially increased.

For developing countries, a central question is whether the urban-industrial system is a desirable model for economic and social progress over longer time horizons. Some maintain that technological and economic growth bring greater choice, more leisure time, and less drudgery; others suggest urban-industrial man has less control over his fate, is less capable of using leisure time to advantage, and is more driven than ever before - as man becomes increasingly disassociated from the natural world, he becomes more dependent on others to meet his needs and more bound up in a contrived world which may be inherently less satisfying. There is also considerable doubt whether the urban-industrial system is an attainable model of development for countries which are poor in resources, overpopulated, and lacking infrastructure and skills. There may be alternative systems of development which promise greater long-term efficiency, more equitable distribution, a higher quality of life, and enhanced prospects that social progress will be sustainable.

Recent experiences of world-wide inflation, the growing gap between the rich and the poor, forecast shortages of raw materials necessary to maintain the urban-industrial system, and increasing imbalances in the environment, should be regarded as persuasive evidence that the urban-industrial system is at high risk. Developing countries need to devise new patterns of development which are less wasteful and which can be accommodated by the limited resources of the biosphere. Instead of relying on modern technology to solve resource shortages and environmental problems, perhaps inadequacies and imbalances in man's approach should be righted. This is a particularly daunting challenge because it means reversing direction, and the urban-industrial model has already instilled certain attitudes and created certain expectations which will be difficult to change. A high priority in developed countries should be to reduce consumption and seek alternative life styles; a high priority in developing nations should be to convert people's expectations and set more realistic objectives. Natural and near-natural areas can

be maintained as a bulwark against inappropriate forms of development and serve as vehicles of such reversals.

Development should be based on goals which serve the true needs of man and are achievable with existing resources used in such a way as to minimize risk. Because of the great differences in conditions around the world, specific objectives and methods may differ from place to place. Traditional systems of land use should be retained wherever possible and development should be directed towards carefully adapting intermediate technologies to the conditions of local ecosystems. The central objective, then, should be to determine what constitutes <u>appropriate development</u> for a given region, i.e., that form of development which promotes a rational form of growth: one that is sustainable, promotes equity, and is designed to meet true needs, rather than one which is hazardous, creates inequitable distribution, and is designed to induce new wants. Development must be given a qualitative determination; it must meet the real needs of society, and it must not endanger survival. A commitment to maintaining a significant number of natural and near-natural areas for their special psychological and ecological values is essential to any model of development which seeks to maximize social welfare and provide for future generations.

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