THE LITHOSPHERE AND LAND POLLUTION

- **THE EARTH**

Often air pollution causes people difficulty breathing. Some groups of people such as infants, the elderly, and people with asthma or other respiratory diseases are more heavily affected by air pollution.

Pollutants in the air, caught in air currents, can cause problems hundreds and even thousands of miles away from where the polluting actually took place. So even people who do not live in a region that is being polluted are affected.

The ozone layer, is one layer in our atmosphere which protects us from sun rays which can harm people. CFCs emitted into the air by Styrofoam, aerosol spray cans, air conditioners, refrigerators, and fire extinguishers destroy the ozone layer.

Not only does air pollution make the air unclean for people and animals to breathe, but it is actually the perpetrator behind acid rain and the greenhouse effect.

- Sulfur dioxide, given off as power plants burn coal or oil, can mix with water vapor and other compounds to form sulfuric acid.
- Nitrogen oxide emitted by automobiles can change in our atmosphere into nitric acid.
- Rainfall is usually slightly acidic with a pH of 6. Acid rain with a pH of 3 is approximately 30 times more acidic than a normal rainfall.
- Acid rain is considerably more acidic than tomatoes. Its acidity fluctuates between the acidity of coffee and vinegar.
- Acid rain can destroy forests and kill animals which drink and live in the streams, ponds, and rivers it contaminates.

- As the earth heats up sea levels may rise. Areas such as southern Florida or Louisiana could flood. When a climate zone shifts, those organisms unable to move and keep up with the change in region could become extinct.
- Carbon dioxide traps the heat. It is created by burning gasoline, coal, oil, and natural gas, as well as when tropical forests are cut and burned.
- Each gallon of gas that is burned releases 20 pounds of carbon dioxide into the air.
- About 50 acres of rain forest are destroyed every minute. The burning of these forests, not only destroys the forest, but it releases carbon dioxide into the air helping to cause a growing problem of global warming through the green house effect.

- **ROCKS**

The global climate depends to a large extent on the carbon cycle. I don't mean the short−term fluctuations that underlie today's climate−change debate, but changes on the scale of many millions of years. The Cenozoic Era of the last 65 million years has been marked by steady cooling and a steady lowering of the carbon dioxide level in the air. That greenhouse gas is removed from the air by green plants, most notably the floating microscopic plants, or phytoplankton, in the sea. As they die, their organic remains rain down upon the seafloor and are partly buried and partly recycled by seafloor life.

Erosion affects this process in two ways. First, the more erosion there is on land, the faster seafloor carbon is buried. The great rivers draining the young ranges of the Himalaya, the Andes, and the American cordillera account for an enormous amount of carbon burial. Second, the more erosion there is on land, the more mineral

nutrients enter the ocean through the world's rivers. Dissolved iron, calcium, and silica from eroded rocks are quickly taken up by phytoplankton, so erosion also serves directly as a fertilizer.

The cool climate of the Cenozoic, therefore, is reinforced by erosion. And the strongest, most effective type of erosion is done by glaciers. In fact, one theory is that glaciers are such potent eroders that they set the height limit for mountains over the whole planet. For that reason, current thinking is that mountain−building, which exposes rocks to erosion both ordinary and glacial, is the real engine of Cenozoic cooling. And mountain−building comes directly from the movements of crustal plates. That insight places erosion right in the thick of current research.

- **SOIL**

Erosion is the wearing away of a material. On earth this material might be sand, rock, or soil. Erosion often occurs when the vegetation that once grew in an area is removed or is too weak to hold the soil in place. Then the loose soil, no longer anchored by the roots of the plants, is exposed for the wind to blow it away or rain and flood waters to wash it away.

In some areas plants are destroyed by acid rain. As the trees and plants die they no longer support and hold the dirt. Also, the slash and burn method being currently used in the rain forest leaves only ash which is removed by wind and rain within just a few years.

Desertification means literally "making a desert," it refers to the erosion of land, usually by wind, in a hot dry area.

Sahel, a region of Africa located south of the Sahara Desert, is quickly becoming desert. Where once there was grassland which herdsman used, moving with the wildlife to the best grazing areas seasonally, there are now small towns and villages. These establishments continually drain the Sahel land of its water from wells, and permanent herds trample and overfeed on the dwindling vegetation. As the plants are unable to grow and reproduce the soil is being swept away leaving desert in its place.

Even parts of the United States have been victim to desertification. At one time Oklahoma was settled by farmers raising cattle. The cattle fed upon already dry grasslands, which seemed abundant. However, in the 1930's a drought occurred. The already taxed land was windswept, blowing the topsoil away. The dust even blocked out the sun, giving this area the name The Dust Bowl.

- **CLAYS STRUCTURE**

The clay minerals are a part of a general but important group within the **phyllosilicates** that contain large percentages of water trapped between the silicate sheets. Most clays are chemically and structurally analogous to other phyllosilicates but contain varing amounts of water and allow more substitution of their cations. There are many important uses and considerations of clay minerals. They are used in manufacturing, drilling, construction and paper production. They have geat importance to crop production as clays are a significant component of soils.

It is the physical characteristics of clays that more so than the chemical and structural characteristics define this group:

- Clay minerals tend to form microscopic to sub microscopic crystals.
- They can absorb water or lose water from simple humidity changes.
- When mixed with limited amounts of water, clays become plastic and are able to be molded and formed in ways that most people are familiar with as children's clay.
- When water is absorbed, clays will often expand as the water fills the spaces between the stacked

silicate layers.
- Due to the absorption of water, the specific gravity of clays is highly variable and is lowered with increased water content.
- The hardness of clays is difficult to determine due to the microscopic nature of the crystals, but actual hardness is usually between 2 − 3 and many clays give a hardness of 1 in field tests.
- Clays tend to form from weathering and secondary sedimentary processes with only a few examples of clays forming in primary igneous or metamorphic environments.
- Clays are rarely found separately and are usually mixed not only with other clays but with microscopic crystals of **carbonates, feldspars, micas** and **quartz**.

- **HUMANS**

Each of us, no mater how carfully we watch what we eat and drink, has traces of industrial chemicals and pesticides lodged in our bodies. It's an unavoidable outcome of living in the world today. Some of these chemicals go by the names of DDT, PCBs, PBB, dioxin, furans, and mercury. These toxins enter our bodies through the food we eat, the water we drink, and the air we breath. Fish and other animals we consume in our diets are also exposed to these toxins the same way. What this means to us is that we receive even higher doses of these toxins, an effect called bioaccumulation. This simply means that the higher you are on the food chain the more of these toxins you'll have stored in your body. The reason for this is that these toxic chemicals don't break down but rather are stored in our fat tissues. When we consume animals that have been exposed, we are consuming the toxins from their systems and adding to our own stores of the chemicals. This progression through the food chain is bioaccumulation and is very dangerous to our health.

Most of the toxic chemicals found in our water supply are fat soluble, which means they remain in a person's body for long periods of time. Every time we drink contaminated water or eat products that were given contaminated water we add to a growing toxic store held in our fatty tissue. Whenever fat deposits are used, such as with what occurs in pregnancy, weight loss, and nursing, these chemical hormones re−enter the blood stream. A mother can pass a portion of her accumulated toxins across the placenta and through her breast milk to her fetus. To the developing embryo, in which many key stages of development are orchestrated by hormonal action, the effect of these chemicals can be devastating.

Most people in the United States and around the world already carry levels of endocrine−disrupting chemicals very close to those found in animals with health disorders linked to endocrine disruption.

Vulnerability
These chemicals affect all humans, some more than others. For example, pregnant women and children are the most vulnerable. Even people that appear healthy pass on the toxic chemicals to their offsping. You see, the effects of living in a polluted environment may not readily appear in a healthy adult, but when they decide to have children the effects of pollution might be readily apparent.

Children can become exposed in utero and through breast feeding at critical stages in their development. In fact, most people receive up to 12% of their lifetime dose of toxic chemicals in the first year of life. Young children are more sensitive to the effects of toxic chemicals because they eat and drink more per body weight and have faster metabolisms than adults. In addition, children do not have fully developed immune systems to help them fight off the effects of these toxics.

Toxic Effects
Toxic effects of chemicals found in our water supply include learning impairment and hyperactivity in children, lowered sperm count in men, immune system disorders, and cancer. Chemical hormones found in our water are now also being traced to increased breast cancer in women, and prostate and testicular cancer in men. " Serious genetic damage might also be occurring. Only time will tell, but we are already seeing serious genetic damage in many species of wildlife that are dependent on the same water supplies we are.

- **SOIL PH**

The soil pH is known to have a major impact on performance of termiticides because it affects how rapidly a compound degrades. The pH is used to describe whether soil is acidic (pH less than 7) or alkaline (pH above 7). Most soils have pH values between 4 and 8. In general, termiticides used today persist longer in acidic soil than in alkaline soil.

- **POLLUTIONS TREND IN PANAMA**

Urban centres are growing extremely quickly throughout Latin America, which automatically leads to a constant increase in private motorised traffic. In the countries of Central America, there are up to 16% more vehicles on the roads every year. It is estimated that 70% of urban air pollution is caused by motorised traffic. This is where the Clean Air Programme of the Swiss Foundation for Technical Cooperation (Swisscontact) comes in: the conduction of regular vehicle checks and vehicle maintenance, the introduction of unleaded petrol and the equipment of all vehicles with catalytic converters are efforts that aim at the reduction of vehicle emissions.

Concentration (Mg/cubic meter) in Panama	
Total Suspended Particulates	499
PM10	85
LED	1.5
Nitrogen Dioxide	41

- **SOIL POLLUTION**

This problem affecting plants include the overuse of pesticides which selects for resistant strains of insects and weeds, the loss of topsoil due to overdevelopment and soil erosion, and the uptake of toxic chemicals through the mismanagement of solid waste. Not only are agricultural crops affected, but natural vegetation in special habitats like in Hawaii are threatened. Although occupying less than 0.2% of the US landmass, Hawaii contains 27% of its endangered birds and plants. Seventy two percent of all the US species that have become extinct in the past years did so on the Hawaiian Islands.

- **PESTICIDES**

Pesticides, poisons, are used to protect agricultural crops from pests. Pesticides, such as insecticides do kill the insects which destroy many crops. However, in the process they also destroy the beneficial insects such as bees and wasps, which pollinate the crops, and predator insects which help to keep the pests under control.

In some cases the insects which are pests grow and reproduce more quickly than the predator insects which keep them under control. If this occurs, then the insecticides actually benefit the pest population and cause more damage than would have otherwise been caused.

In addition, pesticides can contaminate streams, killing off wildlife in the area. They also leave residues on many of the foods we eat making them unhealthy for people.

Biological control refers to the introduction of a high population of beneficial predatory insects. Insects such as ladybugs, who attack and feed upon aphids; the spined soldier bug, who feeds upon the Mexican bean beetle larva; or the preying mantis that eats a vast variety of pests, are placed on the farmland in order to keep the pests under control. The greatest difficulty with biological control is that when a new pest arrives on agricultural shipments or even in the tread of planes it often takes a while for scientists to learn and collect natural predators for these pests.

- **INSECTICIDES**

We'll treat here different kinds of insecticides:

Inorganics

Inorganic compounds of arsenic, such as lead arsenate, have long been used against insect pests.

However, these materials

- are highly toxic to nontarget organisms and
- persist in the environment. (Years after apple growers stopped using lead arsenate, high concentrations of lead can still be found in orchard soils.)

Botanicals

These are organic molecules (or mixtures) extracted from plants. Popular examples:

- pyrethrins
- rotenone
- nicotine
- azadirachtin. This extract from the neem tree affects insect growth and is discussed further under growth regulators.

Features:

- very toxic to insects
- relatively harmless to other organisms (except fish!)
- decompose readily so residues do not accumulate on crops or in the soil
- expensive, but you can get
- more bang for the buck by adding a synergist like piperonyl butoxide. Synergists have little toxicity themselves but enhance the effectiveness of the insecticide with which they are mixed.

Pyrethroids

Pyrethrins break down so rapidly in sunlight that they are of little use outdoors on crops. However, a number of synthetic pyrethrin−like substances − called pyrethroids − do not have this defect and are effective.

Example:

- permethrin (Ambush®, Pounce®)

Bacillus thuringiensis (B.t.)

This bacterium parasitizes many caterpillars. Its spores and/or mixtures of its protein toxins are now being used against a variety of insect pests. Examples:

- Dipel®
- Javelin®
- Agree®

These are all stomach poisons; that is, they must be ingested to work.

- **POLYCHLORINATED BIPLENYLAS PC**

DDT was the first of a long line of insecticides based on hydrocarbons with chlorine atoms replacing some of the hydrogen atoms. Its chemical name is dichloro, diphenyl, trichloroethane (see figure).

Some others:

- methoxychlor
- dieldrin (see figure)
- dicofol (Kelthane®)
- endosulfan (Thiodan®, Phaser®)

DDT was introduced during World War II and, along with penicillin and the sulfa drugs, was responsible for the fact that this was the first war in history where trauma killed more people − combatants and noncombatants alike − than infectious disease.

DDT is effective against

- vectors of human diseases such as
    - ♦ malaria and yellow fever (both transmitted by mosquitoes)
    - ♦ plague (transmitted by fleas)
- many crop pests

Prior to the introduction of DDT, the number of cases of malaria in Ceylon (now Sri Lanka) was more than a million a year. By 1963 the disease had been practically eliminated from the island. However, growing concern about the hazards of DDT led to its abandonment there in the mid−1960s, and soon thereafter malaria became common once again.

DDT was especially effective against malarial mosquitoes because of its persistence − its resistance to breakdown in the environment. One or two sprays a year on the walls of homes kept them free of mosquitoes.

But DDT has several serious drawbacks.

Insecticide resistance

As early as 1946, Swedish workers discovered populations of houseflies resistant to DDT. This was quickly followed by many other reports of developing resistance. Other chlorinated hydrocarbons (like dieldrin and methoxychlor) were developed as substitutes, but in time insects developed resistance to these as well.

Persistence

DDT is

- stable and
- fat soluble.

These properties cause it to accumulate in fat tissue. People who were heavily exposed to DDT (during its manufacture or application) often showed concentrations of DDT in their fat 1000 times higher than that in their blood.

Even these high levels were probably of little harm to the workers. In the early stages of exposure, the blood levels of DDT (and its metabolite DDE) rise rapidly at first and then reach a steady level. From that point on,

the body excretes it as fast as it acquires it.

Biomagnification

Although no harmful effects from average exposures to DDT have been seen in humans, DDT and other chlorinated hydrocarbons have been shown to harm other species, such as fishes, earthworms, and robins.

The hazard of DDT to nontarget animals is particularly acute for those species living at the top of food chains.

- **B'S AND OTHER HALOCARBONS**

Volatile halogenated organic compounds (VHOC, halocarbons) are ubiquitous trace constituents of the oceans and the atmosphere. This group of compounds includes substances of both anthropogenic and biogenic origin. They are involved in a number of atmospheric reactions, among them the destruction of tropospheric and stratospheric ozone. Unlike the chlorofluorohydrocarbons (CFC`s), which are ozone depleting compounds of exclusively anthropogenic origin, and which are destroyed only in the stratosphere, other chlorinated, brominated and iodinated compounds are involved in a number of chemical and biological processes. However, a number of brominated and chlorinated compounds do indeed deliver chlorine and bromine to the stratosphere, and in the stratosphere, bromine is about 50 times more efficient in depleting ozone than is chlorine. The synergistic effect of chlorine and bromine species accounts for approximately 20 % of the polar stratospheric ozone depletion. Methyl chloride and methyl bromide are believed to be the largest single contributors, disregarding the chlorofluorohydrocarbons, of halogens to the atmosphere. It is however possible that other rather short lived chlorinated and brominated compounds could reach the stratosphere as well. For instance, chlorinated compounds with lifetimes in the troposphere of some months are transported to the stratosphere. The magnitude of the emission of naturally produced compounds is of the order of Gmol y−1, which is of the same order as the industrial emissions. The iodinated substances have relatively short life−times in the atmosphere, and are therefore involved in reactions only in the lower troposphere.

Characterisation of the VHOC in the oceans is of special concern since the oceanic flux is still an unknown factor in the atmospheric budgets of halogens. Several factors need to be addressed such as the sources, both biogenic and anthropogenic, and the abiotic and biotic processes that act upon the compounds in the oceans. The production and the rate of loss of halocarbons in the oceans, governs the concentration of the volatile halogenated compounds in sea water and thereby the flux of these compounds between the ocean and the atmosphere. The magnitude of the ocean flux could be sensitive to global climate change since both temperature and marine productivity are sensitive to the climate changes. In other words, it is important to have specific knowledge of the formation and removal of compounds of biological origin in order to be able to make global halogen budget calculations. There is still lack of good estimates of the ocean emission of halocarbons, and therefore, emphasis has to be put not only on measurements of actual surface concentrations, but also on studies of the regulation of the formation mechanism and on the identification of the compounds produced.

We believe that all living organisms have the ability to produce halocarbons, and that this production is a result of the development of photosynthesis and oxygen production and respiration some 3 billion years ago. This implies that production of halocarbons by algae is due to an adaptation to light in order to reduce the amount of poisonous active oxygen species, such as hydrogen peroxide, superoxide radicals and hydroxyl radicals. The formation of halocarbons takes place also in darkness, which supports the hypothesis, since hydrogen peroxide is produced during respiration and by some oxidases.

- **LAND FILL SITES**

Landfilling of hazardous wastes shall be carried out at sites that are isolated from public waters and groundwater. Certain wastes shall be pre−treated by methods such as water removal, crushing, incineration, or

cutting. Measures shall be taken to prevent offensive odors from leaking out of the landfill sites and to prevent the breeding of rats, mosquitoes, and other vermin.

Landfills are classified into three types: isolated, leachate−controlled, and non−leachate−controlled. Isolated landfills are used for the disposal of hazardous industrial wastes. Leachate−controlled landfills are used for the disposal of both municipal and industrial wastes other than hazardous and stable wastes. Non−leachate−controlled landfills are used for the disposal of stable wastes, namely, waste plastics, rubber scrap, metal scrap, waste glass, ceramics, and demolition waste. The standards for landfill site structure and those for landfill site operation and maintenance have been established in accordance with landfill type.

- **RECYCLING METALS, GLASS AND PAPER.**

Communities first understood recycling as the collection of materials. In actuality, recycling involves much more than the collection of waste. Recycling is a continual process of ***Collection − Processing − Transportation − Manufacture − Retail − Consumption***. The most important and often the most neglected part of the chain is recycling−related manufacturing.

Recycling related manufacturing offers a community local economic development potential. In fact, manufacturers of recycled products hold a majority of the economic pay−off of the entire recycling process. Adding to the jobs and revenue that recycling collection and processing bring to an area, manufacturers of recycled products provide high−skill industrial jobs and sizable sales revenue to a community. These new factories hold the potential to revitalize a community's industrial sector, while diminishing the local waste stream through buying locally−derived feedstock. A scrap−based manufacturer tends to be a small manufacturing firm who tend to locate near sources of feedstock. Manufacturing of recycled products offers a community the opportunity of self−reliance, as manufacturing feedstock is mined from a local source − the community recycling collection programs.

Of the materials being recycled today, glass is still one of the most difficult to reuse. One of the major problems with glass recycling is the separation of clear and colored glass. To date, there have been very few applications for mixed glass. Glass made up only 6.3% of the total materials recycled in 1994. Of the total glass being recycled approximately 63% is clear glass used for remelting to produce more containers. There are few takers for refuse glass not presorted by color. In 1993, New York City collected 27,000 tons of mixed waste glass and used it to produce glasphalt−90% asphalt and 10% glass. By 1997, however, collection is expected to quadruple. Cullet may end up in landfills. More and more cities are mandating recycle programs. New ordinances in Philadelphia and Chicago require businesses and multifamily dwellings served by private haulers to implement recycling programs. With more and more glass being collected we must find new value−added uses for mixed waste glass.

- **DISPOSAL OF PLASTICS**

The final stage in a product's life cycle and in the waste management process is disposal. Despite the fact that plastics are used in everything from medical products to beverage containers, plastics constitute a mere 9.4% by weight of all waste generated in the United States. When a consumer chooses to dispose of a plastic product, he/she has two options: proper disposal that would result in it being placed in a landfill or improper disposal, otherwise known as littering.

Proper Disposal: Landfills

While the total number of landfills is decreasing (due to better resource conservation, resource efficiency and recycling strategies, total landfill capacity is actually steadily increasing. Additionally, new landfill technologies utilize plastics' properties to make liners that prevent leachate from leaking into groundwater, thus making landfills even more environmentally−friendly and safe. Take a tour of a real landfill and see the

result of your educated choice to properly dispose.

Improper Disposal: Litter

Littering, illegal dumping, broken windows, and graffiti all add up to burdensome issues which can negatively effect economic or social development within a given area. Whether it is plastic, paper or another type of product that is being improperly disposed of, it is not the packaging that is at issue but rather the human behavior behind the tossing of the trash that needs to be addressed.

- **SOLID WASTES**

  - The average American uses 1,500 aluminum cans a year. All of that aluminum is easily recyclable.
  - Throwing away two aluminum cans wastes more energy than one billion of the world's poorest people use in a day.
  - Landfills, which do not easily break down the items in them, eventually fill up. Even biodegradable items such as ears of corn or paper can take more than 30 years to begin to break down.
  - Landfills which are not properly lined can allow toxins and metals to seep into the ground, possibly contaminating our drinking water.
  - Trash burned in incinerators can help to generate electricity. But if the gases produced during burning are not removed from the smoke, poisons such as dioxin can enter our atmosphere unchecked.
  - The ash that comes from incinerators contains harmful metals such as lead and cadmium. If not properly disposed of rain water can pick up these metals and carry them into our ground water.
  - Trash which is not disposed of properly can harm wildlife. Paints, oils, and cleaning fluids can contaminate the water or food which wild animals use. Plastics not disposed of properly can be swallowed by animals unable to digest them. Some animals can become entangled in plastic six pack rings, wire, twine, plastic bags, or other trash items.

- **ACCIDENTAL POLLUTION**

When accidental pollution of a water resource does occur, response plans must be in place to minimize the impact. The essential elements of procedures for dealing with accidents are described. These include the presence of an effective warning system, the role of monitoring stations, the exchange of information and the availability of a Crisis Management Plan containing emergency procedures. Water treatment options and the use of alternative supplies are also considered. Finally an overview of rehabilitation techniques is given.

It is recommended that water authorities, water suppliers, administrators, industries, transport and farmers should consider and implement the guidance in this document. Water suppliers should also seek closer cooperation with civil protection agencies (fire brigades) to benefit from their experience in developing manuals for intervention during (major) accidents.

The economic consequences of pollution incident prevention and management have not yet been considered. For small resources the cost could become very high. The necessary level of implementation will therefore be a function of the nature of the water resource and the number of people depending on it for their supply.

- **TREATMENT OF INDUSTRIAL WASTE**

A variety of industrial wastes can be recycled for use as products. There are three ways in which industrial waste recycling occurs: at the facility itself (on−site recycling), at commercial facilities that gather waste streams from several companies (off−site recycling), and at a company that uses as inputs in its production process the waste products of another company. In 1995, for example, about 20 percent of all Texas−generated hazardous wastes treated at commercial facilities was recycled.*

Off−site recycling of some hazardous materials is difficult because of the dangerous nature of the chemicals themselves. Unlike some municipal wastes (such as aluminum) that are fairly easy to recycle, some hazardous chemicals are prone to ignite and can be reactive. In addition, industries' fears of accidents and spills during transportation or recycling operationsand the resulting liabilitycan sometimes present an obstacle to the recycling of hazardous materials off site.* For many products, it is far simpler to dispose of the waste on−site than to exchange it with another company or recycle it.

There is considerable debate about just what recycling is. Under Texas's Waste Reduction Policy Act, companies that burn their hazardous wastes for energy recovery in boilers and industrial furnaces can count the waste as "recycled."This approach has been criticized by some citizens living near facilities, as well as by environmental groups who argue that using waste as fuel is really a method of disposal and that air pollution is often created in the burning of hazardous wastes

- **DUMPING AT SEA**

The lawful ocean dumping of various pollutants was once common practice, but is now regulated. However, the wastes that were dumped into the ocean in the early 1900's remain there still. Human wastes, ground−up garbage, water from bathing, and plastics all contribute to ocean dumping.

Examples of trash found in the ocean are: syringes, laboratory rats, human stomach lining, Navy decontamination kits, test tubes with various substances (with radioactive markings), tampon applicators, and a wallet−sized photo of a dead communist dictator.

One of the main causes of trash finding its way to the ocean is the fact that some sewage pipes share their space with storm water drains. Rainfall (at least 1/4 of an inch), causes the sewage pipes to flood and the sewage wastes (basically anything you flush down your toilet), mingles with the storm water drain which flows unhindered to a water source.

Balloons have been known to find their way into animals such as sperm whales, blocking their digestive tracts; causing the animals to die. Plastic six−pack rings choke various animals and other waste is mistaken by animals for food. Basically any unnatural trash can be harmful to ocean life.

- **DISPOSAL OF RADIOACTIVE WASTE**

Radioactive waste differs from chemical waste in its unique property of emitting radioactive ionization. This ionization comes in the form of Alpha particles, nuclei of Helium−4 with 2 protons and 2 neutrons and a +2 charge, Beta particles (electrons with a −1 charge), and Gamma Rays, electromagnetic radiation similar to X−rays which has shorter wavelengths and is more penetrating. These radioisotopes can strip electrons from atoms or split molecules into pieces and can be very harmful to living creatures. Beta and gamma radiation are the most dangerous to living creatures. The damage to living tissue caused by radiation depends on which parts of an organism are exposed and the intensity and duration of the radiation.

Radioactive waste is also different from chemical waste in that it cannot be changed with a chemical reaction to form a non−radioactive product. No matter how it is treated or with what it is mixed, it still emits radiation until it naturally decays. The rate of decay of a radioactive isotope is called its half life, the time in which half the initial amount of atoms present takes to decay. The half life for different isotopes can range from several minutes to millions of years. For example, the half life of Uranium−238 is 3.5 billion years, the half life for Carbon−14 is 5730 years, and the half life of radon−222 is 3.82 days. The purpose in understanding the theory behind half life is to realize that radioactive waste stays radioactive until all the atoms have decayed.

- **DISPOSAL OF BIOHAZARDOUS**

Toxic waste is the most harmful form of pollution to marine creatures and humans alike. Once a form of toxic waste affects an organism, it (the toxic waste) can be quickly passed along the food chain and might eventually end up as seafood, causing various problems. Toxic wastes arrive from the leakage of landfills, dumps, mines and farms. Sewage and industrial wastes introduce chemical pollutants such as PCB, DDT, and Sevin. Farm chemicals (insecticides and herbicides) along with heavy metals (e.g., mercury and zinc) can have a disasterous affect on marine life and humans alike.

Radioactive wastes, reactor leaks, natural radioactivity, and radioactive particles which originate from the Atmospheric Testing Program from explosions of nuclear weapons are dispersed in water all over the world. The effect of these radioactive particles is currently being researched.

All of these factors allow seafood to have a chance of being hazardous to human health. For example, if a fish is contaminated with the metal Mercury (by either eating it or consuming a creature who had), birth defects and nervous system damage in humans may result. Also, Dioxin causes genetic and chromosomal mutations in marine life and is suspected of causing cancer in humans.

Medical wastes, such as stale blood vials, hypodermic needles, and urine samples that have been found in ocean around the U.S. are being researched to determine if swimmers have a chance of contracting Hepatitis or AIDs from such wastes. Other wastes have been known to cause viral and bacterial diseases such as cholera, typhoid, dysentery, and diarrhea.

- **WASTES (FROM HOSPITALS, ETC.)**

There is growing concern to improve the disposal of hazardous solid wastes from hospitals, clinics and other healthcare establishments, in order to minimise the risks posed by such wastes. These risks include the spread of disease, accidents, environmental pollution and offensive sights and smells. They threaten not only hospital staff and patients, but also visitors, nearby residents and recycling workers.

The healthcare wastes have to be managed in two ways. Firstly it brings together observations and data from six major cities in the Middle East, Africa and Asia. These case studies give a comprehensive picture of the current state of healthcare waste management in much of the developing world. Secondly, it suggests how a hospital administrator or consultant could undertake an investigation into healthcare waste management in a particular institution, and so find the answer to this question. For this purpose the main part of the book consists of a series of questions, with comments and observations related to each.

The management of healthcare waste is not simply a matter of data and technology. Improving the situation also requires training, commitment, management, leadership and effective legislation.

Entrevistaremos a continuación al Profesor José Pimentel de la Universidad Latinoamericana de Ciencia y Tecnología (ULACIT)

La primera pregunta que hicimos al Profesor Pimentel fue que nos ayudara a definir cuáles son los principales agentes contaminantes que afectan nuestro ambiente su respuesta fue como sigue:

Los contaminantes atmosféricos son sustancias sólidas, liquidas, gaseosas o ondas sonoras que pueden alterar el medio ambiente atmosférico y provocar impactos.

Principales agentes contaminantes.

Gases y vapores:

◊ Dióxido de azufre y derivados del azufre
◊ Dióxido de carbono
◊ Monóxido de carbono
◊ Óxidos de nitrógeno
◊ Ozono
◊ Compuestos orgánicos volátiles
◊ Hidrocarburos
◊ Derivados halogenados
◊ Gases radioactivos
◊ Dioxinas
◊ Vapor de agua

Partículas sólidas:

◊ Aerosoles
◊ Metales pesados como cadmio, plomo, mercurio...
◊ Compuestos orgánicos y de síntesis.
◊ Compuestos minerales

Otros:

◊ Ruidos
◊ Campos magnéticos
◊ Ultrasonidos

Los contaminantes pueden ser primarios, si causan daño, molestias, o implican riesgos directamente sobre las personas y en general, sobre los seres vivos, como sucede con el dióxido de azufre, monóxido de carbono, óxidos de nitrógeno, partículas, etc., pero también pueden ser contaminantes secundarios si se forman por reacciones químicas a la atmósfera a partir de los contaminantes primarios. Así el ácido sulfúrico y el ácido nítrico pueden originarse a partir del dióxido de azufre y de los compuestos de nitrógeno respectivamente, por lo que serán contaminantes secundarios.

Luego le preguntamos al Profesor sobre a través de qué fuentes estos agentes terminan contaminando nuestro ambiente

Los plaguicidas tienen graves efectos sobre las comunidades de micro fauna y flora de los suelos. Cambios en los ecosistemas del suelo puede ocasionar aumentos o disminuciones de nutrientes disponibles por las plantas, disminución de la nitrificación, etc.

Comportamiento de los productos fitosanitarios en el suelo

En el caso concreto de la utilización de los herbicidas, alterando la cubierta vegetal, puede provocar cambios en el microclima del propio suelo, lo que produce su degradación, erosión y disminución de la capacidad de retención del agua por los suelos, sobre todo en aquellas regiones donde el clima es gélido o más seco, como es el caso de gran parte de la Península Ibérica.

Las características del suelo que afectan al movimiento de los plaguicidas en su interior son fundamentalmente las siguientes:

- La textura del suelo, es decir, la proporción relativa de arena, limo y arcilla. Los productos fitosanitarios tienden a ser adsorbidos por la arcilla y la materia orgánica. Los suelos de textura arenosa o franca generalmente permiten que el agua se mueva rápidamente a través de ellos dando

pocas oportunidades para la adsorción. Sin embargo, los suelos de textura fina obligan a una disminución de la velocidad del flujo de agua, así como a una mayor adsorción de los plaguicidas sobre las arcillas.
- La permeabilidad del suelo da idea de la velocidad con la que el agua se mueve en el suelo. En aquellos que son muy permeables, el lavado se realiza fácilmente, elevando el riesgo de contaminación de las aguas subterráneas.
- El contenido en materia orgánica afecta aumentando la capacidad de retención de agua el suelo por una parte. Y por otra, algunos plaguicidas son adsorbidos por la materia orgánica.

Agua:

Los plaguicidas pueden alcanzar tanto las aguas superficiales como las subterráneas, a través de diferentes vías de contaminación. La posibilidad de alcanzar este medio está en relación fundamentalmente con el poder de disolución del producto en el agua y de su persistencia.

Otros factores que afectan son: el tipo de materiales geológicos, los suelos y las prácticas agrícolas.

La ANAM considera las siguientes vías de contaminación:

- **Aguas superficiales Se dividen en dos grandes grupos:**
- Por contaminación directa: Debido a un uso normal Aplicación de plaguicidas en balsas de riego o pantanos para luchar contra los vectores de enfermedades.
- Aplicación de herbicidas acuáticos, sobre todo en balsas o canales de riego. Debido a una mala utilización.
- Limpieza sin las debidas precauciones del equipo de tratamiento y de los tanques vacíos de aplicación.
- Efluentes de fábricas de plaguicidas u otras industrias que los utilizan.
- Desechos de balsas de desparasitación de ovinos o balsas de tratamientos de productos agrícolas.
- Por contaminación indirecta: Debido a un uso normal
- Plaguicidas arrastrados por el agua de lluvia después del tratamiento.
- Absorción de los plaguicidas sobre las partículas del suelo
- Flujo de aguas subterráneas contaminadas hacia los cursos de agua superficial.

Aguas subterráneas:

Por contaminación directa:

- No pueden existir legalmente prácticas de utilización capaces de provocar la contaminación directa de las aguas subterráneas.
- Desechos de plaguicidas evacuados en sumideros o en pozos.
- Por contaminación indirecta:

*Debido a un uso normal

- Por lavado hacia las aguas subterráneas después de una utilización agrícola clásica.

*Por utilización indebida

- Por lavado hacia las aguas subterráneas después de una utilización agrícola condenable (por ejemplo, utilización de productos químicos prohibidos cerca de pozos, etc...)
- Las vías de contaminación de los plaguicidas y de sus residuos en el medio ambiente y los procesos que intervienen dependen de las condiciones locales y pueden variar de un lugar a otro y de un país a

otro. Además, los mecanismos de lixiviación se encuentran muy afectados por los procesos de adsorción y de retención y por los fenómenos de degradación.

Entrevistaremos ahora al Dr. Eduardo Goddard de la Fundación Natura, quien se ha destacado en estudios sobre el ambiente en Panamá. La primera pregunta que le haremos es sobre la contaminación del agua, cómo ocurre la contaminación del agua?

Los tipos de contaminación se diferencian según su origen. Podemos distinguir:

- **Difusa**. Su origen no está claramente definido, aparece en zonas amplias y no tiene foco emisor concreto.
- **Puntual**. Es producida por un foco emisor determinado y afecta a una zona concreta.

La contaminación **natural** consiste en la presencia de determinadas sustancias en el agua sin que intervenga la acción humana.

La contaminación de **origen urbano** es el resultado del uso del agua en viviendas, actividades comerciales y de servicios, lo que genera aguas residuales, que son devueltas al receptor con un contenido de residuos fecales, deshechos de alimentos y en la actualidad con un incremento de productos químicos.

La contaminación de **origen agrícola** deriva del uso de plaguicidas, pesticidas, biocidas, fertilizantes y abonos, que son arrastrados por el agua de riego, llevando consigo sales compuestas de nitrógeno, fósforo, azufre y trazas de elementos organoclorados que pueden llegar al suelo por lixiviado y contaminar las aguas subterráneas.

La contaminación de **origen industrial** es una de las que produce un mayor impacto, por la gran variedad de materiales y fuentes de energía que puede aportar al agua.

Otras fuentes de contaminación de **origen antropogénico** son:

- Los vertederos de residuos, tanto urbanos como industriales y agrarios.
- La contaminación por restos de combustibles, como lubricantes, anticongelantes, asfaltos.
- La contaminación de agua por fugas en conducciones y depósitos de carácter industrial.
- Las mareas negras, ocasionadas por el vertido de petróleo crudo sobre el mar, principalmente como consecuencia de accidentes de os grandes buques petroleros o como resultado de limpieza.

Dr. Goddard, cómo afecta esta contaminación al agua de nuestro país?

- **La contaminación de ríos y lagos: eutrofización:**

Debido a su poder erosivo, los ríos arrastran sales, materia orgánica y sólidos en suspensión. Por lo que se desencadenan procesos de contaminación cuyos efectos más importantes son:

- Restricción en el uso del agua.
- Alteraciones en la fauna y/o flora acuáticas.
- Apariencia y olor desagradables.

La principal defensa que los ríos tienen para contrarrestar la contaminación es su dinámica. Un ejemplo de esto es el proceso conocido como **eutrofización**, que consiste en un aumento de la productividad biológica que ocasiona un excesivo crecimiento de algas provocado por la introducción en el ecosistema de materia orgánica a través de vertidos de origen agrícola y doméstico.

La eutrofización puede aparecer también en estuarios costeros y mares más o menos cerrados que provoca la aparición de algas tóxicas que acaban con peces, aves acuáticas y mamíferos marinos.

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