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ON

THE ENVIRONMENT: A GLOBAL CRISIS - THE NEED FOR CHANGE

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EDITORS

Asli Bali
Tanya Byker
Kerim Friedman
Jenny Lewis
Manu Rana
Bridget Trazoff
Soledad Varela

SUB-EDITORS

Zia Ahmed
Azim Azfar
Carole Chapelier
Erskine Childers
Drew Deutsch
Maggie Galton
Michelle Gieri
Amal Jasentuliyana
Asu Kirdar
Judy Labiner
Marlene O'Brien
Megan Sweeney
Amanda Topaz

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Drew Deutsch
Amal Jasentuliyana
Marlene O'Brien
Manu Rana

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Isabelle Fymat

PRODUCTION STAFF

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Carole Chapelier
Michelle Gieri
Asu Kirdar
Judy Labiner
Simon Lee
Jenny Lewis
Sarah Lippmann
Solade Rowe
Julie Schneider
Megan Sweeney
Amanda Topaz
Bridget Trazoff
Soledad Varela

WRITERS AND CONTRIBUTORS

Aela Boyum
Benjamin Centenera
Michael Chalfen
Kim Freidberg
Isabelle Fymat
Sharin Huda
Maryam Jafri
Omar Jama
Pei Boon Koh
Simon Lee
Sarah Lippmann
Mette Munthe-Kaas
Gaurav Narula
Smita Narula
Nura Osman
Solade Rowe
Julie Schneider
Christian Sullivan
Seija Tupasela
John Weatherhead
Lan Wong

CARTOONS

Kees Gajetann
John Nguyen

FACULTY ADVISOR

Sylvia Gordon

TECHNICAL CONSULTANT

Francis Wilson

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TABLE OF CONTENTS

WHY WE CARE

As human beings, we have increasingly exploited and controlled our environment. We have treated our environment like a river with a seemingly endless supply of pure water. Only now is it beginning to dawn on us that the planet's environment circulates in a closed system and that what we add to it stays with us. One day, if we are not careful, the river will run dry.

This ecosystem is a limited one, dependent on many fragile balances. Complex cycles maintain its life-supporting ability. However, many of these cycles have been disturbed by us and the activities of our species is taking an even greater toll.

It is this problem that we wish to address in our conference: "The Environment: A Global Crisis - The Need For Change." As we begin to understand the nature of our situation it becomes clear that changes in how we think and live are imperative. Perhaps, because protection of the environment is a global problem, people worldwide will seize the opportunity to work together as they never have before.

We are altering our environment in many ways: ozone depletion, acid rain and global warming are all related to human-generated emissions into the atmosphere. Changes in conditions on our planet manifest themselves in cancer, destruction of lakes and forests, melting of the polar ice caps, weather irregularities and subsequent flooding and loss of coastal land. The deterioration of arable land and the destruction of forests have led to the loss of precious resources, increased the poverty of those who farm the land, and caused the extinction of whole species of animal life. Fresh water and ocean pollution have also hurt plant, animal, and human populations.

The degradation of the environment is accelerating. There are new pressures on the world's economy and its ecosystem: a growing population, poverty, industrialization, and development.

The population of the world is not expected to stabilize before it reaches about 10 billion in the middle of the next century, roughly twice the present number. Population growth today is greatest in developing countries. Rising populations usually imply increasing poverty. And conversely, because poor people often have many children in order to counter high infant mortality rates, poverty tends to increase population. There is not enough room for them to farm so they invade the forests and marginal land in a desperate search for new areas to cultivate. Much land is now degraded from overuse. Famine and malnutrition do the work of population stabilization that more humane methods should achieve. It is difficult for impoverished people to improve their situation without tremendous effort and expense put into development and growth of the economy.

We could return to some old arguments about limits to growth and how, as the world economy cannot expand further without irreparable damage to the environment, we must resign ourselves to some form of triage. We might choose to accept that those who simply do not have the ability to survive will not. The immorality of that choice would make those of us who do survive less than human.

Poverty is not inevitable. The world economy can be developed in ways that include the needs of the poor and enable them to become self-reliant. Programs of development which meet the essential needs of both the environment and the population are feasible. We must begin by accepting the absolute need for

equity in the distribution of resources, and the possibility of attaining this through a kind of development that does not deplete these resources.

Most development has been based on the assumption that "big is beautiful." However, projects such as huge dams, highways, land clearance, mines and mills have often had the most terrible consequences. They have not brought the expected revenues or employment. They have produced chain reactions of environmental damage, including the spread of diseases, floods, soil erosion, and water pollution. In order to pay for their projects and to repay the loans that financed previous ones, developing countries strip the land of its resources to grow cash crops for export, and cut down valuable trees for the lumber industry. Developing countries understandably become especially angry when environmentalists from industrialized countries accuse them of causing pollution. "And what have you been doing the last hundred years?" they ask. "Is your self-righteous concern another way of stopping us from catching up with you?"

The dilemma of development has been that the very means by which it is achieved -- industrialization -- destroys the natural resources on which it is based.

Though industrialization is the greatest single cause of pollution in the modern world, it is also the basis of modernization and high standards of living. No country can hope to feed, clothe, house, employ, transport, educate, and give adequate medical care to its population without using the products of industrialization. Energy is an integral part of both industrialization and everyday life. Most energy today comes from burning fossil fuels such as coal and oil, or from firewood. In one way, industrialization can be seen as a profoundly "unnatural" process; it involves taking resources out of the earth and replacing them with polluted materials that the earth must reprocess in order to make them useful to life again.

The earth as a living organism, or biosphere, is enormously generous, and for the past two hundred years or so has worked hard to compensate for the insults we have inflicted on it. However, the rate of industrialization has increased sevenfold since 1950, and new products made from toxic chemicals have increasingly replaced less harmful ones. Plastics and radioactive materials take so long to become part of the natural environment again that the damage they inflict is particularly serious. The earth is constantly trying to heal wounds and bring forth life, but there is a threshold beyond which it can no longer hold back the downwards spiral of destruction. And there is growing fear that we have reached that threshold.

Unless we soon learn to sustain our life-supporting planet rather then ravage it, we must realize that the environment and the economy are inextricably linked. Development, industry, poverty, and pollution are all matters that must be dealt with on a global scale in order for there to be any hope. Our understanding of the need to halt the destruction of the environment must provide the impetus for social and economic reform throughout the world.

While writing this Working Paper, we realized that we could not begin to cover all the issues involved. We have tried to provide information on the most immediate problems. Our objective is not to depress you, but to make you aware of the problems our generation is faced with. Our environment is in dire need of help, our help. We all sit and wonder what difference it will all make when we live under the constant threat of nuclear destruction. But what we don't realize is that if all the trees in the rainforests are cut down, there won't be enough oxygen for everyone on earth to breathe. So if the bombs don't get us, the pollution will. While we must act through governments to achieve arms control, we can do something about saving our environment right now, like throwing the first draft of an English essay into the recycling box. This is only the first step!

NATURE OF THE PROBLEM

Atmosphere

Ozone

The U.S. National Academy of Sciences estimates that a drop of only 1 percent in ozone levels could cause 10,000 more cases of skin cancer each year in the United States alone. Since 1979, there has been a 40 to 50 percent drop in ozone levels over Antarctica and an average drop of 5 percent over most of the world. This trend shows no signs of slowing down.

Ozone is a rarely occurring triatomic form of oxygen. It is usually created in the stratosphere when ultraviolet rays bombard ordinary oxygen molecules (O_2), thus creating ozone (O_3). Ozone has the property of being able to absorb ultraviolet light, and thus it almost completely filters out the most dangerous types of these rays: UV-C and UV-B. The UV-C rays, which are lethal, are completely absorbed by ozone. The UV-B rays, which currently reach the earth in low levels, already cause sunburn and eye damage, promote skin cancer, and destroy algae. The UV-B rays can also contribute to retarding the growth of food crops and other plants. (UV-A rays, which are harmless, are not blocked by the ozone layer).

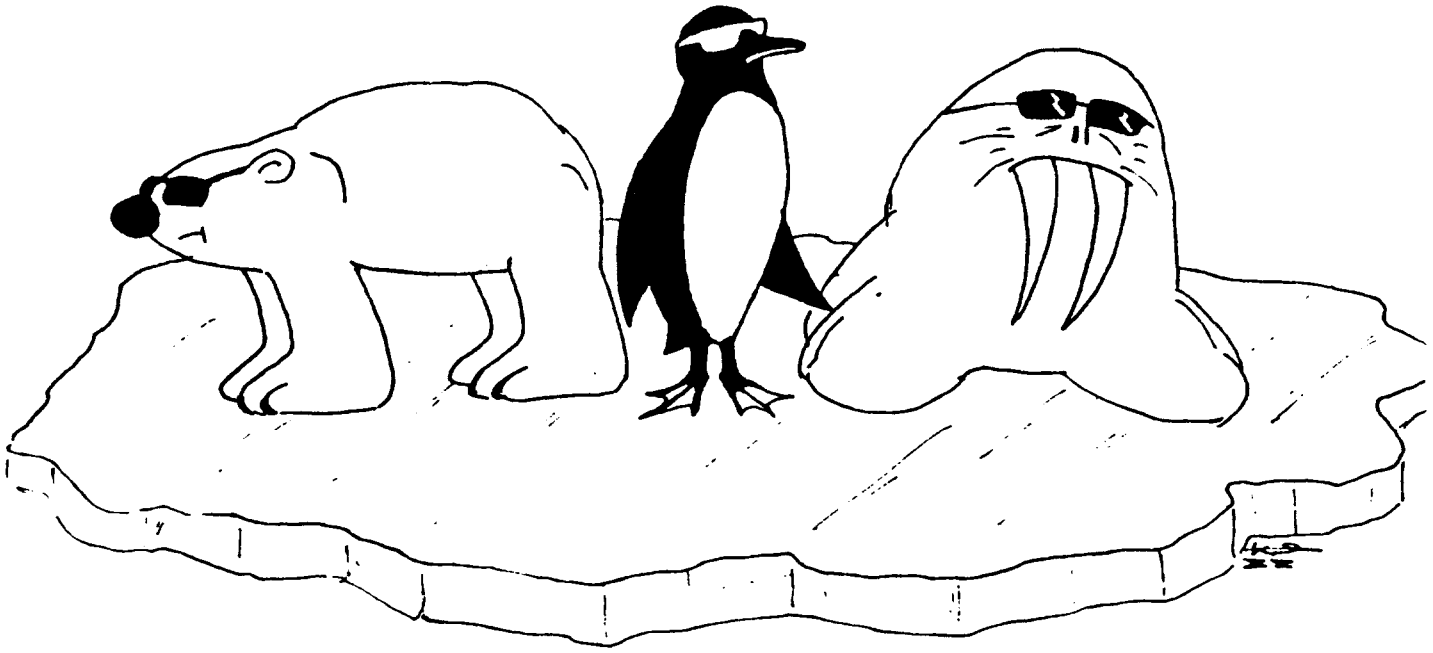
Ozone can be found in various quantities from sea level to a height of about 60 kilometers (about 36 miles) above sea level. Most of the ozone is to be found in a layer between 10 and 50 kilometers above sea level; peak concentrations occur at about 20 to 25 kilometers above the earth's surface. If all the ozone were compressed near the earth's surface, it would constitute a layer only 2 to 3 millimeters thick. As a gas it constitutes only 0.00006 percent of the total volume of air on earth. Despite this seemingly minor amount of ozone present in the atmosphere, it plays a very important part in sustaining human, animal, and plant life on earth.

If the amounts of ozone in the atmosphere are diminished and more UV-C rays are able to reach the earth's surface, people, animals, plants, and materials will be affected as their proteins and DNA (which carries the genetic code of cells) will be damaged. The incidences of skin cancer (it has already doubled globally over the last few years and tripled in Australia) and eye damage to both people and animals will increase. People can wear sunglasses...

Mutations in plants may affect the process of photosynthesis. Crops such as cotton, peas, and beans will have lower yields. Pollens may fail to germinate, killing bees as well as flower species. The UV-B rays that penetrate the water will kill fish larvae and algae, which are the beginning of the aquatic food chain, and thus fish supplies will be depleted. Water based economies throughout the world will be affected. Materials such as paints and plastics will disintegrate. The damage to human health and food supplies is difficult to estimate, but it is a threat that must be taken seriously.

What exactly causes this ozone depletion? Scientists agree that certain chemicals in the atmosphere accelerate the breakdown of ozone. Most of these gases are naturally formed in the atmosphere from reactions caused by the sun's ultraviolet rays, but new ozone is generally formed at a rate sufficient to balance the effects of the natural breakdown.

Since 1960, increased industrial activity, especially in the developed nations, has added



new chemicals to the atmosphere. These chemicals (called chlorofluorocarbons or CFCs) are used as propellants in aerosol sprays, as refrigerant gases, as solvents, and in the production of microchips and conductors. They are also used in the making of styrofoam (for example, in the popular packing material you find when you bring home your VCRs from the store), which, when incinerated, releases toxic gases into the atmosphere. Although it has been difficult to convince many industries, it is most probable that the global ozone decrease is directly linked to CFCs. Lab tests have shown conclusively that chlorine destroys ozone, but there are too many complicated environmental factors for CFCs to be identified as the only major ozone destroyers.

However, there is another problem. Since CFCs take some time to attain the heights at which they do most of their damage, it is difficult to estimate the harm that present emissions will cause in the future. As one CFC molecule can re-form perhaps 100,000 times before its life span of 75 to 100 years comes to an end, one can see that even minute amounts of these compounds can have major effects.

It is possible to measure the relationship between the production of CFCs and the rate of destruction of ozone. If the production of these chemicals increased by 1.5 percent, there would be a 3 percent loss in ozone in 60 years. A 3.0 percent increase in CFCs would lead to a 10.0 percent decrease in the same number of years.

There were warnings of the effects of CFCs in the stratosphere and the possibility of a resultant increase in skin cancer during the 1970s. The U.S. government banned the production of aerosol sprays in 1978; unfortunately, most of the other industrialized countries did not, as they felt it was difficult to define just what exactly was going on up there. Computers are only as good as the information that is fed into them, and the models that were constructed to analyze the problem had to integrate a lot of complicated information -- chemical reactions, differences in temperatures and other conditions at various levels above the earth, the effects of global wind currents and tropical storms. The computers had been directed to discount any information that the programmers thought appeared wildly alarming, causing the answers to fit beliefs rather than actual conditions. It was only after a British research team alerted the U.S. National Aerospace Administration to a "hole" in the ozone layer in 1983, that a review of the information was undertaken which revealed the true gravity of the situation. It is still not clear why the ozone depletion is so severe over Antarctica in the spring -- whether it is caused by ice particles in the stratosphere melting and releasing chlorine molecules, or is the result of a vortex functioning like a drain and sucking the ozone away.

This threat to our environment has created a stir in our society. It is a global problem, not one that affects only certain faraway parts of the world. It affects every single person in the world. In 1985, 21 nations and members of the European Economic Community (EEC) adopted a Convention for the Protection of the Ozone Layer in Vienna. The Convention calls for nations to cooperate in formulating ways to help solve the problems caused by the depletion of the ozone layer. It prompted many countries to ban the use of aerosols and to either ban or limit the emissions of CFCs into the atmosphere from other sources. In September 1987, a Protocol was approved in Montreal to supplement the Vienna Convention; it calls for specific limits to the discharge of CFCs into the atmosphere. Industrial countries (most have signed or are in the process of signing the Protocol) will reduce the production of CFCs by 50 percent by 1999. The use of certain fire-fighting chemicals, which has been increasing even faster than CFCs usage, will also be reduced.

The U.S. Environmental Protection Agency (EPA) has recently announced that it is preparing to enforce the Montreal Protocol. The enforcement of these limits has a political as well as economic impact. It will be expensive to cut down on CFCs, for there are fears that their replacement costs will double, or even quadruple present costs; huge investments will have to be made in discovering substitutes. Methods of recycling what the imposed limits allow a country to produce must be found. This will raise the prices of goods dependent on these materials and

technologies, thus making them less competitive in world markets. No country wants to be "the good guy" and keep the rules only to find that others are breaking them and making profits in doing so.

Emergencies often create their own solutions. A new substitute for CFCs was recently discovered by two U.S. companies. This new compound, called BIOACT EC, would gradually replace CFCs in industrial use and would not harm the ozone layer as its predecessor did. It would, however, reduce only 20 to 30 percent of the CFCs used in industries over the next two years. It is currently being used by relatively few small companies, but its popularity is rising. It has been calculated that the cost of using this new compound is happily about equal to that of using CFCs.

Greenhouse Effect

Since the beginning of time a relatively stable and self-correcting balance has existed between the solar energy reaching the earth and the amount of heat radiating out. Our temperate climate is what has made our earth habitable; it is unlike other planets such as Mars which is entirely frozen, or Venus which is extremely hot. There is now, however, the possibility of a shift in this crucial balance, which could cause the melting of ice caps, expansion of seas, and changes in deserts and fertile land. Scientists predict that by the year 2050, the earth's average temperature will rise between 1.1 and 4.4 degrees Celsius.

Much concern has been focused on this rise in temperature, known as the "greenhouse effect." Rather than being anything new, this process has always existed, regulating the earth's temperature. The atmosphere, composed of a variety of gases, has always acted as a protective layer to retain heat. The problem arises when this process is disturbed by the increased addition of carbon dioxide and other "greenhouse gases." The gases act like the glass in a greenhouse, reflecting more heat rays back to the earth than would a less polluted atmosphere. Thus the earth is warmed. There have been major increases in the amount of carbon dioxide in the atmosphere since the beginning of the industrial revolution in the 18th century.

Right now the concentration of carbon dioxide in the atmosphere is about 0.03 percent. Although statistics are uncertain before 1957, scientists estimate that carbon dioxide concentration has risen from 270 to 290 parts per million (ppm) to about 340 ppm. This amount may double in the next 50 years, as all countries are now dependent on fossil fuels. The causes of this increase are mainly human activities such as the burning of coal, oil, and gas. In addition, the common use of CFCs in coolants for refrigerators and air conditioners and in the making of plastic foam is also responsible for the release of carbon dioxide into the atmosphere.

Other greenhouse gases are methane, nitrous oxide (laughing gas), and ozone. Methane has been increasing by 1.1 percent annually since 1960. It is produced at the bottom of rice fields like "marsh gas," in the stomachs of ruminating cows, and with the burning of fossil fuel. Methane, however, is considered one of the "good" gases when it helps to form ozone in the stratosphere. Nitrous oxide increases in the atmosphere by about 0.2 to 0.3 percent annually. It has an average lifetime of 170 years and is produced by the burning of timber and the spread of fertilizers.

The effects of this "global warming" are still being discussed. Most scientists seem to agree that the warming would be most marked at high altitudes in the Northern Hemisphere, during the winter. Some models show that there would be an average increase of four degrees Celsius in most of Europe, and a five-degree increase over the Sahara. Such figures do not sound important, but we must note that the average temperature during the recent ice age was probably only five degrees colder than now. Besides these climatic changes, there would be changes in sea levels. Most scientists agree that a global warming of 1.5 to 5.5 degrees Celsius would raise sea levels by 20 to 165 centimeters through the expansion of the oceans. For low lying countries like Bangladesh, where flooding is already a major problem, the effects of a rise in sea level would be most serious. Millions of people would lose their homes and livelihood. As the earth warms, the polar ice might melt and raise world sea levels by an estimated 80 meters. Just picture every apartment in New

York City below the twenty-fifth floor submerged in water!

Acid Rain

Water is a basic necessity for all life. While we in the city dread a rainy day, much of the world's population prays for this life-giving substance to fall from the sky. Human beings have brought on this planet, and on themselves, one of the worst problems our environment has had to face, acid rain. Acid rain is harming lakes and forests. Fish are dying, historic monuments are being eaten away, and drinking water is being contaminated.

Acid rain is primarily a result of air pollution. The main culprits are sulfur dioxide emissions from factories and power plants which combine with precipitation in the atmosphere to form sulfuric acid. Even diluted in rain this virulent acid is extremely damaging.

Acidity is measured on a scale of one to seven, known as the pH scale. Unpolluted rainfall has a pH value of 5.6 or higher; the higher the number, the less acidic the substance. The Environmental Defense Fund recorded a pH of 2.0 in acid fog, making it more acidic than lemon juice, which has a pH of 2.2.

Acid rain alters soil chemistry, combines with other chemicals to weaken trees, and harms tree growth. Acid rain can cause the leaching of nutrients from tree leaves. Acid rain also kills the fungi that protect the roots of the trees. If acid rain does not directly kill trees, it weakens their resistance to disease or insect infestation. In Europe, 15 million acres of forest have been destroyed. People react emotionally to the sad vista of dying trees. The Germans have a name for it: "Waldsterben," or forest death.

Fish are very sensitive to changes in acidity. Many fish are suffering from deformities and are dying. Atlantic salmon are disappearing as the acidified water affects their sense of smell, making it impossible for them to find their spawning grounds. At the same time whole lakes are dying, becoming incapable of supporting fish and plant life.

Acid rain also deteriorates marble and limestone and other building materials. Some of our greatest treasures, such as the Parthenon and the Taj Mahal, as well as the Statue of Liberty, are being slowly eaten away. Acidified water, when it comes in contact with metal pipes, releases toxic metals such as lead. Children are particularly susceptible to lead poisoning which can result in brain damage.

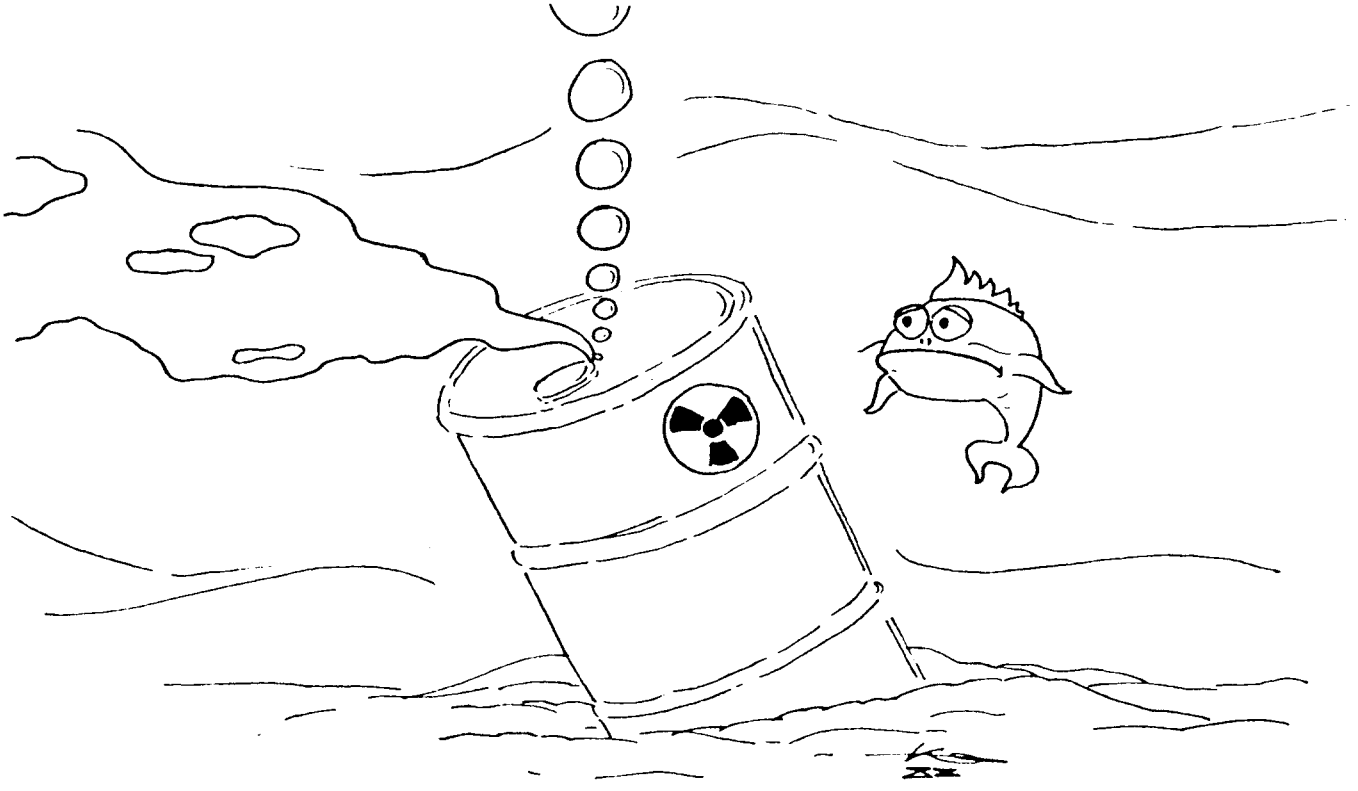
The 1987 Fall report by the United States National Acid Precipitation Assessment Program stated that acid rain posed no immediate threat to the environment or public health. The Canadian government and many scientists have criticized the report, calling it misleading and political propaganda.

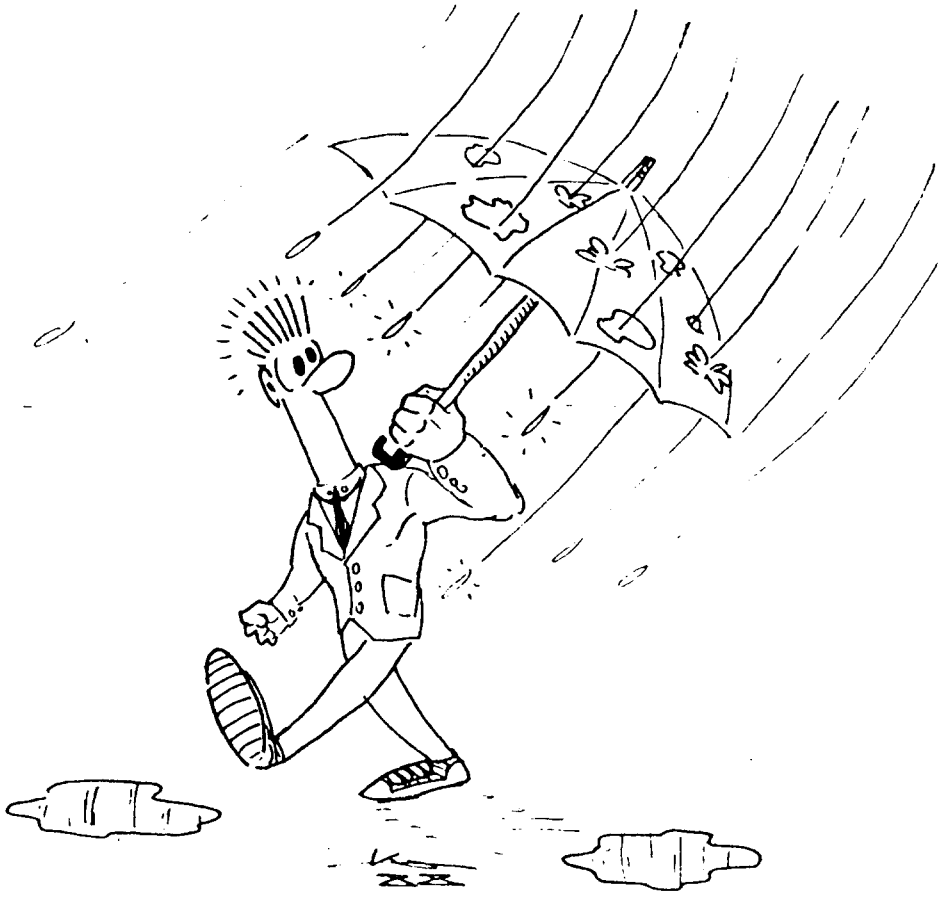
As winds carry pollutants from factories in the midwest to the Adirondacks or Canada, or from Western Europe to Norway and Sweden, the problem becomes a global one. Canada has called for the United States to reduce its sulfur and nitrogen oxide emissions by 50 percent. Twenty two countries in Western Europe, who call themselves "The Thirty Percent Group," have agreed to reduce sulfur dioxide emissions by 30 percent between 1980 and 1993.

Water

Clean Water

We need water for food and sanitation, agriculture and industry. In developed countries, a daily average of 100 liters per person is used for domestic purposes, while in developing countries the figure is more like 15 liters per person. The problems of water center around two facts. First, it is not evenly distributed around the world, and second, it is being wasted and polluted at an alarming rate. People contribute to pollution with their waste -- the problem of what to do with feces has itself become a sub-topic in water management. Farming produces fertilizer and pesticide runoffs, and industry contributes toxic chemicals either through airborne particles that enter water systems in rain, or





through expelling water used in cleaning or production of materials into rivers and lakes. Clean water is becoming a precious commodity. In some parts of the world growing populations are straining already inadequate sanitation systems. In other areas toxic chemicals have contaminated the ground water, and people must buy their drinking water in bottles. Clean water is essential to all life on earth. Plants need it, animals need it, and humans need it. It is an international problem as pollution does not respect national boundaries.

Sanitation and clean water go together. In the developing world, 15 million children under the age of five die annually from diseases related to polluted water. Three out of five people in developing countries do not have access to safe drinking water, and three out of four have no way of disposing of their feces except in ditches, behind bushes, and in rivers which also serve for washing and drinking water. The conditions in urban slums are bad, but in rural communities they are even worse.

People get diarrhea and parasitic diseases from drinking and washing in dirty water. They become too ill to work or look after their families. In China, many rural communities have a high incidence of schistosomiasis, a disease caused by a species of parasitic flatworms hosted in snails which infests the blood stream and damages vital organs. The parasite penetrates the skin of the leg of anyone who walks through the infected water. Other common waterborne diseases include dysentery, cholera, and typhoid; all of these can be caught through the water which they contaminate.

Women traditionally have the task of transporting water, and sometimes spend four to eight hours a day going to and from the nearest source. The strain on their health and energy makes it more difficult to work and bear healthy babies. A high rate of child mortality is one cause of high birth rates. Clean and accessible water means healthy mothers and children which in turn brings down the birth rates and thus lessens the strain on resources.

Sewage disposal is a major problem. "In India, one hundred and fourteen towns and cities dump raw sewage into the Ganges, and in Colombia, the count of fecal bacteria in the river downstream from the country's capital is 7.3 million. The safe drinking water limit is one hundred." [1] The United States recent Clean Water Act proposes to spend billions in building and improving sewage-treatment plants and in monitoring the toxic chemicals that industry spills into water resources.

Toxic spills pose a serious threat to our freshwater resources. Recently 30 tons of chemicals entered the Rhine River from water poured onto a chemical warehouse fire in Basle, Switzerland. Soon after the accident, the lifeless bodies of literally hundreds of thousands of fish and eels were removed from the river in garbage disposal trucks. Mercury, which in only minuscule concentrations can be fatal to plants and animals, was among the poisons involved. Through seepage into the river bed, this poison may contaminate the water used for the irrigation of crops in France, Belgium and the Netherlands and thus eventually enter the delicate food chain dependent on the river and further escalate the disaster. Some governments realize the need to monitor and fine companies when, for their own purposes, they pollute water that belongs to us all. But in many countries industries are not sufficiently controlled and complain that if they had to change their production methods to avoid polluting the air and water the price of their goods and services would rise, and we would all suffer. They suggest avoiding short term pain at the expense of long-term benefits.

The use of water for agriculture can also result in waste and pollution. About 12 percent of all cultivated land depends on irrigation. Some methods of transporting water are very expensive, for example, pumping water long distances. Water is now pumped from the Colorado River to southern California. The demands of agriculture for water have lowered the levels of lakes, rivers, and underground aquifers. In many places land is collapsing as whole underground lakes are being depleted.

The water that runs off fields into rivers, lakes, and coastal wetlands may be contaminated with fertilizers and pesticides.

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1. *Safeguarding the World's Water*. UNEP Environment Brief No 6

These chemicals help algae grow, which causes eutrophication, or oxygen depletion of the water and suffocation of fish and other aquatic life. DDT was banned some years ago in the United States because it was found in species all the way up the food chain from fish to ospreys and humans. A further danger is seepage from toxic dumps and garbage land fills that can add radioactivity as well as a witches' brew of other poisons to waters. Nobody wants those dumps near their ground water. An acronym that refers to that virtuous process of being against toxic dumps but not taking responsibility for either reducing the production of the materials or developing safe disposal methods is NIMBY: it stands for "not in my backyard."

The United Nations considers clean water for human consumption so important that it designated the years 1981 to 1990 as the International Drinking Water Supply and Sanitation Decade (IDWSSD). The International Water Decade expects to spend one-billion dollars in development funds to build small-scale water and sanitation projects in as many areas as possible and to educate people in simple rules of hygiene.

Nowhere can we take clean water for granted. We waste it and spend billions cleaning up what we could have used more wisely in the first place..

"There will come a time when the good water that we use to cook our food, cook our medicine, and clean our babies will not be fit to drink...and the waters will turn oily and burn...the cool waters that we use to refresh ourselves will warm and heat up...our misuse of this water will turn it against us and people will suffer and die..."

Handsome Lake, Seneca Prophet, 1799

Ocean Pollution

The oceans, which cover about seven-tenths of our world, offer abundant resources on which we depend. But our actions are placing this wealth in jeopardy. With a limited understanding of the ocean, and motivated by both good intentions and greed, we have brought about this crisis. Many species of marine life are near extinction and the ocean's ability to regenerate itself is being destroyed.

Slowly the ocean is dying. In the Great Barrier reef off Australia the coral is dying. Divers have found entire areas of the Mediterranean that are incapable of supporting life. More than twenty years ago, the Torrey Canyon, one of the new breed of super tankers, spilled masses of oil off the coast of Brittany. The resulting slick killed much of the sea life on which many depended for their livelihood. It also destroyed much of the coastal life; oil-soaked birds, unable to lift their wings, floundered on the shore. It has left stains on the stunning rocky coast of Brittany that can still be seen today.

All ships dump their waste, including plastic, styrofoam, rubber and beer cans, into the sea before coming into port. Each year many forms of marine life strangle themselves on the plastic debris, or choke themselves by swallowing it.

Each year hundreds of new chemicals are dumped into the seas, adding to the thousands already there. Chemicals, such as mercury have been recorded at levels two-and-a-half times the natural levels; zinc, copper and lead have been found at about 12 times the normal level; antimony at 30 times, and phosphorus at 80 times. The full impact of the presence of these chemicals is not yet known.

Closer to shore, landbased pollution is destroying estuaries and wetlands, the spawning ground of many species of marine life. An alarm has been raised in the United States over the deterioration of the Chesapeake Bay. A similar process of pollution is occurring in many waters all over the world. Once they enter into the food cycle these chemicals affect animal life on all levels, from the smallest fish to human beings. Organic chemicals accumulated by shellfish can cause neurological disorders and muscle and bone deterioration in humans.

The problem exists in many areas along the East Coast of the United States. Pollution is affecting the marine life in Long Island Sound. Many species are dying off. A long stretch of water near New York harbor is

considered by environmentalists to be dead as a result of repeated garbage dumping. They believe this water can not only no longer sustain life, but is also unable to regenerate itself.

Beaches are also dying as toxic wastes and raw sewage are washed up among bathers. A very dramatic example of this occurred last summer in New Jersey. Hospitals in the New York region were dumping their waste products into the waters, affecting 127 miles of popular shores. Among these wastes were some radioactive materials, used syringes, intravenous tubes, empty pill bottles and raw sewage. Many people were reported sick after swimming in the water; there were brown waves (colored by dead algae) and hundreds of dead dolphins and fish washed up along the shores. We are using the ocean as a septic tank for our wastes; we are killing it and we are killing ourselves.

Land

Agriculture

"In the roads where the teams moved, where the wheels milled the ground and the hooves of the horses beat the ground, the dirt crust broke and the dust formed. Every moving thing lifted the dust into the air: a walking man lifted a thin layer as high as his waist, and a wagon lifted the dust as high as the fence tops, and an automobile boiled a cloud behind it. The dust was a long time in settling back again."

John Steinbeck *The Grapes of Wrath*

Land used for agriculture has come under increasing pressure in the last 20 to 30 years. In the developing world, population growth has meant more mouths to feed from the same amounts of arable land. As new generations of poor farmers try to find a livelihood, in some areas (e.g. northeast Brazil, Central Asia, the Himalayan foothills) marginal land with poor soil has been brought under cultivation, causing desertification. On the good land, pressure is created to increase crop yields by methods unknown to traditional agriculture.

Intense mechanization of agriculture has caused the loss of precious topsoil. The rate of soil erosion has increased to a point where it far exceeds the rate of the natural formation of soil. Topsoil is the thin mantle of fertile earth, 15 to 20 cm. thick, upon which all agriculture depends. The loss of topsoil means the loss of essential nutrients. It also increases the cost of farming, as fertilizers must be used to substitute for the soil loss, and irrigation is often needed as the soil's ability to store water is reduced. It is estimated that millions of tons of top soil are lost annually from the world's croplands.

Traditional farming methods such as crop rotation, farming on sloped land with proper terracing, and the cultivation of small fields that do not require heavy machinery, help prevent soil erosion. In Missouri, research has shown an increase in soil erosion, from 2.7 tons per acre when a crop rotation system of corn-wheat-clover was used, to 19.7 tons per acre when only corn was grown. Heavy machinery is required for new agricultural technologies such as forced irrigation, fertilization, and the spraying of pesticides. The use of such equipment has meant the abandonment of field terracing and the removal of tree-shelter belts that once hindered erosion. Tractors and combine harvesters that can only be driven in straight lines must be accommodated. This means that natural barriers to erosion, like hedges, ditches, and mounds, are plowed under, exposing the land to the ravages of wind and water.

The industrial world's demand for more meat has resulted in the use of land to cultivate grain and soybeans to feed livestock. Land that could have been used more carefully by growing food for local use has disappeared, and thus there is local starvation while crops are exported to people who would not need them if they changed their eating habits. The cruel irony is that the people in developing countries need to export their crops in order to earn money to repay the debts they incurred in

modernizing their agricultural methods in the first place.

Throughout the world, much of the large-scale agriculture is run by big landowners or corporations producing cash crops for export. Agribusiness, intent on maximizing profits in the short run, results in crop yields which tend to decrease over time as the fertility of the soil is quickly drained, requiring more and more expensive chemical fertilizers. However, fertilizers deplete the soil, slowly reducing it to dust which is then carried of by both wind and water. Large-scale agriculture also tends to breed pesticide-resistant insects requiring the greater use of stronger chemicals. In the 1960s, over 700,000 acres of cotton fields in Mexico were abandoned because the cotton pests had developed a resistance to all available pesticides.

Some new high yield crops, once heralded as part of a green revolution that would feed the world's growing population, require more and more irrigation. Part of the water brought to the fields evaporates, increasing the salinity of the soil as a result of the crust of salts it leaves behind. Researchers involved in genetic engineering to create new strains of crops that can deal with the current problems tend to ignore the more humble techniques that small farmers can afford to use and which inflict less strain on the environment.

Fortunately, methods such as organic farming exist which conserve the richness of the soil and make it possible to produce crops year after year. Organic farming, like traditional farming, uses natural methods to produce healthy and prolific crops. It completely rules out the use of chemical fertilizers and pesticides. It relies solely on manure, compost, bone meal, and rotations of cloves and legumes to add nitrogen to the soil. It uses ingenious methods of pest control, like alternating rows of plants that repel each other's unwelcome guests, or introducing insect-eating insects. The gentle ladybug is a particular favorite.

Farmers using this system try not only to eliminate chemical residues from the soil but also to develop a "natural" fertility which may take from two to fifteen years to achieve. While the total number of organic farms in the world is small, agrochemical companies are worried about the trend in organic farming. This is due mainly to the sales of organically grown products, which are increasing very rapidly as a more health-conscious public seeks them out. Some organic farmers are producing as much as farmers dependent on chemicals, proving that these methods are both economical and efficient.

Alternatives such as organic farming must be explored if we are to prevent a repetition of the "Dust Bowl" that occurred during the Great Depression, the subject of Steinbeck's powerful novel. While the United States recovered from that, this time there may be no recovery -- for anyone.

Desertification

Desertification involves the destruction of land resources through the loss of the ability of soil to hold moisture, and through soil erosion. Most commonly, desertification results from human activities, such as allowing overgrazing by livestock, overcultivation, and other kinds of poor management of farmland. The effects can be devastating, especially in semiarid regions where desertification can lead to drought and famine. It is a worldwide problem which could in the future greatly affect the populations and natural resources of every continent.

We are accustomed to blaming drought for desertification, but people have lived for centuries on the borders of deserts, and have evolved ways of surviving. Nomads have led their herds from one oasis to another, leaving each area of grass and brush to renew itself until they come around to it again. However, both increase in population and misguided development plans have changed nomadic patterns. For instance, the World Bank wished to help a village by digging a deeper well to a lower water table. The result has been overcrowding around that water source.

When large numbers of herding people remain in one area, they eventually use up its resources. After the 1950s, many new African nations considered they could offer better services to their nomadic people if they remained in one place. They restricted the

areas in which their cattle could graze. The resulting overgrazing and cattle trampling of the grass around water holes left bare patches of land exposed to blowing sand, and thus the desert expanded.

Another factor contributing to desertification is the overuse of cropland, partly to grow food for rising populations and partly to produce commodities for export. New cash crops such as cotton and peanuts are cultivated on former grazing land. Some land is too fragile to sustain cultivated crops and eventually degenerates.

Another human-made cause of desertification is deforestation. Trees hold moisture in the soil, and also trap water so that it can later be absorbed into the atmosphere and return as rainfall.

Some areas of the world are more vulnerable to desertification than others. Semiarid locations are at the most risk. The rainfall, little as it may be, may encourage people to cultivate crops on unsuitable land. Unfortunately, most countries in semiarid areas are low-income developing countries with rapidly growing populations. In Sudano-Sahelian Africa, over 30 percent of the land is at risk of serious desertification, and the figures are similar for western and southern Asia.

Worldwide, the areas impoverished by desertification add up to a territory equal to the size of North and South America put together. Every year, 6 million hectares of arable land are lost to desertification and another 21 million are rendered unusable. Between 1958 and 1975, the Sahara expanded south 100 kilometers. The affected population rose from 57 million in 1977 to 135 million in 1984. One out of every three children in the Sahel does not reach the age of five and thousands suffer from malnutrition, slow reflexes, missing teeth, dry skin, and delayed growth. Desertification not only destroys the environment but the people dependent on it as well.

Deforestation

Vast stretches of land in Asia, Africa, and Latin America were once covered by forests. Only 10 percent of the forests on the African continent remain, and more than half have been cut down elsewhere. Deforestation is accelerating and poses a worldwide crisis.

Forests are cut down for commercial products and fuelwood, and cleared for farming. Forest industries provide us with hardwood, plywood, pulp for paper, gum, resins, oils, and plants for the production of medicines and cosmetics. In many parts of the world wood is the only fuel available for heating and cooking. Growing populations make increasing demands on local wood resources. People, especially women and children, may spend whole days searching for wood to be used as fuel. The landless poor, living as squatters, may make their own clearings using the slash and burn technique. All in all, forests are under attack!

Tropical forests now occupy 20 percent of the earth's surface and are disappearing at the rate of 7.5 million hectares per year (hectare = 2.471 acres). The loss of tree cover eventually leads to the loss of soil as well. In mountainous regions the roots of trees hold the soil itself. Nepal has suffered massive landslides as whole mountainsides, denuded of trees, have collapsed into rivers, blocking their natural flow and causing floods downstream.

Acid rain also causes deforestation. Whatever the relationship of this form of pollution to dying conifers may be, dead trees must be cut down, and the seedlings planted to replace them will take years to mature -- if they do not wither and die in their turn. Can you imagine a world without trees and forests? To paraphrase Joyce Kilmer:

> Pollution is made by fools like me,
> But only God can make a tree.

Rainforests

Beneath the luxuriant canopies of the Panamanian rainforest grows a tree whose medicinal properties can relieve all manner of aches and pains. However, trees like this are vanishing as the rainforests are being destroyed. In Panama, major cities are overcrowded and expanding, pushing people towards the forests where they slash and burn trees to clear land for homes. Plants and

animals in the path of the blaze are reduced to ashes. Unfortunately this devastation is not unique to Panama. Eleven million hectares are removed from the rainforests of the world each year, reducing this resource by six percent each decade. An area the size of New York City is cleared globally every four days. Currently 40 percent of the world's rainforests have been destroyed.

Expanding cities are just one cause of the destruction of rainforests. In Japan, wood is the most popular construction material. The Japanese don't use their own forests for building materials. Instead, they import vast quantities of wood from rainforests. These rich forests breed splendid hardwoods like mahogany and teak. Often, there is no control over loggers, and thus many trees can be cut down in the search for one nice teak to satisfy an exporter's demand. Natural resources that cannot be replaced are being ravaged to please a limited number of consumers.

Land is continually cleared to make room for farming and cattle ranching. Examples of this can be seen in the Philippines, Malaysia, and in Central and South America where rainforests are being demolished in order to create pastures for beef for the American hamburger industry. Once cleared and cultivated, the lush rainforest is gone forever. The fertility of its soil depended on the humus formed by falling leaves. Without them, it loses its ability to sustain growth.

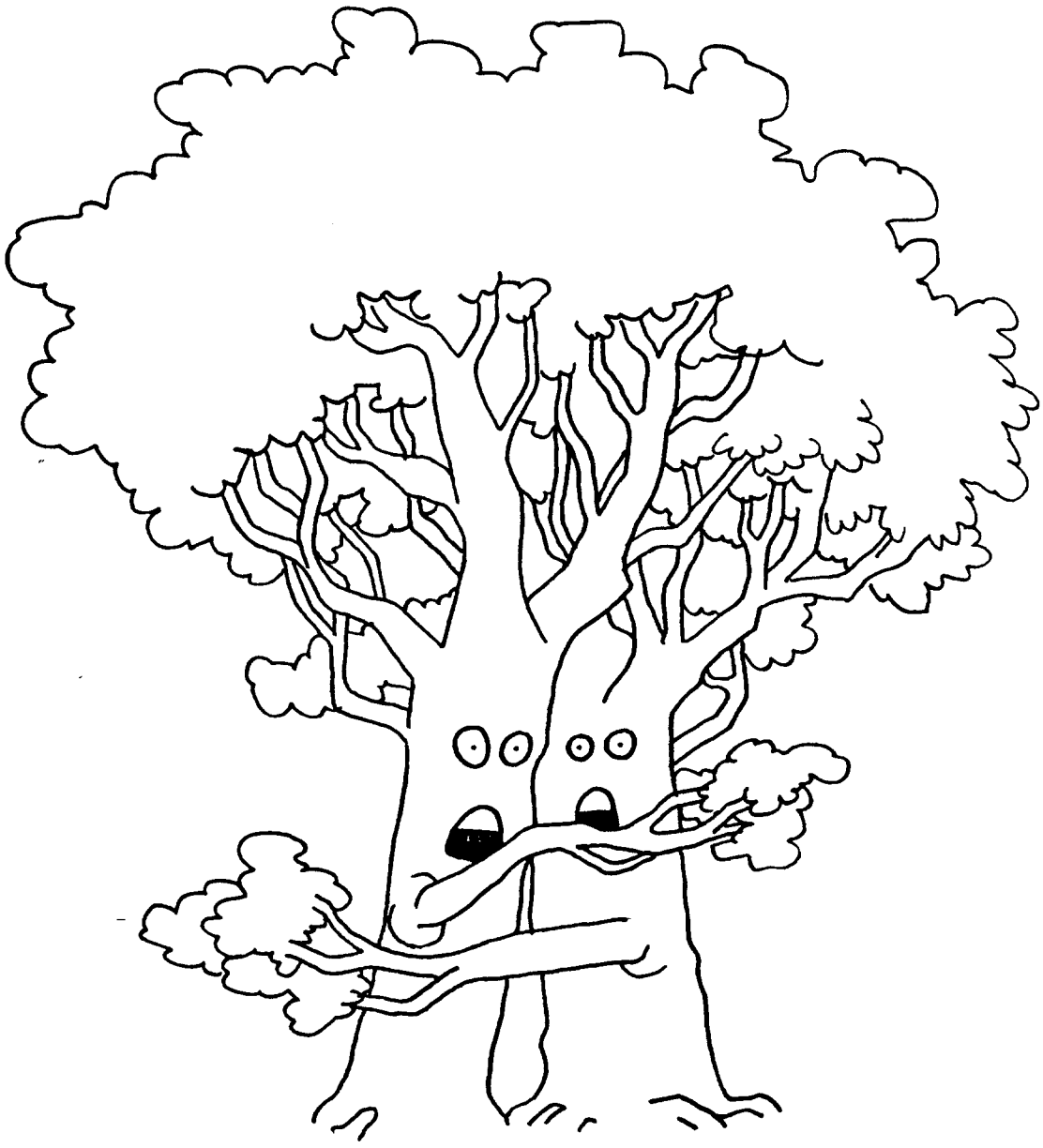
The effects of cutting rainforests are far reaching; any changes affect food supplies, medicine production, climate, and other aspects of our future. Many of the world's most common foods are available because of genetic varieties found only in the world's rainforests. Staples like rice, coffee, peanuts, and oranges are all derived from such sources. Revolutionary food varieties are continuously being uncovered in these forests. One such food is a plant which is three-hundred times sweeter than sugar, but calorie free. The drug industry uses the plants of the world's rainforests, searching for new medicines and maintaining supplies for those already in existence. A treatment for malaria victims is quinine from the cinchona tree found in Peru. A component of the birth control pill is found in yams in Mexico and Guatemala. The preservation of rainforests is a necessity if we are to maintain current standards of living, and hopefully improve them for most of the world.

Rainforests can be described as the "lungs" of the earth. Without rainforests to stabilize carbon dioxide build-up, something as fundamental as the air we breathe will become less suitable for human use. Moreover, cutting down rainforests alters the world's climate. By absorbing much of the sun's energy, rainforests heat air that would otherwise be cold. They recycle three-fourths of the water they receive back into the atmosphere. When the forests are gone, however, only one-fourth of the water is returned. Rainforests soak up water during the rainy seasons, then slowly let it out during dry periods. They act like a sponge for water storage, preventing floods and soil erosion.

Many countries have begun an effort to replant the rainforests they have slashed down and burned away. However, their attempts are insufficient. In Africa, for every 29 hectares cleared, only one is replanted. Other places, such as Brazil, have set aside preserved areas, but they are too small for the diversity of life forms to survive. Far greater areas are being disrupted by the expansion of farming and industry into the Amazon valley. Even recent development plans, like one approved by the World Bank to build a road into the region, are now believed to be misguided and to cause more harm than benefit.

As the roots of the problems are worldwide, the responsibility to help is also global. Price increases should be enforced on rainforest products, for they are valuable and not as plentiful as they once were. The higher prices will lessen demand and profits can be used for reforestation. The consumers of today should not let greed threaten future lives.

Thus far, many wonders have been found tucked away in the world's rainforests. Can we risk losing them? No one knows what is still hidden, and our world is not perfect enough to lose out on the discoveries of new treasures. That may be a selfish reason for protecting these magnificent areas, but perhaps a more practical stimulus than the moral one of respect for the lives and the beauty that flourish within them.



Genetic Diversity

What exactly is genetic diversity? Genetic diversity refers to the great range of distinct life-forms on this planet. As environmental exploitation and pollution destroy more and more plant and animal species, our genetic diversity decreases.

What difference does it make to us if some obscure lichen in the Arctic, which we have never seen or heard about, quietly dies out? Well, let me use lichens to help explain the importance of genetic diversity.

If you have ever sat on a rock by a northern lake and idly scraped off a thin flat plant with a fingernail, you have murdered a lichen. Lichens, though seemingly insignificant, play an important ecological role. First, because when dissected they reveal both past and present levels of air pollution, they are important monitors of copper, zinc, lead, and sulfur pollutants.

In the Cuyuhoga Valley National Recreational Area situated between Akron and Cleveland, lichens containing blue-green algae have disappeared; this type of lichen is able to change nitrogen into a form which enables other plants to use it as a nutrient. They are recognized as major sources of nitrogen fertilizers in deserts and forests.

As a result of the accident in Chernobyl, the lichens that Scandinavian reindeer and caribou rely on for forage are contaminated. Because of this, large herds of reindeer cannot be used as food and must be slaughtered, disrupting the lives of Lapp herders. In many countries, lichens are used by indigenous people as a natural antibiotic. And, in addition to being valuable, they are also beautiful!

There may be as many as 400,000 plant species in the world, and at least 10 percent, perhaps much more, remain undiscovered. Among the plants only recently discovered are many that have been used in cancer treatments and in contraceptive pills.

One of the richest sources of plant life is the rainforest. In Central America alone, 45,000 hectares of rainforests have been slashed and burned down by industry and native populations. In Borneo, to cash in on the high value of tropical hardwood, rainforests are being cut at astronomical rates. The hauling of the cut logs out of the forests rips through protective vegetation, disrupting animal habitats and opening up routes for further erosion. This mindless harvesting sends silt and wood into the streams where fish attempt to live and which local people use for drinking and washing. The loss of the trees allows the sun to penetrate and dry out the fertile ground which not only raises the risk of fire but makes it impossible for plants to grow.

Scientists working in the tropical jungles consider that nothing in the temperate zone can match their beauty. As these priceless "museums of the outdoors," these treasures of nature teeming with life, vanish, yet unknown resources vanish with them.

The disastrous consequences of shrinking diversity are part of human history; we all know of the 1840s Irish potato famine. Had the world not had the original diversity of potato types to fall back on, after the crisis of the 1840s, we would now be experiencing a life without baked potatoes, potato chips, french fries, or more seriously, a staple food for many Central Americans. Another single-species disaster was the wiping out of Sri Lankan coffee in the 1870s.

Modern industrialized agriculture has relied too heavily on cultivating only a few species of crops, ignoring the importance of diversity. Diversity within a species allows plants to adapt to environmental changes. If a gene travels too far away from its homeland, it may become weakened and more susceptible to destruction by disease or exploitation. If the original gene source cannot be tapped during times of threat to a species type, it may be impossible to save. Potato growers, be they Dutch, Irish or Canadian, must look to Latin American germplasm for the vigor that may be needed to keep famine at bay. Coffee that is grown in Sri Lanka originated in Ethiopia.

The "green revolution," heralded in the 1970s as the answer to world starvation, has had unforeseen environmental effects, one of which is the depletion of the gene pool as a result of the overuse of a few high-yield species, and little replenishment of more

sturdy traditional seeds. A few companies have acquired control of the propagation of particular seeds and may prevent the development of other specie types more suitable for small-scale farming. There is concern that the new science of genetic engineering, or biotechnology, will be used for corporate profit rather than social good. A monopoly on the discovery and use of gene varieties can hold back the prosperity and self-reliance of the small farmer. He will never know what could have been useful to him, and will have to pay high prices for what is available.

All nature is linked. When the diversity of plants is destroyed, animal life is imperiled also. A few examples of species on the brink of extinction, due to destruction of their habitats, are: the giant panda, the hyacinth, the macaw parrot, the Corsican swallowtail butterfly, the star cactus, the Ursini's viper, and carnivorous pitcher plants.

Healthy animal life also depends on diversity of animal species. Vivid examples have occurred in our own time. When wolves were wiped out by hunters in large parts of North America, deer herds multiplied to an unhealthy extent so that forests and crops were damaged by overgrazing, and deformity and starvation afflicted many wild herds. The importance of animal diversity has been studied less than that of plants. We do know that when an environmental balance is disrupted, species that remain may become "pests" and destructive of any emergent revival of diversity.

There is another aspect of species extinction. It is horrifying to contemplate a world, just around the corner, in which apes, elephants, tigers, pandas, giraffes, condors, many fish and sea mammals, and hundreds of other beautiful creatures are only a memory.

Extinction is inevitable, as is death, but never before have we been faced with mass extinction of species and the magnitude of the current chain effect. One million species -- out of a total of 5 million -- are at risk of extinction by the end of the century. More species may be lost in our lifetime than in the mass extinction, 65 million years ago, that included the disappearance of the dinosaurs.

As all plant and animal species are linked in complicated, subtle, and often mysterious ways, we can't begin to understand the damage we may be doing. Scientists feel that we may be reaching a point of no return, at which so many species become extinct at the same time that the whole delicate fabric of life on earth is imperiled.

Toxic Elements

Case Studies

Bhopal

On the night of December 2, 1984, what was termed by the factory owners as a "minor leak" occurred in the Union Carbide (U.C.) plant in Bhopal, India. Little did the 350,000 residents of Bhopal know that the deadly gases methyl isocynate (MIC), carbon monoxide, and hydrogen cyanide were flowing out of the plant and creeping among them. When some of the inhabitants saw the clouds of gas coming out of the plant and felt a burning sensation in their eyes, they could not know how badly that exposure would actually affect them.

The painful eye irritations and the vomiting that people were experiencing brought them to nearby hospitals in hopes of finding relief. The doctors at the hospitals had been told by the local medical chief at the U.C. plant that the gas was innocuous and would have very short term effects. The doctors administered the only available medications that, at best, eased breathing, which had been impaired as people's lungs filled with toxic fluids.

Later, a telexed message was sent from the Headquarters in the U.S. which told the authorities of the only antidote to give to the victims of cyanide poisoning. Two weeks after the leak had occurred, the nature of the gases and their damaging effects were discovered, but by then, hundreds had lost their lives. Of the 350,000 inhabitants of Bhopal, 200,000 were treated for toxic poisoning. The death toll is 2600 thus far, but the suffering will go on for generations.

It was later discovered that there was a lot more wrong with the U.C. plant than that one specific leak on that one specific night.

In the United States, there are safety regulations that require any type of plant which produces toxic substances to be at least 80 kilometers away from any neighboring town or city: the Bhopal plant was on the outskirts of a thickly populated area.

The workers at the U.C. plant in Bhopal had made a request to the management for rubber gloves as they feared that the substances they were handling might be dangerous. Management denied this seemingly harmless request with the explanation that the gloves would slow working speed.

When interviewed after the main chemical spill, workers said that the safety valves on the MIC storage tanks usually gave way every four to six months, and this caused small leaks. Upon reporting these leaks to their superiors, the workers were informed that the small amount of leaking gas was harmless, and that occasional leaks were inevitable in such large storage containers.

When the gas leaked on the night of December 2, 1984, there were only two safety masks available in the whole plant; all the other available safety devices were unfit to be used.

Why were all of these facets of a properly and safely run plant allowed to go awry? Why weren't safety inspectors monitoring the plants closely enough to catch the recurring leaks before - they expanded to tragic proportions?

How many devastating disasters of this kind will occur before someone realizes that there cannot be any more? How much longer before it becomes clear to the responsible authorities that production cannot be achieved at the expense of human lives?

Minamata

We have found ourselves in a scary situation. The next time you eat a meal, think about what you know about the food: where was the food grown or raised? What type of water was used to water the plants that make up the vegetables on your plate? What type of food was the cow fed before it was fed to you? Although the answers to questions like these are hard to find before you take your first bite, they are aspects of our lives we must at least consider; how much control do we really have?

Minamata is a highly industrialized town on the southernmost Japanese island of Kyushu. The local fishermen depend on the waters surrounding Minamata for their livelihood. Their fishing waters were being used by a plastic-producing plant to dump effluent containing methyl-mercury, a highly toxic compound. Oddly enough, no one knew this and so could not prevent the tragedy that followed.

The methyl-mercury that was dumped into Minamata Bay found its way into the food cycle, first affecting fish, then those who ate the fish, including the local inhabitants of Minamata. One of the hazards of releasing toxic waste into the environment is that it can accumulate as it moves through the food chain. Larger fish eat many smaller fish with harmless concentrations of a chemical in them. Many of these will then be eaten by bigger predators, and finally by people. By then, the concentration of the toxic substances will have become high enough to cause harm.

This effect was first seen in Minamata Bay when cats who fed on fish were found to be listless and weak. These cats soon became paralyzed and died.

The methyl-mercury claimed its first human victims later the same year. Babies were born deformed, and ultimately thousands of people suffered paralysis and slow deaths, as the poison affects the brain and the nervous system.

Chemical Dumping

An increasing number of developing countries are becoming industrialized, and estimates of the total amount of hazardous wastes being generated by the whole world vary greatly, making comparison among countries very difficult. The U.S. Congressional Budget Office has placed the figure of toxic waste at

approximately 266 million tons for 1983 (it can be inferred that this figure has increased considerably since then). There is more than one ton of toxic waste produced for every person who lives in the United States. Chemical industries have created more than half of this total; metal-related industries account for more than 18 percent; and petroleum and coal products were responsible for approximately 12 percent.

Chemical waste management methods and regulations differ from country to country, but for the most part, people maintain an "out-of-sight, out-of-mind" mentality. It is believed that two-thirds of the chemical waste produced in the United States is disposed of in or on the land. For many years, these wastes have been haphazardly disposed of in unlined impoundments and landfills.

Nineteen percent of land disposal is made by surface impoundments, 23 percent by landfills, and 25 percent by injection wells. All these methods may contaminate the groundwater that we drink. Even some of the most carefully constructed landfills and impoundments have been known to leak. When this happens, surface runoff contaminates both food and crops. Approximately one fifth of U.S. hazardous waste is discharged into sewers, or sometimes directly into rivers and streams: only a small portion of that water goes through the complex yet vital process of recycling, elimination, and detoxification, before it is released into the environment.

The EPA has set up a "super fund" to clean up old waste dumps and spill sites that may be dangerous to people and their water supply. It has also classified ignitable, corrosive and dangerously responsive chemicals as toxic: these include paint from appliance factories, chrome and nickel from metal-plating shops, detergents from chemical plants, and even commonly known wastes such as paint thinners, pesticides, bleaches, disposable cigarette lighters, and oven cleaners.

The number of dangerous dump sites in the United States is increasing steadily. As of October 1984, there were 786 waste sites. The EPA estimates that the number will grow to 2500 in the near future.

The dumping of toxic chemicals is dangerous, regardless of what methods are used. We hope that someone will soon find a safe system of storage in which toxic substances will be impermeably contained and prevented from entering the food chain.

Injection into rock layers is now said to be the safest form of hazardous-waste disposal. Even so, injection wells will endanger groundwater that will pass through it sooner or later due to earthquakes or other cataclysms. Any type of disposal site, no matter how safe it is supposed to be, must be monitored carefully, for by the time it is discovered that one of these containers has failed, it may be too late.

The operation of nuclear-power plants generates a tremendous amount of radioactive material. The most effective method of disposal, so far, is in geological formations such as salt beds and granite. Nuclear-waste dumping is only legal when it is done away from residential areas and on land that usually belongs to the Federal Government. Crops are not to be grown, and people are banned from living in areas exposed to long-term radiation. However, in the western United States, some of the sites being proposed for dumping are near Indian reservations.

Some chemical waste must cross national borders as a result of insufficient disposal facilities in the counties which are producing the waste: some 200,000 to 300,000 tons are shipped every year from Western Europe to Eastern Europe, where 90 percent of the waste is disposed of on land.

The problem of toxic waste disposal has become so serious (with a lack of acceptable disposal sites) that developed countries are offering developing countries payments and loans to dispose of these wastes in their land.

Urban areas like Mexico City, Sao Paulo, Seoul, Jakarta, Lagos, Lima, and Calcutta are examples of the most serious environmental contamination in the world. The 400 kilometers between Rio de Janeiro and Sao Paulo constitute one of the most heavily industrialized regions in the world today. The unregulated dumping of waste is believed to be responsible for the high levels of chromium, zinc, and cadmium found in the

shellfish of nearby waters. When introduced into the body in large quantities (i.e. through food), these heavy metals can cause cancer, liver, kidney, and central-nervous system damage.

The Effects of Toxic Substances on Humans

This topic admittedly reflects the egocentric attitude that human beings have adopted toward the other species with whom they share the earth. However, by considering the effects that some toxic substances have on people, we can infer the danger these substances pose to the biosphere as a whole.

Living things are wonderfully complex. Human beings are made up of approximately 100-trillion cells. Each of these cells is itself a marvel of design, consuming and producing with far more efficiency than the crude man-made machines that pervade modern society. Rather than deploring the seeming fact that "everything in large doses causes cancer," we should revel in the fact that the body resists as well as it does. However, when enough of a foreign chemical is introduced into the human system, our natural chemical reactions may be altered, and this alteration can be toxic.

Toxic substances can be inhaled, ingested, or absorbed through the skin. An inhaled substance can pass from the lungs directly into the blood stream. In the cases of absorption and ingestion, before a substance is dispersed in the body, it may be metabolized and rendered harmless. Nevertheless, all three entry routes can allow chemicals into the body which can then initiate biologically dangerous reactions.

Reactions may occur on the surface of our bodies. Skin is affected by many irritants. There are two major categories of skin irritants: primary irritants and allergens. Primary irritants cause temporary reactions, which may, however, be very severe; the reactions only occur if a toxic limit is surpassed. Allergens make the skin sensitive to further contact; and subsequent contacts are likely to produce increasingly violent reactions from smaller amounts of allergen than the original toxic limit. Chlorinated hydrocarbons such as 2,3,7,8-TCDD (dioxin) and polychlorinated biphenyls (PCBs) cause a skin reaction known as chloracne in which lesions and large abscesses form on the skin.

Irritants and allergens also affect lungs, causing them to secrete mucus. This mucus blocks the tiny air sacs called alveoli, where oxygen enters the blood. The resulting lack of oxygen can cause weakening of the heart and prolonged exposure to irritants destroy the alveoli. Other dangerous chemicals, such as carbon monoxide, have a greater affinity for the blood's hemoglobin than oxygen does. Consequently, these chemicals bond to the hemoglobin replacing life-supporting oxygen. Asbestos is especially noxious as it not only scars lung tissue causing fibrosis but alters lung cells, causing cancer.

Some chemicals are toxic because of the way in which they react with substances already in our bodies. For example, although there are chlorine ions in our body, one cannot find naturally occurring chlorine compounds there. However if chlorine is artificially introduced into the body, it will readily chlorinate many biological compounds and disrupt their proper functioning. Heavy metals such as mercury and lead bond onto the sulfur groups in our enzymes. Enzymes are the proteins that catalyze specific biochemical reactions and allow our bodies to function as efficiently as they do. Heavy metals also affect our nervous system. This hazard drew world attention when a factory in Japan spilled methyl-mercury into prime fishing areas and caused many incidents of Minamata disease.

Carcinogens, or cancer causing substances, attach themselves to our deoxyribonucleic acid (DNA). It is DNA that is responsible for the ability of our cells to reproduce. Carcinogens not only alter our DNA, allowing cancerous cells to reproduce, but can also impair the enzymes that correct such alterations.

One other hazard of great biological importance is radioactivity. Radioactivity is the emission of sub-atomic particles into the air. These particles bombard the atoms in our body and strip them of their electrons. Because radioactivity attacks all atoms, and not specific molecules or organs as toxic chemicals do, it is especially dangerous to our health.

With as many variables as there are in the environment, it is hard to conduct controlled studies. Many usually innocuous chemicals react in certain environments to become toxic; others become toxic by participating in metabolic reactions in our body. The effects of chemicals in the body are often multiplied by reactions upon each other. For example asbestos, which kills the macrophages in our lungs, leaves our lungs more susceptible to attacks from bacteria. Another difficulty in toxicology is the lag between the entry of a chemical into a body and resulting symptoms. Some methods used to investigate toxicology have unavoidable and inherent flaws. Experimenting on lab animals sometimes has no bearing on the effects of a chemical on humans, and many people oppose such experiments on moral grounds.

Because of these hurdles which stand in the way of proper study, not enough is known about the effects of the thousands of chemicals that pollute our environment. In some instances, this uncertainty alerts us to dangers that we cannot afford to ignore. In other instances, it becomes a political argument for those corporate and government interests that wish to delay legislation for change.

Urban Environment

Increasing populations and migrations of people into urban areas throughout the world have intensified environmental problems. World population growth is figured at 2 percent per year; but what is alarming is that the population of urban centers of 1 million or more people is increasing twice as fast as the world population in general. By the year 2000, the urban population of the world will be more than 3 billion people. Approximately 50 percent will live in cities with populations of more than 1 million inhabitants.

Urbanization threatens the stability of the world ecosystem, because it reduces the planet to a barren rock devoid of life forms. The world's cities are, and in the past have been, the main source of environmental degradation. The proliferation of humans concentrated into a small area results in a multitude of furnaces, incinerators, burning garbage dumps, motor vehicles, railroads, aircraft, power plants, oil refineries, mills and factories -- all of which use the environment as a vast dumping ground for solid, liquid, and gaseous refuse.

The resulting air pollution is a threat to health. Studies of 38 urban centers in the U.S. provide consistent statistical evidence that increasing concentrations of certain substances, in particular of nitrogen dioxide and sulfur dioxide, are associated with increasing mortality rates, chronic diseases linked with aging, and various forms of cancer and heart disease. In cities like Tokyo, Los Angeles and Mexico City the pollution is sometimes so bad that people are warned to stay indoors, and traffic policemen wear masks.

The automobile, necessary to transportation in every urban center, not only threatens human health with the noxious exhaust (including carbon monoxide and lead) that it expels into the air but also tends to generate noise pollution. There is no longer any doubt that noise impairs the hearing of individuals who live and work in noisy surroundings. Studies in Scandinavia and France illustrate that industrial workers have suffered major hearing losses that could only be attributed to the effects of noise.

The increasing overpopulation of the urban environment has placed a strain on water resources. This rapidly growing population decreases the quantities of water available to the individual, thus municipal water systems must be expanded. At the same time, the volume of wastes from washing and defecating increases, and therefore requires a similar revision and an expansion of the sewage system.

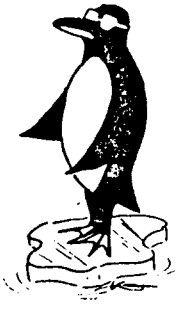
In less developed countries, capital is limited and systems for new water supplies and sanitation are either unavailable or inefficient. Many of the existing systems suffer from leaks which allow sewage to mix with the drinking water. In cities lacking piped-in water, there is an increase in the incidence of acute respiratory and intestinal problems, tuberculosis, hepatitis, and typhoid.

Industries based near cities cause further water pollution. Pesticide factories, tanneries, paper and pulp mills, petrochemical and fertilizer complexes, and rubber factories along the route of the river Ganges use it as a waste-disposal site.

The strains of living in urban communities are not only physical. The dangers of crime, the bleakness of treeless expanses of concrete, dirt, poverty, and slums, sap the spirit and turn us into alienated zombies who shut out the environment as well as each other.

Scientists, engineers, and human-interest groups are presently reaching into new social and technological disciplines for long-range solutions to the problem of the urban environment. The World Health Organization (WHO) is a branch of the United Nations dedicated to achieving healthy environments and life-styles with plans such as the "Healthy City Project." In cooperation with several nations, this project aims to improve living conditions for all urban dwellers by the year 2000. It concentrates on improving health and education facilities, encouraging youth participation and "networking" between cities. The success of the project depends on citizen groups: they must take control of their own lives and environment. If they can do this, an overall healthy attitude towards achieving a better quality of life is possible.

Increasing urban populations will not only put stress on the world's land and water but will also degrade human social and economic conditions. A threatened urban environment, in addition to being polluted, is one whose population suffers from a poor quality of life. This is not just a material concept of better housing or facilities, but an emotional and spiritual one as well. Cities also need esthetic surroundings, parks and community centers. They will be the environments for half the world's population and must themselves be in harmony with the global environment.



WHAT CAN BE DONE

Alternative Technologies

Introduction

It was during the early stages of industrialization that people first began to notice the disastrous effects they wrought upon the environment. Thus they reached the mistaken conclusion that industry and its requisite technology were the causes of the environmental crisis; that the only solution was a complete return to nature.

The only way to achieve a balance between human progress and the preservation of the environment is through research and development of alternative technologies. While it is true that technology can, and has been used in a way that is hazardous to the environment, with careful planning and guidance, technology offers the most pragmatic solution. The aim of research has too often been to find the technological solutions which are the most profitable in the short run. Though many important solutions may be profitable, many of the most essential are not, or at least not in the short run. This prevents them being implemented by industrialists who may only look forward to the next quarterly earnings.

In the search for dramatic speedy answers, people tend to ignore the smaller, but often more effective solutions which are aimed at solving basic human and environmental problems.

We cannot ignore technology altogether and "return to nature." Such an economy could not long sustain a human population of 6

billion. The answer lies in "alternative" technologies, in perceiving that "small is beautiful," as well as often wiser and more effective.

Plastics

The most obvious solution to disposing of plastics conveniently seems to be incineration. Though this method reduces the volume of solid waste by almost 95 percent, it produces toxic gases and ashes. Because there are many types of plastics, many different types of incinerators will be needed. Clearly a great deal of research and imagination are necessary to develop ways to "recycle" these nonbiodegradable substances. One example is the reuse of polyethylene terephthalate, or PET (the substance used in the production of plastic soda bottles). The bottles are shredded and used as stuffing for seat cushions, sleeping bags, and jackets.

Completely recyclable substitutes might provide a much more efficient solution to the plastics problem; an elementary substance such as paper is one example. Styrofoam, a form of plastic, is being phased out as a packaging medium by major fast-food restaurants; it is being replaced by paper and cardboard containers. But paper is not as strong or flexible as plastic.

The chemical structure of petroleum (the substance from which plastics are manufactured), a combination of hydrogen and carbon molecules, contributes to the plastic's unique and useful properties. It has been recently discovered that cornstarch (a biodegradable substance) possesses a very similar chemical composition to that of petroleum. Because of this characteristic, it is hoped that "corn plastics" will replace plastic in many of its present-day uses.

Recycling

In our garbage cans there is a wealth of valuable substances: glass, paper, and lightweight metals. These materials are being dumped in landfills where they take up tremendous space and are useless. It is a crime not to recycle them -- such a process not only saves money but reduces the pressures of pollution on the environment.

Industries all over the world have found that recycling is far less expensive than manufacturing new products from scratch. For example, building a mill designed to use waste paper is 50 to 80 percent cheaper than one using virgin pulp.

Recycling relieves pressure on the environment. Materials such as metal are nonrenewable; once they are removed from the earth, they will not be replenished. As the supply of these resources is limited, it makes sense to reuse them. Metals such as aluminum and steel can be recycled indefinitely.

As glass is nonbiodegradable, it becomes a problem at landfills because it takes up too much space. The alternative is to reuse the glass by crushing, melting, and reblowing it. Glass can also be recycled indefinitely.

If paper were to be recycled, we would eliminate over 50 percent of our solid waste and reduce the number of trees cut down each year to produce paper. For example, recycling all the copies of the Sunday edition of The New York Times would save 75,000 trees. Unfortunately, paper cannot be recycled indefinitely. After several trips to the recycling mill, the fibers become too short for paper manufacture. The fibers can, however, then be used for insulation and packaging material.

Recycling as a practical, everyday system will mean changes in our living habits -- more time and effort spent in sorting our garbage. It also means changing our notions that recycled products are not as "clean" and "high quality" as "new" products. Moreover, the economic advantages are becoming more and more apparent as the following quote will make clear.

"In the United States, aluminum can manufacturers promote can recycling in all states. Since 1981, more than half the 300 billion aluminum cans sold have been returned for recycling. The average can that comes out of a store is remelted and back on the supermarket shelves within six weeks. American customers have received over $1 billion in direct payments for their efforts. Largely because of stepped-up recycling programs, the industry used 22 percent less

energy to produce a pound of aluminum in 1984 than in 1972."[2]

Filters and Scrubbers

Most countries pollute the air by pumping pollutants -- fumes, dust, gases, and smoke -- into the atmosphere. Industries have developed devices and techniques to help control the emission of toxic pollutants. Two such devices are filters and scrubbers.

Filters are primarily made of metal, plastic, or fabric. They are used to capture a variety of solid and gaseous pollutants. The main function of filters is to separate as much of the pollutants from the smoke or fumes emitted by industrial smokestacks as possible. However, such filters are very expensive, and therefore many industries are reluctant to install them.

Scrubbers can be made of rubber, ceramics, carbon steels, or ordinary steels. They can often be found in use in incinerators. Most scrubbers contain a water medium which absorbs the gaseous and sometimes toxic products (hydrogen chloride, sulfur trioxides, organic acids, and aldehydes) and traps particulate matter. Unfortunately, expense is again a problem. Like filters, the cost to purchase and operate the scrubber equipment is so high that their use is again rejected. Even though developing countries which are just beginning to industrialize have good intentions, the exorbitant costs of scrubbers and filters are such that they cannot afford to purchase them.

The technology exists to control many forms of air pollution. Unfortunately, until governments decide to enforce the use of existing technology and people are prepared to pay the price for its implementation (despite the short-run increase in prices that will ensue) nothing will be done.

Reforestation

For a reforestation project to be successful, it must be preceded by much research. Studies must be made of the region where the trees are to be planted because it is important to know which types of trees are best suited for a particular environment. Some factors important in choosing the correct trees are the local soil, the amount of rainfall, and other weather patterns of the area. Another factor is the eventual use of the trees: for the prevention of erosion, fuelwood, or simply to stop desertification and hold moisture in the soil. All of these factors will help to decide exactly which trees are needed so that seedlings can be matched to the problems they are intended to solve.

Reforestation is not a complicated technology, but it has two major problems: first, it is very expensive, and, second, it requires millions of hours and workers to be successful. Once there are sufficient funds for a reforestation project, a new problem is labor. Who will plant the seedlings and care for them? The planting process is not difficult but there are tremendous numbers of trees to be planted over huge areas. The best solution is to involve local people. Seedlings can be distributed by governments, or governments can make seedlings available at low prices and show people how reforestation can be profitable. Even these incentives are often not enough; people do not see the point in spending time to plant trees. They believe forests are best turned into farmland and often the need for fuelwood is so great that the trees are cut down before they are fully grown.

Educating people in the advantages of reforestation, as well as giving local people a stake in the process, seems to be the most successful approach to the labor problem in some countries. In Nepal, for example, the government hired workers to plant trees to boost employment and also to increase the fuelwood supply.

Though the deforestation problem is far from solved, there have been several successful large-scale projects aimed at restoring the damage. In China, the government has implemented a nationwide planting campaign. Aerial seeding was used in certain areas, hand planting in others. They have so far planted 165 million hectares. If the planting progresses at the present rate, China will go

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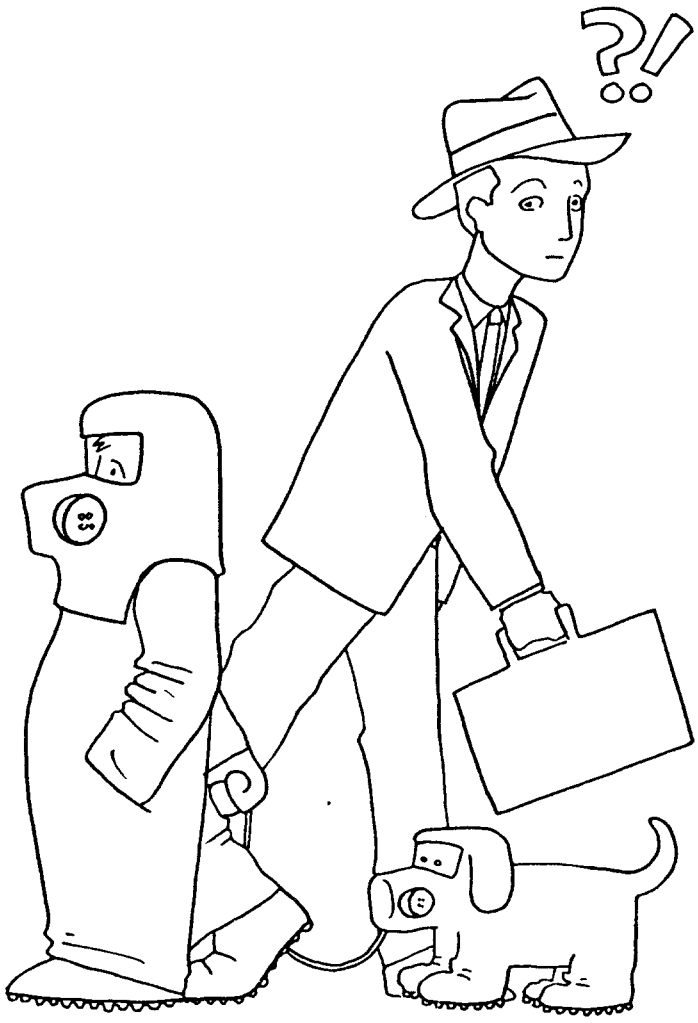
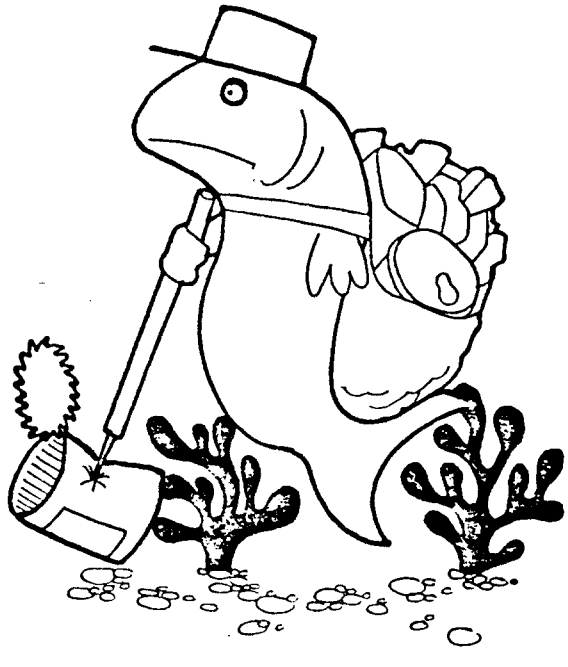
2. Pollock, Cynthia, Mining Urban Wastes: The Potential for Recycling, Worldwatch Paper 76. Worldwatch Institute, 1987





from having 12 percent of the country covered with forest to 20 percent by the year 2000.

In India, as tree plantations were not providing sufficient fuelwood, the government distributed 200 million tree seedlings to villagers and small farmers to try to encourage local self-sufficiency. Unfortunately, it was found that even this large amount of seedlings was not enough to solve the fuel problem. The introduction of a new design for a wood stove has eased the strain on local fuel resources. These stoves utilize the heat generated by the burning wood more efficiently, and so require less of it.

The goal of reforestation is to achieve a one to one ratio between hectares of trees cut down and hectares of trees planted. In parts of Africa, this ratio is 29 to 1. It will be a difficult task to catch up with the years of exploitation and the depletion of forests; replanting trees will not replace the ecological diversity of our lost forests. Our only alternative at this point is to educate local people in preservation and to supplement the trees we have left, and to give local people a material interest in conserving them.

Toxic Wastes

One of the potentially harmful consequences of industrialization is a toxic-waste spill. The easiest way to prevent the damage caused by such a spill is to minimize the production of toxic chemicals in the first place.

There are several steps that industries and governments can take in order to reduce the hazard of waste spill. The most important is the reduction of chemical wastes at the plants themselves. This can be done by researching alternative methods of production. Toxic wastes can be separated into two categories: recyclable materials and those that must be disposed of as safely as possible.

Governments have a responsibility to give industries the incentive to do all that they can to avoid spills. One such incentive would be to impose a tax on chemical waste; this would in turn raise money for safe chemical-waste disposal. Another, would be to penalize plant operators for not following regulations which prohibit the manufacture or disposal of chemical wastes.

The final stage involves wastes that reach a dumping site. The processing there involves the oxidation and incineration of the wastes, their transformation into something less harmful. The final, treated wastes will be dumped into lined, treated landfills.

These precautions will add heavy costs to the production of toxic chemicals, and will spur research for less harmful substitutes. However, the actual production of toxic chemicals cannot be avoided altogether, but it can be greatly minimized and thus reduce the threat they pose.

Water Management

Pumps and Wells

In many parts of the world, ground water is the only source of clean water. Ground water flows in underground aquifers that are replenished by rain, which seeps through the soil. Ground water is being used faster than it is being restored. It is also being polluted by seepage containing fertilizers, pesticides and toxic wastes. There are ways of dealing with this problem besides preventing pollution in the first place. Ground water is not fast flowing, therefore if regular tests are taken from "test-wells", contamination can be foreseen. Once contamination is detected, the water can be blocked and pumped to the surface, or alternately, treated underground. There are several methods for treating the contaminated water; the most common are filtration, which removes microscopic particles from the water, and the addition of a substance such as carbon to the filters that removes pesticide and fertilizer residues. These methods, however, are expensive, and may not remove all toxic substances.

There are several ways of reaching ground water, and digging wells is one of the simplest. However, these can easily become contaminated, and they are not always deep enough. About six years ago the United Nations Development Programme (UNDP) and the World Bank tested a wide range of pumps for use in Third World villages. What

was needed were pumps that could be driven to deeper sources of ground water, and were enclosed to prevent contamination by the people and animals using them. The difficulty was finding pumps that were able to survive everyday use by an entire village. The planners and engineers were looking for a pump that could be maintained with simple skills and tools and could withstand hard wear without breaking down. These pumps should ideally be made locally so that spare parts are easily accessible. This simple technology is both effective and manageable. The system has proved its worth in the many villages where it has been put into effect.

Lakes and Rivers: Wetlands and Estuaries

Sewage treatment and the control of industrial wastes is an early measure preventing contamination. The present problem, however, is the cleaning-up of the damage that has already occurred. Toxic sludge has settled to the bottom of lakes and rivers and will continue to pollute the waters for many years. In some cases attempts have been made to dredge up this sludge, but then its disposal becomes another problem.

The problem of thermal pollution is easier to solve. Industries often use local rivers, lakes or streams to cool hot machines and then dump the heated water back into the local water source. There are several solutions to this problem. One is to build artificial "cooling ponds" in which the water can be dumped to cool before it is pumped back into the lake. A second solution would be to build cooling towers in which water is pumped up to the top of the tower, and then forced out of sprinkler heads to fall into a basin at the bottom. The water is pumped up over and over again, losing more heat each time it goes through the tower. The heat absorbed by the tower can be used as energy; this process is called "co-generation."

Some hopeful signs appear when regulations are strictly enforced over a period of time. Lake Erie had been severely affected by chemical and thermal pollution, but some years later, the trout returned. The runoff of pesticides (like DDT) into bays and wetlands was causing the possible extinction of birds like the osprey, which are only now beginning to reappear.

Sewage

Our world population of 5, going on 6 billion people creates tremendous amounts of waste. One kind of waste we would rather not have to deal with is sewage. We have always thought that sewage was useless, if not dangerous. Once it is flushed away we tend to forget about it.

At Cornell University a method has been developed to turn sewage into reservoir-quality water -- and to make a profit in the process. The two-stage process can be successful in almost any climate.

The first stage is a "biological system": anaerobic bacteria are suspended in the sewage and the bacteria convert soluble organic materials into methane gas, which is commercially useful. The second stage is when the partly "cleaned" water is placed into a shallow tank, where plants are grown. The roots of the plants remove nutrients from the water, which is then of reservoir quality. It seems that nearly all nonedible plants can be grown through this process -- for example trees, shrubs, roses, geraniums, chrysanthemums, grass, and reeds, and they can be sold commercially. This system is far superior to present sewage-treatment systems which do not clean the water so well.

Unfortunately, developing countries in which 75 percent of the world's population lives do not have the facilities to dispose of their waste. While, for us, waste disposal is not even an issue, it constitutes a major problem and health hazard for much of the world. Efficient systems of separating sewage storage from human dwellings, where it cannot cause infection and disease, need to be developed. One latrine, developed with aid from the United Nations, composts the sewage so that it can then be used for fertilizer. Latrine research is not a romantic subject, but it is a necessary one!

New Energy Sources

Most of the energy we use for heat, light and to power our machinery and transportation comes from the burning of fossil fuels. This burning not only depletes nonrenewable resources but also pollutes the environment. Using less of them, or replacing them with renewable and cleaner sources, can help the environment. A new class of ceramic superconductors has generated enthusiasm because of its promises of highly efficient energy and the possible elimination of pollution. If electric current can be transmitted over vast distances with no resistance, then less energy is needed to generate it and less fuel needs to be burned. Some forms of industrial machinery and waste may also be eliminated with the use of semiconductors in heavy industry; the magnetic forces could be used to lift and carry heavy objects efficiently.

One of the problems of earlier superconductors was the extremely low temperature to which they had to be cooled. New materials have now been discovered and they can be cooled to sufficiently low temperatures by using liquid nitrogen, a relatively inexpensive material costing 40 cents a gallon. Some problems still prevent the widespread use of superconductors, but progress is being made.

There are many natural sources of energy which could be further developed if the demand for them made production practical. The use of wind as power and the thermal energy of the ocean are both sources of energy that are nonpolluting. In addition, some residential commercial structures are being designed with solar collectors in which water is heated by the sun and used for energy. Many companies are experimenting with photovoltaic cells that are capable of directly converting sunlight into electricity.

Another option is the use of nuclear power. The potential of nuclear energy is extensive, but there are several problems. Uranium is a very valuable source of energy --- one pound of uranium can produce as much energy as 2,300,000 pounds of coal or 250,000 gallons of petroleum. Unfortunately, both the extraction of uranium and the building of nuclear reactors are dangerous and costly. And there are further dangers in the disposal of radioactive materials and of another accident like Chernobyl. Superconductors could help with some of these problems. Because they can carry electricity over long distances without loss of power, nuclear reactors could be built far from population centers.

Garbage and sewage, wastes that are dumped and cause pollution, can be used to create energy. Especially designed incinerators can burn solid waste as fuel. The Cornell University research to turn sewage into clean water has another benefit: through the action of bacteria, organic pollutants in the waste are turned into methane gas, an important source of fuel.

Political and Social Solutions

Governments and the Environment

Governments have a responsibility. When dealing with important and pressing issues, they must provide a leadership role. Government is the only institution that has the power, the means and the strength to accomplish anything on the scale that action on environmental issues requires. The greatest stumbling block is the reluctance of governments to acknowledge the severity of the situation. The challenge ahead of us is to make sure that governments understand the need to integrate environmental welfare with economic policy, and to eliminate various forms of pollution before they enter the environment.

We can influence government's actions. The main objective of politicians is to please the electorate. They will tend toward the more 'sensational' issues, to win the attention of the voters. It is therefore up to us to make the environment that issue. Once we educate ourselves, we not only push our government into action. If we have the political will to use our power we can bring about the kind of change we need to save the environment.

Responsibility for the environment goes beyond the individual, to industry, financiers, and many different agencies. The media also bears a responsibility to make sure that the

actions of these groups are accurately reported and that they know that they could be called to account at any time. Such "citizen surveillance" is both a threat and an opportunity for a new partnership between government and industry and the people.

In the industrialized west, one environmental movement has gained prominence and political significance. The Green Party became a part of West German politics about eight years ago, and it has now become a European movement with seats in the legislatures of several countries. The movement is essentially a strong advocate of ecological balance and nonviolence. It is important to realize that the Greens have had a significant effect on German politics in the sense that the mainstream parties are now more concerned with environmental issues. This matters a great deal because it shows that if environmental awareness is improved and people become involved in this issue through a group or movement, the government is forced to be more sensitive to the environment.

One of the worst problems in getting government to take action is the way it is organized. Bureaucracies are slow moving and agencies that are set up to deal with problems usually act to patch up the damage rather than prevent it in the first place. Another nuisance is departmentalization of the existing agencies. Because of this separation, economic decisions can be made with no inkling of the effect they may have on the environment. Government leaders also act irresponsibly when they pass legislation to appease certain special interest groups.

Environment and the Law

There are two legal forums which deal with the environment: the national court systems and the International Court of Justice at The Hague. Because of the differences between the court systems of the world, the International Courts take on special significance as the only common meeting ground. An obstacle for the environment here, as it is with all issues, is that disputing countries must agree to abide by the decision for it to be effective. There is no international police force that can make sure of compliance. International law must be strengthened both to perfect the rights of different countries in relation to each other and to insure a healthy environment for the individual.

Another problem is the length and cost of litigation. It has become almost impossible for small environmentalist groups to take environmental offenders to court. In the United States, the recently contested case of Kemner vs. Monsanto, involving the toxic chemical dioxin, that pitted a community against an industrial company, illustrates some of these problems. The four-year trial appears to be the longest running jury trial in U.S. history. This case is far from over yet: the two sides are getting ready to appeal the present verdict.

The Bhopal gas leak case, being fought in the Bhopal district court, pits the Government of India against Union Carbide. The judge ordered Union Carbide to pay $270 million in interim relief. The company objected to paying compensation before the case had been settled. However, even though this idea was obviously unappealing to Union Carbide, it is a very good way of compensating victims while a trial runs on. Courts provide us with the possibility of such litigation. The enormous fines that could be imposed on polluters are strong deterrents from continuing such behavior.

In the United States, the work of the Environmental Protection Agency (EPA) has been hindered by its tendencies to sympathize on the side of industry. As a result many special-interest environmental groups, such as the Environmental Defense Fund (a non-profit group that litigates and does research) and the Natural Resources Defense Council (another litigating group) have sprung up to back the environmental cause. The EDF and other environmental groups envision the birth of a "new environmentalism." Industry cannot always be blamed as the villain in causing harm to the environment. We need the goods and services it produces, and the jobs it provides. There are alternate ways of dealing with the problem. One of the first moves that must be made is research leading to constructive suggestions. The EDF does just that; it now searches out new solutions in both technology and procedures and urges

corporations to use them instead of being taken to court.

Social Resources

"The earth does not belong to man. Man belongs to the earth. The earth is our mother...All things are connected like the blood which unites one family. Whatever befalls the earth befalls the sons and daughters of the earth."

Chief Seattle, 1855

As human beings, we have seen fit to take our earth for granted. We have never hesitated to exploit it in order to gratify our immediate wants. We have felt free to abuse our fellow humans as well as the earth and its other inhabitants.

Now that we realize the position we have put ourselves in, we panic. We throw around accusations to find the scapegoat for our problems. But even though we made the mess, we are reluctant to clean it up. We begin to feel that the task is altogether too overwhelming, and that nothing we can do as individuals will make a difference. This is just not true.

We are our own best resource for solving the problems we have made. Although people take, they also give. We complain of over population, but healthy, educated people are not a burden on their societies. They have energy, ingenuity and, let us hope, good will.

We are concerned about genetic diversity among plants and animals, but we should also treasure the cultural diversity within our own species. We can learn from each other's experiences how to enrich our lives without harming the earth we inhabit. We need to respect and protect those people who still live close to nature, indigenous people all over the world who have much to teach us. Our technological "sophistication" has given us a sense of superiority. Perhaps we need more humility to see value in different life-styles.

The ability to change is within each of us, whether we are willing to allow it to surface or not. All we need is a subtle shift in attitude and behavior. No one enjoys having to sacrifice comforts they have become accustomed to, but it must be done. We cannot just think of ourselves right here, we must look to our planet's future. We should learn to give as much as we take from the environment. If we want our standard of living to remain, isn't it better to give a little now than to have it all taken from us later?

Shortening one's shower by ten minutes saves many liters of water; buying biodegradable detergents helps keep rivers clean and thus saves the lives of thousands of fish; collecting newspapers for recycling drastically reduces the number of trees that are cut down each year; putting on a sweater instead of turning up the heat, or opening a window instead of turning on the air-conditioner, conserves watts of electricity; and buying organically grown food instead of those grown with the aid of chemicals, pesticides and fertilizers, helps reduce land and water pollution. All of these, though seemingly minor, can make a world of difference.

We all tend to be sticks in the mud when it comes to changing our ways. The appalling condition of our environment is not just due to big industry, although we like to make it easier on ourselves by saying so. We have a responsibilty too, and we must face up to it.

We have been tough on the earth, now its high time we were tough on ourselves. We, as groups and individuals, have the strength to make the difference. We can lobby against our governments' weak policies concerning the environment. We can start conserving and putting back as much as we take out. And we can stop supporting the industries which produce their goods at the expense of our rapidly degrading environment.

It is essential that we take a new stand. We have been lying to ourselves and rationalizing away the problem for too long. We must face the global picture and realize that we have the power to bring about change.

THE GLOBAL VIEW

Introduction

Acid rain knows no boundaries; nor does toxic runoff or industrial waste. There are lessons which "mistakes" like Chernobyl and the Rhine River have taught us: environmental disasters do not discriminate.

As nations are becoming more and more dependent on each other, the need for international cooperation is becoming increasingly apparent. This is especially true on matters concerning our environment. Nations can no longer deal with pressing problems individually; the need for global preventive action has become urgent.

International cooperation is not an impossible task. In fact, it now seems inevitable. Nations must, and have begun to, work together to solve the problems which threaten to destroy our existence. A new awareness concerning the interrelationship of the environmental and economic factors has spurred international action. We have come to realize that environmental abuse is not confined by territorial boundaries, but is a shared problem, one that affects the earth, the oceans, and the atmosphere, all of which, are part of our "only one earth."

"Our Common Future"

The United Nations has been aware of the problem of environmental degradation and its effect on the human condition for many years. At the urging of the General Assembly, the Secretary General established the World Commission on Environment and Development in December 1983. Headed by Gro Harlem Brundtland, the current Prime Minister of Norway, the commission published a report in March 1987 entitled "Our Common Future."

This report, also known as the "Brundtland Report," outlines many of the consequences of environmental degradation and proposes several ways by which the problem can be dealt with on an international level. The report does not concern itself with the environment alone, but stresses the importance of the link between economic development and the preservation of the environment.

Development, in both industrialized and developing nations, has been the cause of many ecological disasters. Within industrial nations toxic and chemical wastes pollute the air and water systems, and, often, careless and excessive use of land and forests causes ecological disasters. Rapid industrialization, which has been a part of recent development strategies, has also created strain on the environment.

The Brundtland Report recognizes poverty as one of the major causes and effects of global environmental and economic problems. Poverty causes nations to destroy their environment in a desperate attempt to feed their people, and to be able to export in order to repay international debts. But this damage causes further poverty which, in the long run, hinders economic growth. The vicious cycle of poverty which leads to environmental degradation that, in turn, leads to even greater poverty, is as unacceptable as the ecological misuse that is occurring in industrialized nations.

The Brundtland Report stresses the importance and need for major changes in both the attitudes and organizations of our societies, and proposes to reverse the process of ecological exploitation through what is called sustainable development. At the rate at which we are consuming nonrenewable fuels and

abusing the earth, we shall be without resources in the latter half of the twenty-first century, leaving our grandchildren with a depleted shell of a once fertile planet. It is necessary to stop the exploitation of the earth by adopting the kind of development that can be carried on over a period of time without stripping the environment of its resources.

The Brundtland Report suggests several prerequisites for sustainable development. One is economic growth for all nations, particularly those in the developing world. Another is that a global minimum living standard must be established in order to improve the conditions of the poor. Others include: basic human needs such as food, water, and shelter that must be satisfied by assuring all people jobs. Population growth must be stabilized through education and health care. The rate at which limited fossil fuels are consumed must be reduced. Technology must be appropriate for the broad purposes of sustainable development. Equal weight must be given in policy decisions to both economic and environmental concerns.

In order for involvement at the local level to take place the local people must be given the power to make the necessary changes. Their involvement is essential if sustainable development is to be successful on a large scale. Thus, sustainable development has come to mean an economic strategy which engenders a whole new mode of thinking -- cooperative, self-reliant, participatory and above all, caring.

The Global Commons

The oceans, outer space, and Antarctica, areas known as "global commons," are international domains over which no nation has any jurisdiction. The United Nations has developed a series of agreements protecting these areas from exploitation or pollution.

The Law of the Sea

In December 1982, after more than a decade of controversy and negotiation, the Third Conference on the Law of the Sea completed a Convention and invited member states to sign it.

One of the main issues dealt with in the convention is marine pollution. There are several types of pollution which affect the oceans. Pollution originating on land reaches the oceans through rivers, estuaries, reservoirs, pipelines and drainage sewage installations. Countries are required to pass laws regulating this.

Pollution from seabed activities -- like mining or oil drilling -- will be controlled by a Seabed Authority. Pollution on the high seas comes from "dumping" wastes from ocean going vessels which is very difficult to monitor. Flag states are responsible for seeing that their own vessels comply with marine-pollution laws. The port state may investigate any alleged pollution incident involving foreign ships. Countries can take any necessary action, including the detention of a ship, if pollution is suspected and if it takes place on their territorial sea.

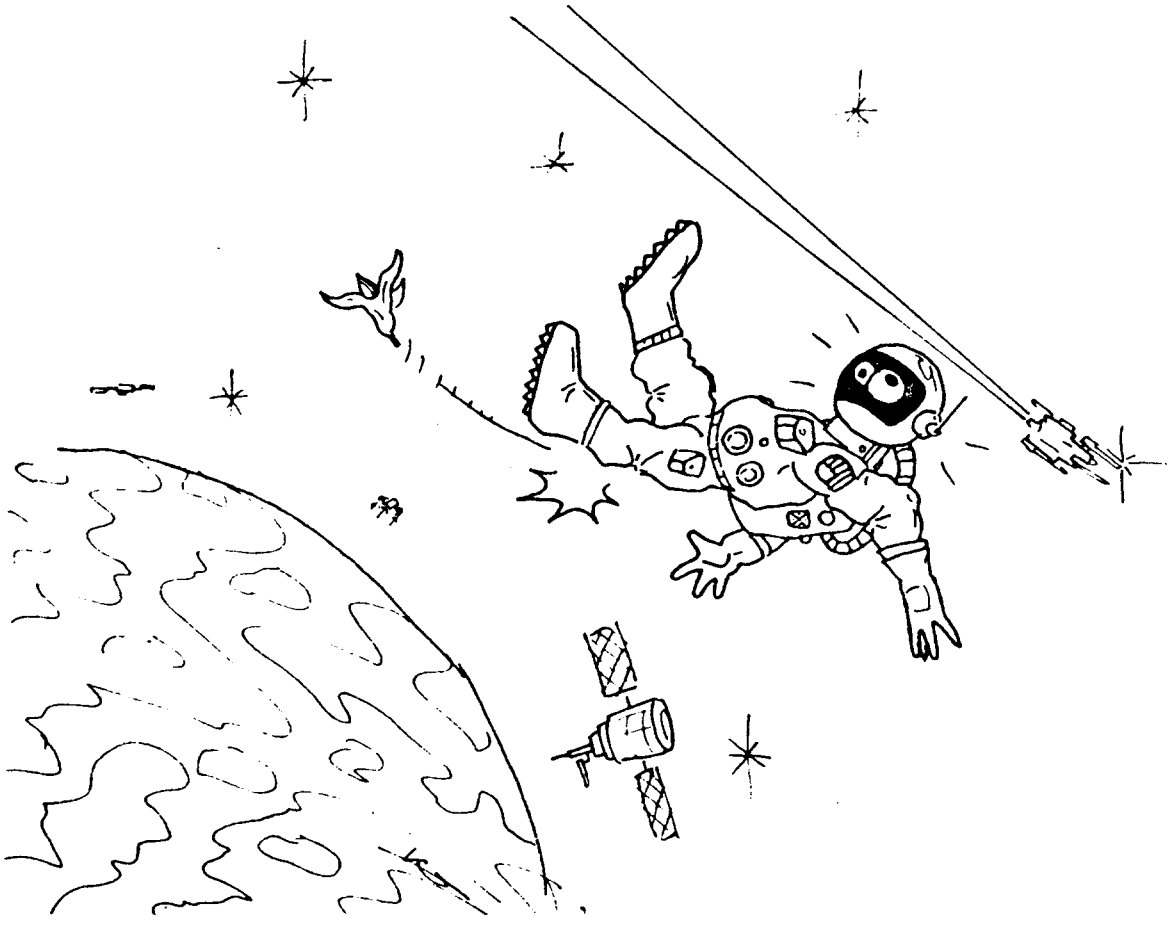
One year after it is ratified by sixty states the Convention will go into effect. As of November 1987, thirty-five states had ratified it.

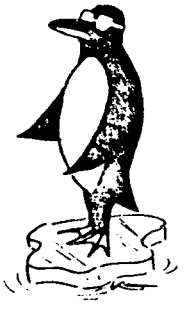
Outer Space

Space will probably become the most vital of the global commons. When we have exhausted the limited resources on our earth we shall have to look to space for new energy sources. John F. Kennedy described the importance of space best when he called it the "new frontier."

Outer space is essential to communications, new pharmaceuticals created as a result of zero-gravity experimentation, and understanding of the composition of the universe. From space, it is possible to study the earth as a whole: the divisions humankind imposes upon it cannot be seen.

Our future will require resources greater than any one nation can amass, and will therefore necessitate a common endeavor on the part of all nations. Early signs of this cooperation can be seen in the forthcoming U.S.-Soviet mission to Mars.





It is, however, possible that the probes will not be able to leave the earth's vicinity as they may be blocked by the thousands of pieces of debris orbiting our planet. These objects are the remains of earlier launchings -- expended boosters, instrument covers, clamps, and a multitude of other objects. Seven thousand of these objects have a diameter greater than 20 centimeters in size. Two thousand are in the 10 to 20 centimeters range, and about 50,000 are less than 10 centimeters in size. This is not an insignificant amount as even a 0.5 millimeters metal chip traveling at 30,000 kilometers per hour can easily penetrate a space suit and cause the death of an astronaut.

The Outer Space Treaty, ratified by the member states of the United Nations in 1967, hopes to achieve the removal, or at least control of this "space garbage."

Antarctica

Antarctica is the only continent with no indigenous human inhabitants. It has an animal population of insects, fish, birds and mammals. In addition, coal, oil, gas and minerals can be found.

The harsh weather conditions make it almost impossible to live in Antarctica. Major disputes between nations over territorial claims would be difficult to sustain.

Antarctica was declared a " Global Common" on June 23 1961, in a treaty signed by eighteen countries. The treaty states that Antarctica should be used for peaceful purposes only. It prohibits military maneuvers, nuclear testing, and the storage or disposal of radioactive wastes. Nations that are full members to the treaty may inspect each other's stations, ships and planes, to insure that all follow its terms. If conflict arises, parties should negotiate among themselves, and if they cannot arrive at an agreement they should take their case to the International Court of Justice in The Hague.

Very few disputes have arisen. It might be possible to find profitable sources of exploitation in krill, a species which closely resembles shrimp, in the waters surrounding Antarctica. Mining in Antarctica could also be profitable, giving rise to competing claims. However, scientific cooperation in research has so far proven to be more advantageous than any of these other alternatives.

The United Nations

The United Nations system has many vital roles to play in strengthening cooperation between nation states for the protection of our common environment. It can organize research and assemble and present the results to the international community because it is trusted as a source free of commercial or other special interests. It can gain support to enact a new international law for the protection of the global environment. It can get the nations of the world to agree on global strategies and to invest resources to implement them through its system of development funds and specialized agencies.

In 1972, these roles were recognized at the special United Nations Conference on the Environment held in Stockholm, Sweden, and the governments of the world decided that a new "lead agency" would be needed. It is called the United Nations Environment Programme (UNEP), with headquarters in Nairobi, Kenya.

Governments, however, have not made UNEP a big agency. They decided that it should have a small staff although, made up of high-level specialists. The annual budget of UNEP seems at first sight to be ridiculously small, only about $40 million -- the combined budgets of the Bronx and San Diego zoos. But because it is a U.N. body, UNEP has been able to mobilize vast human resources in undertakings all over the world and persuade governments to invest more and more funds into environmental work.

In research, for example, UNEP works with the United Nations Educational Scientific and Cultural Organization's (UNESCO) Man and the Biosphere Programme, which is doing research in seventy countries. UNEP works with the World Health Organization (WHO) on health and environment and has just been asked to add to its health research a study of risks from diesel vehicles fumes and acid fog. Another example is UNEP cooperation with the United Nations Centre for Human

Settlements (UNCHS) to study how to insure environmentally sound communities.

All of the research is designed to lead as quickly as possible to decisive international action, where again the United Nations' role is to mobilize this action through moral leadership and by making accurate information available to everyone. Thus UNEP operates "INFOTERRA," a global data bank of information about the environment and the damage it is sustaining. UNEP maintains the world's first "International Register of Potential Toxic Chemicals" (like a "Wanted List" of chemicals that may be poisonous), with the United Nations World Meteorological Organization (WMO) and the International Council of Scientific Unions. There is now a worldwide network to monitor global climate change. The most recent and dramatic result of this kind of work has been the new Ozone Protocol signed in Montreal, Canada, in September 1987, under UNEP sponsorship. UNEP is now preparing another new international legal treaty that will control the movement of hazardous wastes across national boundaries.

The impartial authority of the United Nations can often achieve agreement where other channels have failed. All the countries bordering on the Mediterranean Sea have now agreed to curb the very dangerous emissions of industrial and sewage waste. UNEP works with the United Nations Development Programme (UNDP) and the United Nations Sudano-Sahelian Office (UNSO) to combat the desert that is creeping south below the Sahara in Africa, and to find new ways of helping growing African populations have enough cooking and heating fuel without destroying all the trees and bushes in their environment. Another program is concerned with preventing modern development from further destroying the tropical rain forests. The U.N.'s objective is to persuade all governments to make an "environmental impact assessment" of every proposed development project so that it will not have the poor results that many have had, and mobilize world public awareness that every village, every province, every city, is a part of Planet Earth's future.

While much progress has been made, it is clear that it has not been enough or fast enough. Governments are beginning to realize this: the new ozone layer protection agreement was signed in record time. But in many parts of the world, there is still resistance to the idea that social control of technology, is needed. Massive funds must be invested quickly and on an international basis simply to halt change to our irreplaceable environment and repair the damage already done. The U.N. system is not anywhere near being a world-environment protection authority; its entire budget for everything it does in every field (about $5 billion a year) equals the amount that the United States and Canada are talking about spending merely on acid rain monitoring, research and prevention.

How far and how rapidly the nation states will be willing to work together, accept U.N. leadership, and invest in its global and regional strategies to protect the environment of planet earth will probably depend on what "We the Peoples of the United Nations" will demand. Social and economic change can only come about through political will. Are we prepared to take action and compel our governments to pass legislation to bring about the aims and ideas of sustainable development?

PERCEPTIONS

"The White people never cared for land or deer or bear. When we Indians kill meat, we eat it all up. When we dig roots, we make little holes. When we built houses, we make little holes. When we burn grass for grasshoppers, we don't ruin things. We shake down acorns and pine nuts. We don't chop down the trees. We only use dead wood. But the White people plow up the ground, pull down the trees, kill everything. The tree says, "Don't. I am sore. Don't hurt me." But they chop it down and cut it up. The spirit of the land hates them. They blast out trees and stir it up to its depths. They saw up the trees. That hurts them. The Indians never hurt anything, but the White people destroy all. They blast rocks and scatter them on the ground. The rock says, "Don't. You are hurting me." But the White people pay no attention. When the Indians use rocks, they take little round ones for their cooking....How can the spirit of the earth like the White man?...Everywhere the White man has touched it, it is sore."

Holy Wintu Woman[3]

"The old Lakota was wise. He knew that man's heart away from nature becomes hard; he knew that lack of respect for growing, living things soon led to lack of respect for humans too. So he kept his youth close to its softening influence."

Chief Standing Bear of the Lakota[3]

Consideration

I miss seeing stars at night. Being from Arizona, I'm used to seeing stars. I guess I took them for granted because I didn't really appreciate them until I came to New York City; and suddenly I couldn't see stars in the sky anymore.

I'm deathly afraid that in the near future, billions of other people like me will come to a similar realization on a greater scale; How long will it take to notice that the trees are gone? Or that food no longer has a taste? Or that water has gained one? How far must the condition of the earth deteriorate before we notice and take action? A small thing such as not being able to see stars made me realize that something must be done to help ourselves.

After leaving the protective shelter of my bedroom walls, all my senses are assaulted: a siren can be heard from the street below, the television informs me of the amount of U.S. dollars spent on nuclear arms -- I change the channel. A commercial showing starving people in Africa appears; some people are asking for a donation. A National Geographic program comes on telling about people clubbing baby seals and hunting whales. I take down an address they give and turn off the television. Sending money to the organization will be an easy way to get it off my conscience and I will soon, hopefully, forget about what I have seen. I walk into the kitchen and drink a glass of water. Its aftertaste lingers in my mouth as I go out into the street, on my way to school. The stench of the car exhaust burns my nostrils at first, but I soon get used to it. And the

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3. Quoted in T.C. McLuhan, *Touch the Earth*

roar of motors along with honks and screeching stops become a small blur in the corner of my mind. Arriving in school, the outside world is soon forgotten; I am caught up in "my own problems" and must concentrate on schoolwork. But there is always a twinge of worry nagging at me.

In the fast-paced world of today it is hard to see oneself in perspective with the entire planet because there is so much going on within a close perimeter. Trying to form a relationship between the rainforests in South America and yourself -- understanding how their disappearance will affect you -- is not always possible. "The Environmental Problem" is how it is always described. Not OUR environmental problem. "THEY are cutting down all the forests" is the phrase used instead of "WE are killing our own trees." The way we speak of our world and describe IT (instead of Her) alienates us from our world. The world is always described as a separate being from ourselves. Instead of an extension of ourselves, our world is seen as a thing, or a rock, on which we live. Immediate problems take precedence over long-term ones. Factories and large industries are more concerned with profits than with long-term consequences. People are concerned with themselves.

Last week I proposed recycling bottles, cans, and paper to my parents. "Too much trouble," was the reply I received. And I admit, I wasn't very eager myself to fish through our garbage to pull these things out and bring them back to school, or the store, etc. Other ideas, such as not taking a shower every day in order to conserve water, were also vetoed. Perhaps the problem isn't really with the government or industry, but with society and the individual. Our environmental problem doesn't need more solutions -- just more care.

Amanda Topaz

What's your Excuse?

"Preserve the environment!" they scream. A scream heard too often to take any notice of. If one needs to adopt a cause, why would one choose the environment? It is certainly more glamorous to belong to Amnesty International than to empty out paper-recycling boxes! "We are butchering the Earth, our precious and unique home..." True, but "slash and burn" seems far less criminal when applied to trees. Two thirds of the world belly goes to bed starving, and we are supposed to worry about the whales and the eagles? The environment is important, but isn't there a matter of priorities here?

Why environment indeed. One cannot look on this as another "cause". It is more like cleaning your room. I like to let everything accumulate on my floor; the magazines near the closet, schoolbooks closer to my desk, novels generally finding themselves under my bed. Everything with its own general "area" on my carpet, an indolent system that has worked for the last four years of high school. Last Christmas, two days before leaving the country, I couldn't find my passport. Fourteen days and $60 later, after I had gone through a whole bottle of Tylenol, my room was, and still remains, perfectly organized. Mother nature has repeatedly entreated us to clean up. If we do not listen, lives will be lost -- unlike passports, there can be no applying for new ones.

Take a drive down the New Jersey Turnpike at night. One can see a graveyard of smokestacks, switchyards and catwalks. The nauseating belches of smoke do nothing to dispel the bleak isolation of these manmade plants. It is ironic that these perversely large science labs should be called plants. Don't think environment is for sobbing nature lovers only. Meddling with nature is more dangerous than we would like to think. Chernobyl, ozone, photochemical smog -- how these words pass right through us!

There is a point where idealism and dreams must merge into things done. It is not enough for us to write articles, hold conferences and strut around wearing buttons on our chests. The problems are very real, and no amount of wishing will diminish them. There is a saying, "A vision without a task is but a dream, a task without a vision is drudgery, a vision and a task is the hope of the world." (Seventeenth century English church saying)

Amal Jasentuliyana

In late 1984, rumor had it that unless factory, car, plane and cigarette fumes were reduced, the world would experience incredible changes in the whole weather scheme and that by the turn of the century the poles would melt, flooding some major cities. The oceans would rise, submerging some bodies of land, and the Sahara Desert, although hot as an inferno, would be wet, maybe even fertile.

"What a disaster"! I thought, turned off the television and then walked to my bedroom at ease, knowing that the governments in charge of the world would stop this fiasco, would temporarily close down factories and, in hours of conference upon conference, devise some system that would reduce the pollution.

But the next day, the factories across the river were still in service, the smoke rising from the stacks in seemingly innocent puffs of white cotton.

And the next day, and the next day were the same.

Maybe that's why, when it comes to this issue, I'm jaded. The world needs to understand the complexity of the problem and take action. But we won't. The EPA and the U.N. groups need support from the people, from the world at large, and most of all, the cooperation of each and every government. Without this alliance of forces, the realization that this is not just a United States or Canadian or Soviet or Brazilian issue, that this is our business and that we must work together to overcome it, close to nothing can be achieved, and very slowly at that.

The first step is recognizing the sure death of the human race unless action is taken, and from then on it is a race against time and decay: I hate to think that the day the world takes any notice of the problem will be the day we all go up in smoke.

Nura Osman

"We have not inherited the earth from our fathers, we are borrowing it from our children."

I'm angry at my parents and the adults around me for concerning themselves with my future profession and future salary, but not my future home -- the Earth. They have left me an inheritance of factories, nuclear arms, and pollution among other things saying, "Here! Look at all we've made for you. Take it and earn a living."

I for one refuse it. I won't just live with the world the way it is now. My mother died of cancer. I don't intend to. I like people trees, animals and life in general; I want to preserve them.

My parents weren't aware of a problem with the environment, but I am. I can do something about it. I'm not always sure what, but there must be something. I'm patient. Although I don't expect everything to change in one day, there is hope. We can save the world.

Amanda Topaz

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