



# World Ecology Report

Critical Issues in Health and the Environment

*Knowledge brings new choices. Education brings new knowledge.*

## SPECIAL FOCUS: *Nuclear Tragedy: The Medical, Political and Technological Implications of Chernobyl Ten Years Later*

During the early morning hours of April 26, 1986, the twentieth century's worst nuclear catastrophe began to occur in the small ancient village of Chernobyl in northern Ukraine. Pripyat, two miles from the reactor site, now a ghost town, was once home to 45,000 people, many of whom worked at the nearby Chernobyl nuclear power facility. The name Chernobyl (spelled Chornobyl in the Ukrainian language) connotes nuclear catastrophe, on a scale far exceeding the radiation levels produced by the atomic bombs dropped on Hiroshima and Nagasaki in August 1945. The magnitude of the devastation to the environment and to human life caused by the intense explosion and fire in reactor number four is still unfolding. Although medical and political consequences of the nuclear calamity are better understood a decade later, the technological implications remain insufficiently addressed. In the interest of furthering knowledge about the effects of Chernobyl, World Information Transfer interviewed Dr. Yuri Shcherbak, Ambassador of the Ukraine to the United States, epidemiologist, founder and leader of the Ukrainian Green Movement (the Green Party since 1990) and author of many scientific articles and works of fiction including the documentary novel *Chornobyl* (MacMillan 1989). Dr. Shcherbak was one of the first medical specialists on the scene in Pripyat.



**Ambassador Yuri Shcherbak**

formed a plume that traveled north and west dropping radioactive fallout over Eastern and Northern Europe. The US and Japan also measured increased levels of radiation after the Chernobyl explosion. Agricultural and animal products were destroyed because of radioactive contamination in Poland, Germany, Austria, Hungary, the Nordic countries, the United Kingdom and the Baltic States.

The severity of the explosion of nuclear reactor 4 challenges comprehension. Nuclear explosions tend to be recognized as a mushroom cloud rising from ground zero. Science fiction portrayals of radioactive contamination tend to show people or objects glowing a bizarre color. In the past ten years, pictures have emerged that suggest the endless misery of this calamity: children suffering from cancers, severe birth defects, empty villages, impoverished people in radioactive gardens, and the crumbling "sarcophagus" that houses the destroyed reactor which now contains extremely high radiation levels of dust.

The estimates of the damage vary as different groups measure the degree of destruction at varying times and in some cases with underlying political objectives. The Soviets wrote that 90 million curies of total radioactivity were released. Ambassador Shcherbak suggests that this is a minimum estimate and indicates that the amount of fallout is much closer to that released by a medium sized nuclear bomb. Research at the Massachusetts Institute of Technology (M.I.T.) indicates that about 260 million curies were released. Over 260,000 square kilometers of territory in Ukraine, Belarus and Russia were contaminated and continue to register more than one curie per square kilometer of cesium

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#### AFTERMATH OF THE EXPLOSION

Fire continued for 10 days after the initial explosion, showering a wide area with highly radioactive fission material consisting of uranium, plutonium (the most toxic element known) iodine 131, strontium 90 and cesium 137. These toxic materials





**Two of the many Ukrainian children who have died from radiation induced illnesses from the Chernobyl accident—a legacy of the Soviet Empire.**

**SOURCE:** *Nuclear Energy and the Non Proliferation Treaty: An Authorized Albatross?*, Lawyers' Committee on Nuclear Policy, March 1995.

137, one of the most dangerous radioactive toxins. Over 5% of Ukraine's territory is contaminated. Much of the agricultural area of Ukraine, 26,000 square kilometers, remains toxic. Less contaminated places are still being cultivated, although the long term effects of eating crops grown in low level radioactive soil is unknown. An area within 30 kilometers of the nuclear power plant is now largely lifeless. The radioactive waste contained within the reactor remains lethal with a total level of radioactivity at several thousand roentgens per hour. Most ominous are the 800 hastily built clay lined burial pits for radioactive debris. Little attention was given in their design to prevent seepage into the ground. Sediments of the Pripyat River are contaminated with radioactive material at estimated levels measuring 10,000 curies of strontium 90, 12,000 curies of cesium 137, and 2,000 curies of plutonium. The Pripyat is a tributary of the Dnieper River, and both rivers supply about 30 million people with water. The health effects of this chronic contamination of drinking water is unknown.

#### **MEDICAL IMPLICATIONS**

It has been estimated that the Chernobyl explosion caused more radioactive contamination of Europe than all the nuclear weapons tests combined since 1945. The

explosion of reactor number 4 of the Chernobyl nuclear power plant resulted in acute radiation sickness of 187 people and the death of 31 workers at the reactor site. Over the past decade, 30,000 of the 400,000 workers who served as "liquidators," disposing of the most toxic waste and constructing the now decaying "sarcophagus," have become sick with illnesses related to radiation exposure. 5,000 of these workers are no longer employable due to their debilitation. Dr. Shcherbak cites Greenpeace as having arrived at a fair estimate of 32,000, as the total number of deaths thus far, resulting from the Chernobyl catastrophe. The International Union "Chornobyl" sites the death toll at 40,000. The World Health Organization estimated in November 1995 that 5 million individuals had been affected by "significant fallout of radioactive nuclides." According to WHO, thyroid cancer has increased in the areas most affected with close to 400 cases in Belarus, 220 cases in Ukraine and 62 cases in the Russian Federation.

Dr. Shcherbak explains that the increase in thyroid cancer in children occurred as a result of inhalation of air borne iodine 131 immediately after the accident. About 13,000 children were initially exposed to radiation doses to the thyroid of about 200

roentgens, twice as high as adult nuclear industry workers are allowed to experience in a year. Because Soviet authorities did not prevent them from going outside and going to school, the long term incidence of cancer among those who were children at the time of the nuclear reactor explosion is expected to increase. Oncological illnesses among children in Ukraine have tripled since 1986.

Thyroid cancer is the most prominent post-Chernobyl illness among children as well as adults. However, the signs of sickness are growing. Among the "liquidators," a syndrome called "Chornobyl AIDS" has been designated to describe a condition in which people suffering from cancer also have impaired immune systems which make them more susceptible to other diseases, including severe cardiac problems and pneumonia. The birth rate in Ukraine has been declining and currently there are less than 500,000 births per year compared to 800,000 in 1976—ten years before Chernobyl. Moreover, the death rate surpassed the birth rate in 1994, and the longevity rate of the population has been dropping. The infant mortality rate is double the European average. Among newborns, it is estimated that only about 20% are born healthy. Among the "liquidators" of reactor number 4, one in three men have suffered from sexual or reproductive impairment, including reduction in the ability of sperm to fertilize. Ukraine has the world's highest infertility rate. Pregnancies with complications and birth defects have been on the rise. In the months following the nuclear tragedy, thousands of women from northern Scandinavia to the Adriatic Sea had abortions rather than risk the likelihood of bearing children with severe birth defects caused by radiation exposure in utero. In Belarus, abortion rates continue to exceed the norm.

Birth defects include unformed limbs and mental retardation. The greatest risk for mental retardation is expected to occur in children conceived roughly between mid-January to mid/late March 1986, and born between September to November of that year. Those children would be turning ten years old this year and should be in fourth grade. There are no accurate figures for the number of fetuses exposed to high levels of radiation. Moreover, there is scant accounting of children who suffer from mild forms of mental retardation. There has not been a reliable demographic baseline

of mental dysfunction established by the former USSR, so there is currently no certain way to detect abnormality except to compare births to an abstract standard of normality. Prevalence rates of mental retardation among the general population have not been firmly established for many reasons including terminology. Within these limitations, trends have appeared that suggest that mental retardation within the general population occurs at rates lower than 2% and is more prevalent among males than females. These gender trends were also found in the former USSR according to a study published in 1990. Mild to moderate mental retardation occurs more frequently than does severe retardation. Symptoms of retardation appear more often between the ages of 10 and 20. It is also imperative to recognize that pregnant women who conceived before and after three months when radiation exposure would have had the most profound effects, nevertheless exposed their unborn fetuses to elevated radiation levels for months in millions of cases. The effect of continued exposure on the development of the brain of the fetus is not known.

Children evacuated from the most dangerous area around the reactor have experienced a 10 to 15 fold increase in neurological and psychiatric disorders. The World Health Organization has found it not uncommon for people in the region widely affected by Chernobyl to come to clinics complaining of symptoms similar to the Japanese survivors of the atomic bombs. According to the WHO, symptoms include headaches, intestinal complaints and chest pains with no discernible physiological source, sleep disturbances, loss of concentration, alcoholism, depression, divorce and suicide. The psychosomatic disorders have arisen from stress caused by large scale evacuation and relocation, preoccupation with fear of radiation exposure, and discrimination of the Chernobyl refugees because they received new houses and pensions in the safe areas to which they were moved. Dr. Shcherbak estimates that in the first five years after the Chernobyl calamity, 20,000 medical personnel (almost all of the medical people in Ukraine) worked on behalf of Chernobyl victims.

### POLITICAL IMPLICATIONS

Ambassador Shcherbak is among many who believe that the low level Soviet response to the Chernobyl disaster significantly contributed to the dissolution of the

## Nuclear Power Reactors in Operation and Under Construction at the end of 1995

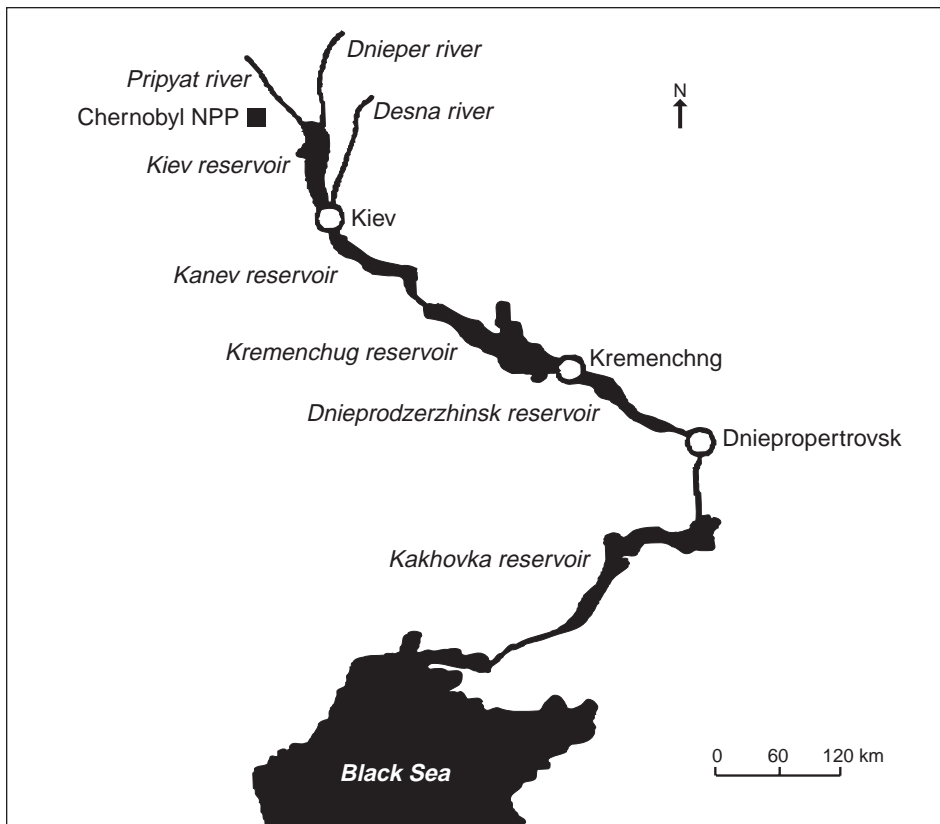
Country Name	REACTORS IN OPERATION		REACTORS UNDER CONSTRUCTION		ELECTRICITY SUPPLIED BY NUCLEAR POWER REACTORS IN 1993		TOTAL OPERATING EXPERIENCE TO END 1993	
	No. of Units	Total MW(e)	No. of Units	Total MW(e)	TW(e).h	% of total	Years	Months
Argentina	2	935	1	692	7.2	14.2	30	7
Belgium	7	5527			39.5	58.9	121	7
Brazil	1	626	1	1245	0.4	0.2	11	9
Bulgaria	6	3538			14.0	36.9	71	1
Canada	21	13800			88.6	17.3	304	11
China	3	2100	1	906	2.5	0.3	2	5
Cuba			2	1200				
Czech R	4	1648	2	1824	12.6	29.2	30	8
Finland	4	2310			18.8	32.4	59	4
France	57	59033	4	5815	350.2	77.7	766	5
Germany	19	20798			145.0	29.7	469	1
Hungary	4	1729			13.0	43.3	34	2
India	9	1593	5	1010	5.4	1.9	110	3
Iran			2	2392				
Japan	50	39671	4	4003	246.3	30.9	603	7
Kazakhstan	1	70			0.4	0.5	20	6
Korea RP	11	9120	5	3870	55.4	40.3	81	1
Lithuania	2	2370			12.3	87.2	16	6
Mexico	2	1308			3.7	3.0	4	9
Netherlands	2	504			3.7	5.1	45	9
Pakistan	1	125	1	300	0.4*	0.9*	22	3
Romania			1	650				
Russia	29	19843	2	1875	119.2	12.5	468	6
S. Africa	2	1842			7.2	4.5	18	3
Slovak R	4	1632	2	776	11.0	53.6	53	5
Slovenia	1	632			3.8	43.3	12	3
Spain	9	7101			53.6	36.0	128	8
Sweden	12	10002			58.9	42.0	195	2
Switzerland	5	2985			22.0	37.9	93	10
UK	35	12909			79.8	26.3	994	2
Ukraine	15	12679	2	1900	75.2*	32.9	143	11
USA	109	98784	1	1165	610.3	21.2	1810	8
	<b>427</b>	<b>335214</b>	<b>36</b>	<b>29623</b>	<b>2093.4</b>		<b>6902</b>	<b>2</b>

Note: The total includes the following data in Taiwan, China: 6 units, 4890 MW(e) in operation; 33 TW (e).h of nuclear electricity generation, representing 33.5% of total electricity generated there; 74 years 1 month of total operating experience  
Values with asterisk are IAEA estimates

SOURCE: International Atomic Energy Agency PRIS

USSR. The Soviet leadership's decision to publicly deny then cover-up the dimensions of the catastrophe occurred five years after Mikhail Gorbachev initiated his policies of "Glasnost" or openness. Ambassador Shcherbak contends that many

people who supported Soviet policies saw that lies and secrets ruled the government. Roughly one million people reacted to the destiny of their children forever shaped by Chernobyl and could not forgive the Soviet system. He states that many very frightened



**Water bodies affected by the radioactive contamination from the Chernobyl accident.**

SOURCE: *New York Times*, March 31, 1996, "Chernobyl: Ten Years on Radiological and Health Impact," AEN/OECD.

people sought information to safeguard their children and found no information or support forthcoming. The Soviet response worsened the fear of residents most directly affected by the blast. Ultimately, Pripjat became a deathtrap, and "Glasnost" a lie. From 1989 to 1990, Ambassador Shcherbak served as head of the sub-committee for nuclear energy and nuclear safety. This sub-committee was part of the Committee on Ecological Issues.

His group produced a great deal of material about Chernobyl and related nuclear safety issues, however, he does not know where that material is or what happened to his reports. In 1991, on the fifth anniversary of Chernobyl, the Ambassador organized public hearings to address the responsibility of the Soviet leadership in multiplying the tragedy of Chernobyl. A mock trial was held that accused Gorbachev and the leader of Ukraine's communist party, personally. In August 1991, the Soviet Union began the process of dissolution. One might argue that the Soviet decision to build a nuclear power plant so close to the densely populated capital city of Ukraine was itself a political

decision reflecting the age old animosity between Russia and the independent republic of Ukraine. The Chernobyl nuclear power plant was built close to a water system used by 46 million people. Dr. Shcherbak thinks that this animosity continues to influence what he perceives to be Russia's lack of interest in Chernobyl. He points out that Russia inherited the assets as well as the liabilities of the former USSR and Russia is not really interested in the aftermath of the Chernobyl disaster.

**TECHNOLOGICAL IMPLICATIONS**

The Chernobyl nuclear explosion and ensuing radiation poisoning left a legacy of ecological destruction that continues to erode human health. Dr. Shcherbak, however, pointed to the most challenging issue surrounding this nuclear debacle. That is the question of what he terms "supertech-nology." In response to a question inviting him to tell readers of the *World Ecology Report* what might be learned regarding Chernobyl, he answered, "I would like everyone to realize that the Chernobyl issue is not an issue just for the former obsolete USSR technology—this is a big illu-

sion...Chernobyl is a problem of civilization. It is the first message to take into the next century because globalization of our lives in a technological sense...is very dangerous..." He suggests that the level of safety in technological systems is underdeveloped and warns that in a small country, a technological disaster such as Chernobyl could end the existence of a nation. Being a realist, he understands the attraction of nuclear energy as a source of cheap and "clean" electricity. Currently, nuclear power supplies 40% of Ukraine's energy needs. Dr. Shcherbak believes that knowledgeable individuals can demand more careful, pragmatic, and far-sighted approaches in forecasting the consequences of technological systems before they are instituted. He has proposed an Institute of Catastrophology which would be charged with the responsibility of studying measures that would prevent catastrophes, not only at nuclear facilities, but also in the construction and maintenance of dams, and industrial plants.

The possibility of safe technology that would provide electricity to large populations and meet industrial demands raises the immediate question of how to fulfill Ukraine's need for energy. The other reactors at Chernobyl are of the same unstable RBMK-1000 design as reactor number four. The G-7 nations along with the Commission of the European Communities have come to an agreement with the government of Ukraine on closing all of Chernobyl and supporting a replacement facility. The agreement was reached in a Memorandum signed by the G-7 and the EU nations in Brussels on September 11, 1995. Ambassador Shcherbak notes that in the Memorandum these nations agree to "support the decision of Ukraine to close the Chernobyl Nuclear Power Plant by the year 2000." However, he points out that there has been no firm date for the closure of the plant and similarly there is no timetable for development of a replacement facility. The Memorandum states that "complementarity between measures summarized herein to support the closure of the Chernobyl Nuclear Power Plant and the development of a long term energy sector strategy in Ukraine, taking into account sound economic, financial and environmental criteria and leading to an efficient sustainable, market-oriented energy sector..." would be followed. The Memorandum further acknowledges the need to promote a "high level of nuclear safety around the world" yet noting "that

the early closure of the Chernobyl Nuclear Power Plant will have adverse economic and social implications for Ukraine..." In the short term, the G-7 and Ukraine "will work with the relevant international organizations as well as ...donors on an expedited basis to...implement projects for short term safety upgrades at Chernobyl III and for decommissioning of the Chernobyl Nuclear Power Plant..." Regarding the potential danger for further radioactive exposure from the decaying "sarcophagus," the G-7 and Ukraine have agreed "to cooperate in the development of a cost effective and environmentally sound approach to the shelter for Chernobyl IV...as soon as possible..."

Ambassador Shcherbak's proposal for an institute charged with studying and forecasting the consequences of "supertechnological systems" would solve one of the critical problems facing populations who rely on nuclear power; that is, insufficient information regarding the safety to human health of nuclear power plants. The intentional withholding of information by the Soviet leadership in Moscow and Kiev cost the health of millions of citizens of the former Soviet Union and continues to cost Ukraine, Belarus and Russia in large sums of money from their stricken economies. Ambassador Shcherbak notes that one important reason for the Soviet's decision to sacrifice millions to radiation induced cancers was that Soviet propaganda had been so focused on nuclear war that the government refused to associate nuclear bombs with nuclear power for electricity. Now it is understood that the explosion in the Chernobyl reactor number 4 was just like a nuclear bomb and that the town of Pripjat should join Hiroshima and Nagasaki in the list of cities engulfed by nuclear blasts of modern technology.

#### SOURCES:

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- Press Releases in relation to the International Conference on International Consequences of the Chernobyl and Other Radiological Accidents, Geneva, Nov. 20-23, 1995.
- *Scientific American*, Ten Years of the Chernobyl Era, April 1996.
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- "Health Related Impact of the Explosion at the Chernobyl Energy Station," Children of Chornobyl Relief Fund and International Children of Chornobyl Foundation.

## Chronology of the 1986 Chernobyl Explosion

Operators at the Chernobyl power plant were to conduct a test to see how long the generators would run without power. In order to accomplish their task, they reduced power in reactor 4 and interrupted the flow of steam to the generators. Because of the poor design of the RBMK-1000 reactors, a flaw exists that causes the reactor to become unstable at low power. The operators increased the risk of a reactor destroying itself by disabling safety systems. The operator thought the systems might interfere with the test results thus ignoring the safety systems that were developed to shut down the reactor before a catastrophe could occur.

APRIL 25 - 1:00 am: Reactor at full power. Power reduction began, as planned. 1:05 pm: Reactor power at 50%. All steam switched to one turbine, as planned. 2:00 pm: Reactor power stayed at 50% for 9 hours because of unexpected electrical demand.

APRIL 26 - 12:00 am: In continuing the power rundown, the operator made an error that caused power to drop to 1%, almost shutting down the reactor. This caused the core to fill with water and allowed a neutron absorber, xenon, to build up, making it impossible to reach the planned test power level. The RBMK design is unstable if the core fills with water. 1:00 to 1:20 am: The operator raised power to 7%, attempting to control the reactor manually. This caused fluctuations in flow and temperature. Almost all control rods were withdrawn seriously weakening the capability of an emergency shutdown. 1:20 am: The operator blocked automatic reactor shutdown first on low water level, then on the loss of both turbines. He was afraid that a shutdown would abort the test and wanted to keep the reactor working to run more tests if needed.

1:23 am: The technician started the test using the remaining turbine, causing power to rise slowly at first. He then pushed the manual shutdown button. The reduction in flow as the voltage dropped caused a gradual increase in boiling which led to a rise in power. This probably produced the fast power surge due to the rod design. 1:24 am: The reactor power surged to about 100 times full power. Fuel disintegrated. Excess steam pressure broke the pressure tubes. The pressure in the reactor core blew the protective top shield off the reactor exposing the entire area to extremely high doses of radiation. Explosion and fire followed. On April 26, while the crumbling reactor burned, initially spewing deadly amounts of extremely radioactive fallout over 5000 square kilometers, local children went to school and people conducted their daily lives as if nothing were wrong. The Communist Party Regional Committee in Pripjat, following Moscow's orders, instructed the schools to hold normal instruction, thus condemning hundreds of children to disease and slow death brought on by radioactive poisoning.

APRIL 27 - 2:00 pm: 49,000 residents of Pripjat and others within a 10 kilometer radius of the power plant were evacuated. By this time, those living close to the explosion had suffered exposure to extremely high levels of radiation for close to 36 hours. The approximate dosage for these evacuees has been established at 12 rems per person, according to the US Nuclear Regulatory Commission.

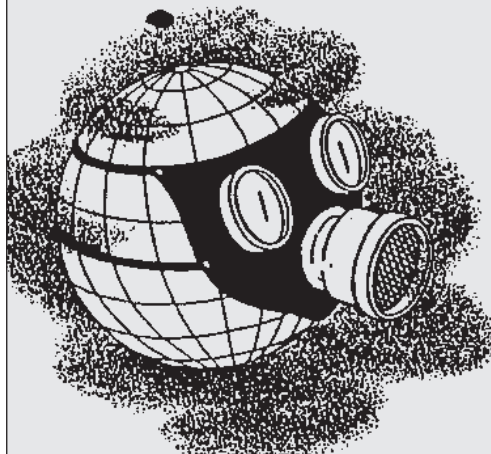
APRIL 28 - Swedish experts detected increased radiation levels.

MAY 1 - As part of the May Day celebrations honoring communism, children paraded through the streets of Kiev, only 60 miles from the site of the nuclear blast. Radio iodine content of the air over Ukraine's capital city peaked on May 1. Thus more children were unnecessarily condemned to the ravages of cancers in the service of communist ideology.

MAY 2 - Soviet authorities publicly acknowledge Chernobyl explosion.

MAY 15 - Evacuation of children 14 years and younger begins.

1990 - Four years later, the Supreme Soviet of Ukrainian Soviet Socialist Republic declared the country an ecological disaster zone, finally recognizing the devastation to land, water and air of the radioactive contamination that Chernobyl produced.



## Chernobyl's Food Contamination

Radionuclides showered farms, grazing lands, forests and waterways in a wide and uneven path north and west of the site of the Chernobyl nuclear explosion. Ten years after the catastrophe, studies have still not yielded a clear picture of the dimensions of the radioactive contamination of land and water that affects food production. Moreover, there is no certainty about the corrosive influences of eating radioactive food over time. Medical specialists anticipate that eating food polluted by radioactive fallout may contribute to incidences of cancer as well as impaired reproductive systems, but accurate measurements depend on the food itself and its absorption of particular radioactive isotopes, tillage and food processing techniques, food quantities ingested and cooking methods, combinations of foods, and idiosyncratic resistance to the influences of carcinogens. It is unlikely that a definitive portrait of the impact of the Chernobyl catastrophe on food will emerge, but current information paints a picture of food contamination in eastern and northern Europe that may take generations to repair.

### CROPS AND ANIMAL PRODUCTS

Radioactive particles fell directly on crops and animals as a result of the initial explosion, ensuing fire, precipitation and wind. Soil absorbed high quantities of a variety of radionuclides making very fertile topsoil unsafe for crops. The most important radionuclides affecting food after the nuclear reactor accident are iodine 131, cesium 137, cesium 134, strontium 90. Concentrations of cesium were found to be higher in wild animals than in domesticated ones where Prussian Blue boli

was introduced into the feed to decontaminate cows. In the days after the explosion, thousands of prime commercial cattle were slaughtered in Ukraine and Belarus.

Restrictions had been placed on animal products in some European countries including hundreds of thousands of British sheep, as well as sheep and reindeer in Scandinavia. In the United Kingdom the radioactive plume from Chernobyl deposited mostly very mobile cesium isotopes from May 4-6, 1986. Most of these isotopes were taken up by grazing animals. Currently the total number of livestock still restricted is under 400,000, mostly in Scotland and the mountains of Wales. As measured in males, cesium 137 levels reached a peak over a year after the nuclear accident in late 1987 due to the consumption of contaminated foods. Since then, cesium 137 contamination of soils has been declining slowly. However, this decrease has occurred unevenly and continues to depend on the degree and kind of initial contamination.

In Belarus, the nation most tainted by Chernobyl fallout and once considered part of the "Bread Basket" of the former Soviet Union, one-quarter of the arable land is no longer habitable. The soil in the region surrounding the city of Gomel, Belarus, 70 miles north of the Chernobyl nuclear station, still holds most of the radionuclides which fell on it ten years ago.

### FOREST PRODUCTS AND WILDLIFE

Fruits, vegetables and animals populating forests absorbed higher concentrations of radionuclides than agricultural lands because of the filtering qualities of trees. People who

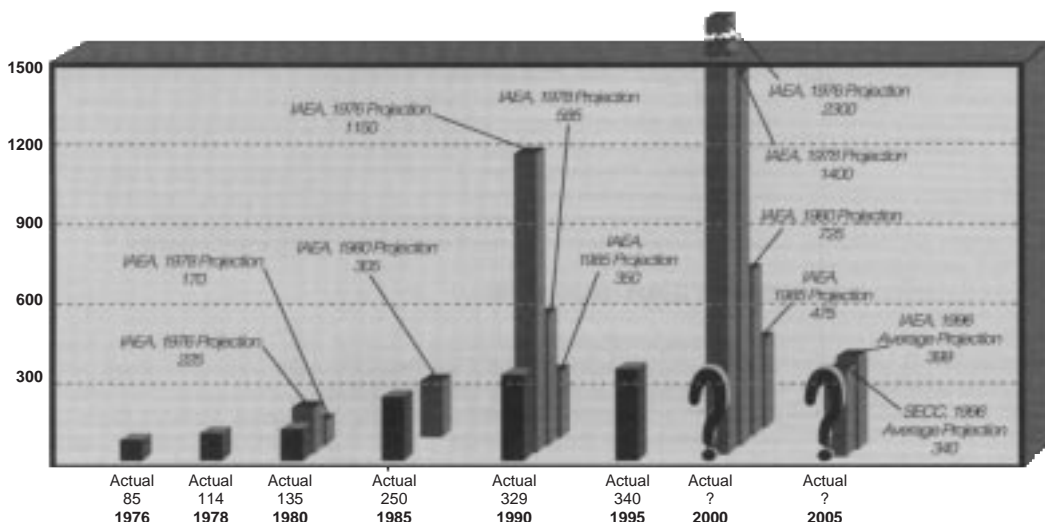
relied on wild game, berries and mushrooms, increased concentrations of radionuclides in their bodies to dangerous proportions. Mushrooms tended to contain high levels of cesium. Forest workers were particularly vulnerable to radioactive exposure receiving doses estimated to be three times higher than others living in the same region. Employees in forest-based industries such as pulp, paper production and logging suffered similar heightened exposure. The waste products from these industries added to the sources of radionuclides polluting the affected regions. There is no certain time after which forests will be free of the radioactive impact from Chernobyl.

### DRINKING WATER AND WATER ECOSYSTEMS

There is a danger that strontium 90 could contaminate drinking water 10 to 100 years from the time of the nuclear explosion in the most severely contaminated areas. Contamination of sediment could slowly seep into water systems. Already, there is some evidence that this may be occurring in the regions most directly contaminated by Chernobyl. Outside the former USSR, lakes and fish remain contaminated above levels acceptable for commercial use. About 15% of the lakes in Sweden, or about 14,000 lakes, were contaminated with radioactive cesium by 1987. However, the safety of fish depends on the type of fish and lakes, and it is only now in some instances that fish and lakes are viable again. In other cases, contaminated lake fish will continue to be a long-term problem.

**SOURCE:** *New York Times*, March 31, 1996, "Chernobyl: Ten Years on Radiological and Health Impact," AEN/OECD.

## Projected and Actual World Nuclear Capacity, 1976-2005 (in gigaWatts)



**SOURCES:** SECC MYTHBusters #10, Spring 1996; International Atomic Energy Agency and Safe Energy Communication Council.

## HEALTH AND ENVIRONMENT: *Humans at Risk*

Developing countries generally have widespread and serious environmental pollutions that affects health. Coupled with this is rapid urbanization, which tends to exacerbate environmental problems to almost unmanageable proportions. Traditional diseases linked to inadequate sanitation and to malnutrition are highly prevalent and a clear indication of these social and environmental deficiencies. Socioeconomic development has brought with it increased exposure to chemical and physical hazards, raising the toll taken by chronic disease, trauma, poisoning, violence and emotional disturbances. In addition, habitat destruction has been a dangerous by-product of socioeconomic development.

The close relationship between health and environmental conditions is drawn into focus by the critical socioeconomic changes that are affecting the developing countries. Because of the shortcomings in the fulfillment of basic sanitary needs, in many nations diarrheal and parasitic diseases are a leading cause of high mortality and morbidity among certain population groups, especially children and the aged. At the same time industrialization and urban growth have increased the health risk from exposure to toxic substances and hazardous wastes that are polluting the air, water, soil and food.

The adverse effects of industrial activities on human health cover the spectrum from relatively high-level exposures of small populations in the occupational setting to usually lower level of exposure of the general public. While there are a few clear-cut cases, such as acute intoxications associated with exposure to pesticides, illness caused by long-term exposure to pollutants is often difficult to identify conclusively.

### DIARRHEAL DISEASES AND CHOLERA OUTBREAKS

Diarrheal diseases constitute one of the most important health problems, affecting children in particular. The magnitude of the problem differs markedly from developing to developed countries. Among children under 1 year of age, mortality rates for diarrheal disease range from 0.5 per 100,000 live births in Canada to 967.3 per



**Children wearing masks to protect themselves from pollution from nearby factories at their school in Lanzhou, China.**

**SOURCE:** The Associated Press

100,000 live births in Nicaragua, a figure almost 2,000 times higher.

The mortality rate for diarrheal diseases other than cholera is declining in all developing countries, basically due to wide use of oral rehydration therapy.

Cholera is almost always introduced into new areas by infected travelers. However, within infected areas, disease is transmitted from person to person by contaminated food and water. An outbreak of cholera in Kinshasa, Zaire, which began this past February, has killed 27 people as of March 25. The epidemic has not spread beyond the capital city according to WHO's representative in Zaire, but there were indications that the outbreak was not confined to poor areas. Illness, like pollution, knows no economic or national boundaries.

Disposal of untreated waste water constitutes a critical problem in all developing countries. The waste contaminates and damages water courses and groundwater, which are the sources of drinking water for large and small communities. In addition, this water is often used for bathing, recreation, irrigation, raising fish, further increasing the potential for health problems.

The large-scale use of untreated domes-

tic sewage for irrigation is common in many arid and semiarid zones. High rates of enteritis, typhoid fever, and hepatitis occur as a result of the consumption of raw vegetables irrigated with untreated waste water.

### CHEMICAL EMERGENCIES

As industrial activity in both developed and developing countries has increased, the potential for major catastrophes has also increased, and the number of significant accidents involving chemicals with serious health and environmental effects has been rising. Furthermore, particularly with the massive expansion in the availability and use of chemicals in developing countries, the number of poisonings of all types has increased, from household emergencies (children swallowing chemicals at home) to industrial devastation (production or storage plant explosions and product releases).

The most common chemical accidents in almost all countries involve flammable liquids and gases. The large accidents, such as the massive release of industrial chemicals in Bhopal, India, in 1984 are usually the ones that attract the public's attention, but the most common accidents are the

### Major Water-Borne Diseases

DISEASE	VECTOR	NEW CASES	DEATHS
Diarrheal diseases		1.8 billion	3 million
Dengue fever	Mosquito	560,000	23,000
Yellow fever	Mosquito	200,000	30,000
Dracunculiasis (Guinea worm)	Water flea	100,000	n/a
Japanese encephalitis	Mosquito	40,000	11,000

DISEASE	VECTOR	POPULATION AT RISK	DEATHS
Malaria	Mosquito	400 million	2 million
Schistosomiasis (Bilharziasis)	Snail	200 million	200,000
Lymphatic filariasis (Elephantitis)	Mosquito	100 million	43 million (disabled)
Onchocerciasis	Blackfly	17.6 million	35,000

SOURCE: *World Watch*, March/April 1996.

smaller ones that occur during the routine handling and transportation of chemicals.

#### ARSENIC EXPOSURE

Arsenic is a naturally occurring element that is widely distributed in the environment. All human beings are exposed to low levels of this element. Arsenic has been classified by the U.S. Environmental Protection Agency as a known human carcinogen when exposure occurs by inhalation and oral routes. In developing countries above-average levels of exposure are associated with ingestion of drinking water naturally contaminated with arsenic or by inhalation and ingestion of contaminated soil around copper smelters. Although treatment facilities have been introduced to reduce arsenic content in the drinking water supplied to the larger cities, many people continue to be exposed to unsafe levels of arsenic in their water.

Chronic exposure to arsenic in drinking water has been reported in Argentina. The estimated population at risk exceeds 1 million inhabitants, some of them living in small towns and villages scattered in large, semiarid territories. In Argentina chronic arsenic poisoning is a widespread public health problem, known since 1913. Cutaneous alterations (keratosis in palms and soles, melanoderma, and multiple epitheliomas) have been described.

#### AIR POLLUTION

Over the past years, air pollution, resulting from urban development and rapid industrialization, has become a major

issue. Adverse health effects have been associated with three types of air pollutants: 1) sulfur dioxide and particulate arising from the combustion of fossil fuels; 2) photochemical oxidants formed in the atmosphere from a complex chemical reaction between precursor hydrocarbon compounds and nitrogen oxides, which are largely related to such motor-vehicle emissions as carbon monoxide; and 3) a miscellaneous class of air pollutants such as hydrogen sulfide, lead, and cadmium, which are mostly emitted by such localized point sources as smelters, refineries, power plants, and manufacturing plants.

Air Pollution has most severely affected the large metropolitan areas with concomitant increases in total suspended particulate (TSP) and sulfur dioxide (SO<sub>2</sub>). In many urban areas the mean annual TSP exceeded 100 ug/m<sup>3</sup>; the WHO recommended value is 60 to 90 ug/m<sup>3</sup>. It is expected, as published in epidemiological studies that these exposures, adjusted for age, will be linked with about 6% of the reported mortality due to respiratory pathology. These pollution levels contribute to the increases of chronic cough among children and chronic bronchitis among the elderly.

Considering that the trend toward urbanization will not decline, and that it is closely linked with a continuous increase in the number of vehicles on the road and with local industrialization, it is very likely that efforts to control auto and industrial emissions will not be effective enough to reduce air pollution. On the contrary, there

is a great chance that air quality in the large metropolitan areas will continue to decrease placing even more people at a higher risk.

#### HABITAT DESTRUCTION AND DEVELOPMENT

Prospects for improving both the environment and people's well-being are closely linked with reviewing and adjusting the development model, which may help end economic stagnation by allowing greater freedom and democracy, promoting better care and protection of the various ecosystems, and fighting inequality.

Developing countries with rapid urbanization are undergoing enormous social and economic changes. Paradoxically, the same pattern of behavior that produce progress often create environmental problems, that offset some of these achievements and may result in long-term deterioration. The potential health effects of environmental deterioration are becoming major items on the agenda of governments. There is growing recognition that development models have contributed to the intensification of poverty and habitat destruction inadvertently offering new opportunities for lethal microbes to infect the human population. (See *World Ecology Report*, Winter 1995).

Zaire's leading virologist suggests that outbreaks of the Ebola virus in Africa might be connected to environmental damage in the interior of the African forest because Ebola outbreaks seem to be associated with ecosystem disturbances. Professor Jean-Jacques Muyembe told an international conference on Ebola organized by the World Health Organization that in Gabon, the site of the most recent outbreak, "gold prospectors went deep into the forest. They cut down trees in all directions." This gave rise to the emergence of the virus which appears to lie dormant in the forest until logging or some other activity stimulates the microbe. The source of Ebola has not been discovered, but it has been suspected to reside somewhere in a host in the Africa forest. Muyembe noted that the first recorded outbreak of Ebola in Zaire in 1976 occurred in the equatorial province of Yambuku in a forested region. The most recent epidemic in Zaire in the small city of Kikwit, May 1995, infected 316 individuals and killed 245—a 77% death rate. The number of deaths in the Gabon outbreak was 23 as of February 23. The small number of fatalities



occurred because the epidemic occurred in a remote region in combination with the government's rapid response to contain the spread of the disease.

Patterns of social and economic development differ between industrialized and underdeveloped countries. The most striking difference is that industrialized societies are largely consumer-oriented, relying on the mass production of goods and services, whereas underdeveloped countries are essentially based on resource exploitation, relying on agriculture, mining, forestry, and other natural assets to raise the standard of living. Both approaches have potentially serious but quite different impacts on the environment and on health. In developing countries, the pressures of poverty and population growth force people to cultivate ever more marginal lands. This cultivation further erodes the thin soil and depletes shallow water resources, creating even greater poverty as crop yields fall and women spend more of their day searching for firewood and fetching water. In the industrialized countries energy consumption results in the emission of 6 billion metric tons of greenhouse gases into the atmosphere each year, even though these countries have only a fifth of the world's population.

Three quarters of the poor people in the South live in ecologically fragile areas. It is estimated that at least 14 million have become environmental refugees, driven from their homes by ecological degradation. A recent report of the World Bank stated that "more than a billion people—about one third of the total population in developing countries—live in poverty." Despite progress, as measured by aggregate per capital consumption and improvements in social indicators (in some countries), poverty increased in many countries. Further, the United Nations Development Programme recognizes that "human development is moving to center stage in the 1990s. For too long, the question has been: How much is a nation producing? Now the question must be: How are its people faring?"

**SOURCE:** WHO Press Release, H/2899 Feb. 20, 1996; Reuters News Service

*Those who cannot  
remember the past are  
condemned to repeat it.*  
—George Santayana

## Progress Towards Health For All by the Year 2000

Estimated global values for selected indicators related to targets of WHO's Ninth General Programme of Work (1996-2001) in 1980, 1990 and 2000 (estimates)<sup>a</sup>

INDICATOR	1980	1990	2000 (estimates)	TARGETS
<b>Health Status</b>				
Life expectancy at birth (in years)				
• Global figure	61	64	67	In all countries, life expectancy at birth will be 60 years or over
• (Number of countries reporting a figure of 60 years or over)	(86)	(103)	(111)	
Infant mortality (per 1,000 live births)				
• Global figure	82	65	54	In all countries, infant mortality will be 50 per 1,000 live births or under
• (Number of countries reporting a figure of 50 per 1,000 live births or under)	(70)	(83)	(99)	
Mortality under 5 years (per 1,000 live births)	117	92	74	
<b>Disease Status</b>				
Poliomyelitis incidence	630,000	116,000	nil	Eradication of poliomyelitis
Dracunculiasis prevalence (adults)	12 million	3.0 million	nil	Eradication of dracunculiasis
Leprosy prevalence	10.5 million	5.5 million	300,000	Elimination of leprosy
Neonatal tetanus incidence	1 million	0.5 million	negligible	Elimination of neonatal tetanus
Hepatitis B carriers among children	NA	350 million	400 million	Control of hepatitis B
Tuberculosis deaths	2.9 million	2.9 million	3.5 million	Control of tuberculosis
Malaria deaths	1.45 million	2.25 million	1.95 million	Control of malaria
<b>Health Care Coverage (%)</b>				
DPT (third dose)	8	83	98.5	Primary health care available to whole population
Poliovirus vaccine (third dose)	8	85	99	
Safe water	52	75	86	
Sanitation	24	71	92	
Delivery of babies by trained personnel	NA	55	60	
<b>Health Resources<sup>b</sup></b>				
Percentage of GNP expended on health	3.2	3.0		
Per capital health expenditure (in US\$)	111	135		

<sup>a</sup>Based on data available in 1992.

<sup>b</sup>Central government expenditure only.

NA—not applicable; DPT—diphtheria/portusis/tetanus vaccine; GNP—gross national product

**SOURCE:** The World Health Report 1995: Bridging the Gaps, World Health Organization, Geneva.

## FOOD FOR THOUGHT: *Non-governmental Organizations and the United Nations: A Partnership for the Betterment of the Human Condition*

During the past couple of months I represented the Secretary-General of the Second United Nations Conference on Human Settlements (Habitat II) at several conferences and symposia held in major cities of the United States. Participants in those meetings included representatives of non-governmental organizations (NGOs), local authorities, community-based organizations, and academics, among others. The topics of discussion naturally revolved around Habitat II, and how the various participants related to it, or expected it to affect their lives and environment. However, discussions invariably involved the United Nations in general, and its relations with NGOs and civil society as a whole.

I came away from those meetings with mixed impressions about the level of knowledge of participants about the United Nations. On the one hand, I was highly impressed by how well informed some participants are on United Nations issues. Other participants, on the other hand, especially those from community-based organizations, seemed to lack even basic information about the organization, and have no idea how NGOs can relate to the United Nations, and collaborate with it for the betterment of humankind.

In this column, I shall focus on reviewing the relationship between NGOs and the United Nations, with emphasis on the opportunities for strengthening what had effectively become a partnership between the two.

The past ten years witnessed a significant growth of the non-governmental sector in most parts of the world, both numerically and in activities and influence. Four factors can be cited in explaining this welcome phenomenon: first, the general growth and strengthening of the NGO movement throughout the world in the aftermath of the Cold War; second, the gradual removal of opposition to a meaningful NGO participation on the part of former Eastern Bloc countries, and many Third World countries [For decades, NGO participation at UN fora had been limited to the most restrictive interpretation of Economic and Social Council (ECOSOC)

Resolution 1296, which set the terms for such participation]; third, a marked increase in moral, political and financial support to NGOs by institutions and foundations operating in Western democracies; fourth, the communication revolution made it possible for NGOs from North and South to receive information easily and readily, and to network among themselves on an unprecedented global scale.

These developments, added to the positive disposition of concerned UN officials, produced new policies and friendlier attitudes toward NGOs throughout the UN system. More flexible criteria for NGO accreditation to UN conferences were introduced.

Participation of NGOs in UN events and activities, such as the Fiftieth Anniversary of the UN, produced added support for the UN and greater contributions to its activities and operations worldwide.

NGOs have greatly expanded their commitments and operations in the areas of economic and social development, which is particularly evident from their increasing involvement in the programs and activities of the United Nations in these areas. Indeed, after over four decades of UN existence, during which relations with NGOs remained at arms length, a new relationship has emerged whereby participation of NGOs in UN activities is strongly encouraged, and is viewed as a "guarantee of the political legitimacy of international organizations" according to Secretary-General Boutros Boutros-Ghali.

Perhaps more than anywhere else, NGOs' participation and valuable contributions at UN conferences reflected the common concerns of the UN and the global civil society. During the first half of this decade seven international conferences dealing with education, children, environment and development, human rights, population, social development and women were held under the auspices of the United Nations. NGOs made such valuable contributions to the processes and outcomes of these conferences, to the extent that Member States and their delegates came to increasingly seek their advice, and include NGO representatives

in their discussions and deliberations.

Humanitarian assistance to victims of conflicts and natural disasters stands out as the finest example of partnership and collaboration between NGOs and the United Nations. Such collaboration is often exercised under difficult circumstances, as I have personally experienced during my service as UN Spokesman in Somalia. Yet, without such collaboration many relief and rehabilitation programs in conflict and disaster stricken areas could not be carried out, nor would thousands of lives be saved from hunger, malnutrition and disease.

Just as important from the United Nations standpoint, NGOs prove more effective in conducting its monitoring work than are UN Agencies or national Governments. NGOs offer the UN invaluable feed back in various forms on a wide range of issues and subjects. For instance, information provided by NGOs have on many occasions enabled the United Nations to deal more expeditiously with cases of human rights violations. Another area where NGOs could render great service to the UN is that of providing early warning concerning possible breakouts of ethnic and other forms of internal or regional conflicts.

NGOs are currently preparing to actively participate in the last major UN conference of this century, Habitat II, which will take place in Istanbul from 3-14 June, 1996. Labelled as "The City Summit", Habitat II will incorporate the findings, and benefit from the lessons learned from previous conferences and their follow-up processes. Habitat II shares major guiding principles with the global civil society, including civic engagement, sustainability and equity. Perhaps more than ever before, Habitat II offers NGOs a unique opportunity to make significant contributions based on their valuable experiences. In fact, NGO representatives assumed active roles in all preparatory meetings of Habitat II, and made valuable contributions to the Habitat Agenda, notably the draft Global Plan of Action.

—Farouk Mawlawi,  
Senior Advisor and NGO Liaison Coordinator,  
HABITAT II



## DID YOU KNOW?

■ The Ethyl Corporation (US) has introduced a manganese fuel additive known as M.M.T. formethylcyclopentadienyl manganese tricarbonyl. This additive raises the octane level of gasoline and therefore engine performance, but environmental and medical critics charge that this additive is toxic to the brain, especially the developing brains of children. The current director of the Environmental Protection Agency (EPA) in the US, Carol Browner, is one of the critics. In 1994, the EPA prevented the manufacture and use of this additive to US gasoline because of the potential health risks. In October 1995, a US court overturned the EPA-ruling and allowed Ethyl Corporation to sell and test M.M.T. at the same time. Canada has used M.M.T. for about 19 years. While the manufacturer claims Canadians have suffered no health problems related to low level exposure to this manganese additive, laboratory studies of rodents indicated brain damage caused by high dose exposure to the substance. The lack of studies on low dose chronic exposure to manganese in humans especially young children is of particular concern to two of Ethyl Corporation's medical critics, Drs. Landrigan and Needleman, of Mt. Sinai School of Medicine (in New York) and University of Pittsburgh, respectively. They claim that children are particularly vulnerable to the effects of neurotoxins because their nerve cells in the brain are continually developing. Furthermore, they contend, young children play close to the ground where automotive exhaust is most concentrated and therefore, would cause the greatest harm. They argue for further research before M.M.T. becomes a government sanctioned gasoline additive. The Ethyl

Corporation, on the other hand, dismisses studies of laboratory rats because of the high dosages applied. The use of M.M.T. in Canada has produced no data suggesting that the manganese derivative is a health hazard. However, as Landrigan and Needleman assert, no systematic studies of manganese in humans exists, except for the high risks of direct exposure to manganese experienced by manganese miners. The Ethyl Corporation is the same company that, in 1922, produced the lead additive which improved automotive engine performance. Sixty years later, leaded gasoline was banned in the US because it was recognized that leaded exhaust fumes from automobiles damage children's brains.

**SOURCE:** *New York Times*, editorial by Drs. Landrigan and Needleman, March 13, 1996; op-ed letter by Mr. Gottwald, Chairman and CEO, Ethyl Corporation, March 18, 1996.

■ A 1994 study by scientists Daniel Pisello and Richard Piccioni found a correlation between Strontium 90 levels in milk and fetal mortality rates and concluded that fallout in the 1960s may have caused the deaths of 400,000 American infants.

**SOURCE:** *Cleaning up America The Poisoned*, Lewis G. Regenstein, Acropolis Books Ltd., Washington, DC, 1993.

■ Deaths from infectious diseases are increasing world wide. One of the most important causes of this virulent phenomenon is the improper use of antibiotics for viral infections and over prescription of antibiotics for bacterial infection. As microbes tend to become resistant to antibiotics after prolonged exposure, incidence of untreatable bacterial infection is on the rise. A recent study of US death certificates demonstrates that between 1980 to 1992, death from infectious disease rose by 58%. A second study done at the Center for Disease Control (Atlanta, Georgia, US) reported that from 1980 to 1992, death from infectious disease rose from 40 to 65 deaths per 100,000 people. When deaths due to HIV are subtracted, the increase remains at 22% for this twelve year period. Most of the deaths were caused by fatal respiratory and blood infections. Between 1991 and 1994, bacteria has become increasingly resistant to antibiotics of all strengths. Severe streptococcus pneumonia infection progresses from the lungs into the bloodstream. Since a vaccine exists for this disease, one way to slow its virulence is to rely more heavily on the application of the vaccine than on the use of stronger antibiotics.

**SOURCE:** *Science News*, Vol. 149, Jan. 20, 1996.

■ The black-footed albatrosses of remote Midway atoll in the Pacific Ocean show evidence of significant contamination from DDT compounds, PCBs and dioxin-like substances. According to the Midway research team, composed of scientists from several nations, the amount of DDT compounds found in albatross eggs was close to two parts per million. Thinning of eggshells—which interferes with normal birth of birds—has occurred at levels between two and three parts per million in other birds, suggesting that the albatross population of Midway may be nearing a threshold beyond which the bird population will decline. Since DDT has a half-life of about three years, and since the ratio of the breakdown compound DDE to its parent DDT is 1 to 1, the DDT being detected is from new sources. The researchers suggest that the toxins most likely come from the Pacific Rim countries and India. DDT is widely used in developing nations to control mosquitoes and agricultural pests. According to one of the team's scientists, a DDT plume comes off the coast of Southeast Asia and is carried by currents into the north-central Pacific where Midway lies. Because the black-footed albatross eats high on the food chain, feeding on squid, flying fish eggs and flying fish, DDT compounds would appear in high concentrations. The use of DDT was banned in the US, Canada, and Western Europe since the mid-1970s. The dioxin-like substances that the research team detected may be traced to the birds' ingestion of floating plastic debris. Researchers suggest that the trash dumped off the coast of Japan and other Pacific Rim nations is the source for the toxic plastic debris.

**SOURCE:** *New York Times*, March 12, 1996.

■ A new international association of community health centers has come into existence as a result of the Conference of Community Health and Social-Service Clinics held in Montreal, Quebec, Canada, in December 1995. The conference was sponsored by the World Health Organization, the Organization for Economic Cooperation and Development (OECD) and the World Bank. The Quebec Federation of local community health centers (CLSCs) will temporarily be responsible for secretarial and coordination functions. The goals of the newly formed association include an emphasis on solidarity, consensus-building, sharing information and common orientations.

**SOURCE:** *Quebec Update* Vol. XVIII, No. 9, Jan. 19, 1996.



## GOOD NEWS

### **BIOREMEDIATION: *The Future of Waste Management***

The interdependent relationships between living and non-living entities that inhabit our planet are so complex that some scientists look at the earth as if it were a single organism, thus altering one component changes the entire biosphere. Over the course of many years, humans have managed to do this in many ways—we have destroyed species of plants and animals, we have influenced the way forests regulate the water cycle, how wetlands filter pollution. Tens of thousands of species of animals, plants and insects vanish every year according to biologist E.O. Wilson and some biologists approximate that 10% to 20% of the estimated 10 million species of living things on our planet will disappear by the year 2020.

By burning fossil fuels like oil and coal we also changed the atmosphere by releasing an estimated 5 billion tons of carbon dioxide annually into the atmosphere.

While we are guilty of exploiting and polluting the planet, by recognizing the ways we affect the most basic chemical cycles will we be able to solve some of our most dangerous environmental problems.

Molecular Biology and Environmental Science seem to have little in common, both are relatively new areas of scientific research. Yet, it has been known for many years that there are vast numbers of unknown species of microorganisms, including bacteria, fungi, algae, etc. that inhabit the natural world, and that many of

these species have the capacity to use certain toxic chemical pollutants as carbon and energy sources. Thanks to advances in biotechnology, scientists are finally becoming aware of the potential of these friendly microorganisms in areas of bioremediation. Bacteria are especially remarkable in their ability to enzymatically transform a large variety of potentially dangerous compounds, such as industrial solvents, PCBs, even pesticide residues, which are toxic to most living organisms, to safer compounds.

#### **BIOLOGICAL CLEANUP OF HAZARDOUS WASTE SITES**

Hazardous waste is one of the most frightening and intractable problems caused by industrial societies. These by-products of manufacturing attack the overall health of the environment as well as humans. The Council on Economic Priorities estimates that 80% of people in the United States live somewhere near a hazardous waste site. In the past, hazardous waste was simply dumped into open pits in the ground, or stored in metal drums which eventually leaked and seeped into soil, or was pumped untreated into rivers and streams. Today, the EPA's Superfund spends billions of dollars each year to clean up hazardous waste sites and according to the EPA, some 195,000 sites generate hazardous waste in the US and 300 million to 700 million tons of toxic matter are created every year.

In some cases, waste is reclaimed, hazardous materials taken from it and reused (recovering lead from car batteries for example) or is treated so that it is no longer hazardous. There is also bioremediation, the use of natural organisms to help cleanup the environment.

Toxicologists have long known that toxicity is a relative phenomenon dependent on the metabolic profile of particular organisms and environmental contaminants differ in the ease with which they can be biologically degraded. However, biological processes are extremely reliable only when the conditions surrounding the environment are understood.

One of the most difficult groups are polychlorinated biphenyls (PCBs). This is due to their chemical instability, low water solubility and the fact that they were used and discarded as complex mixtures. However, it has been discovered that some bacteria are able to use BP as a carbon and energy source and some are capable

of degrading PCBs.

Investigators at General Electric Company Research and Development identified just such a bacteria when looking for a way to clean up the PCB contaminants it had discharged into the Hudson River many years ago. This strain of Bacterium LB400 was isolated from soil samples from a disposal site where various pollutants had been identified (including BP and PCBs). LB400 proved to degrade an impressive assortment of PCB congeners, including some containing several chlorines.

Aromatic Hydrocarbons, Polyaromatic Hydrocarbons (PAHs) are actually found in nature and it is widely agreed that most of these compounds are formed through the pyrolysis of organic matter. Many of these hydrocarbons are suspected carcinogens and the amount found in air and soil samples has increased over the last century. This is mostly because of the increased use of petrochemicals and the manufacturing of petroleum based products like polymers, plastics, pesticides, solvents, explosives and even pharmaceuticals.

PAHs are also among the main ingredients of Creosote, a substance hundreds of companies have used to treat telephone poles and railroad ties. The now defunct American Creosote Works contaminated water and soil with thousands of gallons of creosote and pentachlorophenols. SBP Technologies, Inc. discovered a bacterium that degrades carcinogenic PAHs, and using the old American Creosote Works location as a test, was successful in cleaning the site up.

It is relatively easy to isolate microorganisms from the environment that use simple aromatic hydrocarbons as carbon sources and new research has focused on isolating microorganisms able to degrade much more complex aromatic hydrocarbons. Today this technology is being used to biodegrade aromatic hydrocarbons in the environment, waste treatment plants and industry.

Few environmental catastrophes are quite as dramatic as a massive oil spill. Oil spills do their environmental damage by poisoning the food chain as well as the environment in general. Bioremediation works especially well when pollutants are petroleum based, therefore, has shown to be promising for oil spills. For cleaning beaches, using naturally occurring bacteria to break down the oil, a chemical "fertilizer" is sprayed onto oil-drenched beaches.

This "fertilizer" promotes the growth of microorganisms that literally eat the oil. After the 1989 Exxon Valdez spill in Alaska, researchers from the EPA designated some areas on the contaminated beach, for treatment with fertilizer, and some with no treatment. After 2 summers, the treated plots degraded 2 to 4 times as fast as those left to natural processes.

#### **BIOREMEDIATION IN ENVIRONMENTALLY SAFE FARMING**

The yield of food per acre has skyrocketed in the 20th century, involving the use of modern machinery and an arsenal of technology, including chemicals such as fertilizers and pesticides to increase food output. This technology has been of particular help to third world countries since it allows a relatively small number of farmers to feed a large number of people.

But, this has come at a cost. Chemical fertilizers damage lakes, streams and rivers and they destroy the soils natural balance, causing erosion and stripping the soil of nutrients. This sets up a vicious cycle where more fertilizer is used to make up for soil depletion.

Pesticides in particular do an enormous amount of environmental harm, killing fish, birds and other wildlife and are capable of devastating entire species and ecosystems. Pesticides poison an estimated 1 million people per year with up to 20,000 deaths worldwide.

Integrated pest management is one way to minimize and possibly eliminate the harm pesticides do to the environment. One method calls for the introduction of predators that control pests. In Indonesia, for example, farmers were taught how to conserve a spider that eats the brown planthopper, a pest that feeds on rice fields. After only 3 years, farmers were using 90% less pesticides which saved them money and increased crop yields and profits.

Natural pest control methods not only result in a cleaner environment but produces more profits for farmers by reducing farming costs, as massive amounts of pesticides are not only dangerous, but expensive.

During the 1996 planting season, farmers in the Southwest United States will begin planting the first seed products with built-in protection from damaging pests.

Mycogen Corporation, an agricultural biotechnology company in San Diego, California, using *Bacillus thuringiensis* (Bt)

technology, developed the first hybrid seed for corn, genetically engineered with Bt genes that will give corn plants built-in protection from the European Corn Borer.

Mycogen has also developed environment-safe, biologically engineered insecticides, fungicides and herbicides. The company is continuing its patented Bt technology to produce insect resistant soybeans, sunflowers, and cotton, to name a few. These products reduce or eliminate the need for chemical pesticide applications.

Other strains of the bacteria Bt have had important uses in controlling other dangerous pests. The World Health Organization and others spray Bt on vast areas of Africa, Asia and South America, killing off malaria-bearing mosquitoes. Bt has also been discovered to kill the black flies responsible for River Blindness in West Africa, almost eradicating the disease.

#### **OTHER WAYS BIOREMEDIATION CAN BE USED TO CLEAN UP THE ENVIRONMENT**

■ Much of the acid rain in North America is traced back to sulfur from coal combustion. Bacteria has shown promising results in removing most of the sulfur before the coal is burned.

■ We think of plastics as new materials, but bacteria have been making them for 3.5 billion years. Many species make polyesters almost identical to those found in synthetic fibers. The important difference between biologically produced plastics and chemical synthetics is that the former is biodegradable; the latter, like all synthetics have a mirror image molecular chain that inhibits biodegradation. With a world quickly running out of landfill space, the market for biological plastics is timely and necessary.

■ "Bioventing." This is the process of pumping polluted air through microbe laden soil and groundwater, where the contaminates in the air are eaten by native bacteria. "Recycled" air analyzed at the surface has been tested clean.

■ Bioremediation has also been tested as a replacement for harmful chemicals such as paint thinners or strippers. Two bacteria and a fungus were discovered eating paint from a chunk of painted metal at an old paint landfill, according to Technical Research Associates in Salt Lake City, Utah. Their researchers continually seek out microorganisms wherever they see equipment falling apart.

We have made much progress on regulating waste, but, we must continue these efforts, especially with regard to existing waste sites. We still produce too many wastes. We must learn to cut down our consumption of goods and develop environmentally friendly manufacturing techniques. In the long-run, the human organism is the most effective bioremediation weapon.

#### **SOURCES:**

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## *Voices of the Planet*

■ World Information Transfer's Fifth Annual Conference, Health and the Environment: Global Partners for Global Solutions, April 25 and 26, 1996, at the United Nations in New York, co-sponsored by the Government of Lebanon. This year's topic is "Toxic Waste: Its Effect on Health." "Commemorating the Tenth Anniversary of Chernobyl" will be the topic for the Thursday and Friday morning. For further information, please contact WIT. Tel: (212) 686-1996; fax: (212) 686-2172; e-mail: wit@igc.apc.org.

■ WIT has available its conference video which is a compilation of conferences held between 1992 and 1995, titled "Health and Environment: Global Partners for Global Solutions." The video is US\$ 19.95. Please contact the WIT Headquarters in New York. Tel: (212) 686-1996; fax: (212) 686-2172; e-mail: wit@igc.apc.org.

■ The agenda for the Habitat II Conference in Istanbul, Turkey, June 3-14, 1996, is available on the Internet at <http://www.igc.apc.org/Habitat>

■ World Information Transfer will be holding two events in Istanbul with the cooperation of Pathfinder International (Dr. Demut Gural). A Health Caucus is scheduled for June 6th, 7th, and 8th and a conference on

"Health in the Habitat—Humans at Risk" on June 10th, at the NGO Forum.

■ The World Food Summit: Mobilizing the Authority, Capacity and Wisdom to Eradicate Hunger from the Earth. Heads of state and government from throughout the world will gather in Rome in November to join in an unprecedented attack on the hunger and malnutrition that blights the lives of hundreds of millions of men, women and children.

The meeting, to be held November 13-17, 1996, at the headquarters of the UN Food and Agriculture Organization (FAO), will be the first World Food Summit ever convened. It comes at a time of growing international concern over declining production and rising prices of cereals, a leading staple food.

FAO Director-General Jacques Diouf, who proposed the Summit, says he is convinced that practical action at the local, national and international levels can achieve its goal of providing "Food for All."

The task is formidable. FAO estimates that in the developing world alone, some 800 million people, 200 million of them children, are chronically undernourished. Millions more suffer from debilitating diseases related to micronutrient deficiencies and contaminated food and water.

"It is unacceptable that hunger and malnutrition continue to diminish the human potential of over 800 million people in developing countries in an age when we explore the planets and beyond," Dr. Diouf said.

And the FAO Director-General warned that "world food production will have to increase by more than 75 per cent over the next 30 years to ensure adequate food supplies." The world population is expected to reach nearly 8.3 billion by the year 2025, compared to 5.7 billion today.

To hold down costs, preparatory work has been undertaken by existing FAO committees, including the 1996 cycle of biennial Regional Conferences. The Fourth International Technical Conference on Plant Genetic Resources begin held June 17-23 in Leipzig, Germany, is also expected to make an important contribution.

For further information, contact Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy, Telephones—Press Room: 52253259, 52253625; Radio: 52253594; Television: 52253528; Telex: 610181; Cables: FOODAGRI ROME; Fax: 52255924, 52253699, 52254974.

■ The Commission on Sustainable Development will meet in New York at United Nations Headquarters from April 18 to May 3, 1996. Parallel to its annual meeting, several organizations will host side events related to the work of the Commission. The following is a partial list of organizations holding side events: UNESCO Panel on Education, April 18; UNCTAD and DPCSD panel on trade-related issues, April 22-23; ICFTU Panel on Employment and Sustainable Development, April 23; ILO Panel on Environment and the Workplace, April 24; Youth Panel, May 1; Panel on the 1997 Review of Agenda 21, May 2. Information on meeting times and places and the meetings and rooms will be announced at a later date along with the completed schedule of CSD Side Event Panels. Contact the Secretariat of the UN Commission on Sustainable Development, Room DC 2-2270 United Nations, NY, NY 10017, tel: (212) 963-3170; fax (212) 963-4260. CSD Documents can be obtained on the Internet at <http://www.un.org/DPCSD>.

■ Dubos, René. *Celebrations of Life*. New York: McGraw Hill, 1981.

Amidst the plethora of treatises about environmental threats to life, it is refreshing to reread a book that celebrates the human potential in solving complex environmental problems. Through his writings, René Dubos (1901-82), French born American bacteriologist widely recognized for his major contribution to the development of antibiotics, continues to offer insight into global environmental problems and their solutions. We recommend Dubos' *Celebrations of Life* for its optimism and vigor. His book "is an expression of my personal experiences." Chapters III and IV have a particular resonance in this post-Chernobyl era. Here, Dubos argues for the importance of thinking globally but acting locally and personally by first examining then altering one's own behaviors. He recognizes the similarity of environmental problems everywhere, but understands that solutions are always shaped by local conditions and "choices." In this and the following chapter using historical and contemporary examples, he demonstrates how individuals and societies have made choices to change the direction of their lives when that direction became unworkable. As a scientist and humanist he clearly presents the very dynamic relationship between humans and their environments and fully believes in the possibility of people to make

the choices that will solve the most ecological complex problems.

■ Sagan, Carl. *The Demon-Haunted World: Science as a Candle in the Dark*. New York: Random House, 1996.

As the millennium approaches, there appears to be growing interest in alien abductions, angels and other visions, magic and faith healing. The renowned scientist, Carl Sagan, clearly states in his latest book that scientific thinking is the only route to the acquisition of knowledge. The process of scientific thinking is the well known scientific method practiced by scientists, social scientists and others to develop hypotheses which are then tested and occasionally turned into scientific truths. Sagan has been a popular spokesman for the scientific method as the means to develop the knowledge that leads to truth. Here he contrasts belief in alien abduction which he rightly calls pseudoscience with scientific investigation. Though this book is 400 pages long, its subject is extremely important. Sagan is among the thinkers who assert that truth gained through the scientific method is under assault in many places and by many groups including companies like the US tobacco industry and governments. Most important, he writes that scientific thinking which he calls the "candle in the dark" is fundamental to democracy.

■ *Your World*. United Nations Publications, London: Havrill, 1992.

The United Nations Environment Programme's (UNEP) photographic competition led to the production of this compelling group of images. Contestants were asked to express their "visions" of the world's current condition either as "celebration" or "condemnation." Of the 32,000 entries, UNEP selected 214 photographs for the book. The contrasting images powerfully illustrate environmental problems as well as the natural beauty of the earth and it is for the poignancy of the contrasts that we recommend this collection of photographs.

■ *Consolidated List of Products Whose Consumption and/or Sale have been Banned, Withdrawn, Severely Restricted or Not Approved by Governments*. Department of Policy Coordination and Sustainable Development, United Nations Publications, 1994.

We recommend this 935-page compendium of products as a valuable reference source.

**POINT OF VIEW** *continued from back page*

cated the magnitude and devastation caused by the accident. Rightly, the nations most damaged by radioactive contamination from this disaster—Ukraine, Belarus and Russia—are willing to remember and memorialize that day of devastation.

The future health of humans remains at risk until nuclear energy becomes a safer technology and is based on a much greater knowledge and awareness of the impacts of low level chronic emissions of radionuclides and other waste material produced by nuclear energy. Those of us who think about the future inherited by our children and grandchildren, should heed the warning of Chernobyl, increase our knowledge of the health impacts of nuclear and other energy sources, and decide how we want to try and secure a technologically safer future for our loved ones than we have presently claimed for ourselves. Finally, alternative sources of renewable energy which pose fewer health hazards exist and require fuller appreciation, dedication and development, so that sun, water and wind become more widely utilized as sources of inexpensive power to fuel the world's growing economies.

**CORRECTION**

*Winter 1995 Issue*

front page photo—Seaside, Florida,  
Source: Alex S. MacLean/Landslides

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## POINT OF VIEW: *From the Entrails of Chernobyl*

Like the canary in the coal mine whose death warns humans of lethal carbon monoxide fumes, the nuclear accident at the Chernobyl nuclear power plant in Ukraine on April 26, 1986, cautioned all of us about the ultimate dangers of nuclear energy. The Chernobyl accident further signaled our responsibility to know as much as we can of the risks involved in the technologies we use. The world's inhabitants may face the same fate as the canary if we ignore the warnings and look the other way, captured by the illusion that Chernobyl had nothing to do with us.

Chernobyl heightened several problems about nuclear power plants that remain unsolved. The first has to do with waste storage facilities; the second concerns low level chronic emissions of radionuclides and the influence of those emissions on local habitation of people, animals and vegetation; the third regards human errors, a series of which ultimately resulted in the widespread and generational devastation caused by the Chernobyl meltdown. In too many discussions with knowledgeable individuals, the common response to Chernobyl is that the accident was the result of antiquated technology in a totalitarian political system. At this point, it is probable that former Soviet politicians and private citizens know better than others what nuclear energy can breed. The paradox is that relative to fossil fuels, nuclear power is clean, cheap and renewable. However, unlike the knowledge about the environmental impact of fossil fuel use, no one yet fully understands ecological influ-

ences of nuclear energy—except when there is an accident.

Why then, do educated people tolerate the insufficient levels of safety and knowledge about the ecological and health effects of nuclear power plants? If the world's citizens are capable of protesting against the French government's resumption of nuclear tests, why don't those same people rage against generators powered by nuclear fission—the same chain reaction that produces the atomic bomb. The critical problems of nuclear power plants—fall-out, waste storage and human error—pertain to nuclear weaponry. Is it that we are blinded by the need for what we believe is “cheap electricity” and ignore the possible reality? Add to this, faith in technology and belief in human imperfection that induces us to accept the view that technology can compensate for human blunders.

We lean towards a vision of a peaceful future, free of nuclear warheads, yet fueled by nuclear power. Yet, when we start to question what happens to unspent nuclear material after the world's bombs are dismantled we begin to recognize the similarity of the hazards posed by both nuclear weapons and nuclear power plants.

Another signal warning that nuclear power plants put human health at risk comes from predicted worldwide water shortages in the not too distant future. Nuclear and fossil fueled power plants are the single largest industrial users of fresh water due to the vast quantities of water

required for the job of cooling. While most of the water used for industry is returned to the water cycle, it is often contaminated with chemicals including PCBs, dioxin, and heavy metals. Water thus polluted, contaminates the supply of drinking water, bodies of fresh water in which fish consumed for food swim, and water used for agriculture.

Since Marie Curie's death from radiation poisoning in 1934, it has been known that radioactive material threatens human health depending on degree of exposure. Madame Curie shared the 1903 Nobel Prize in Physics with her husband Pierre and physicist Henri Becquerel for their discovery of radioactive elements. She won an unprecedented second Nobel Prize in 1911 in chemistry for her work on radium. Her momentous discoveries took her life as the radiation poisoning that killed her occurred from chronic rather than acute exposure.

Everyone and everything around and alive at the time of the Chernobyl explosion and fire absorbed increased amounts of radiation, the quantities depending on one's proximity to ground zero. Pregnant women in the region unavoidably exposed their unborn fetuses to mild or severe abnormalities. While Chernobyl was not the first accident at a nuclear power plant, it is the worst and the best known as it affected the greatest number of people and has been attributed to bringing down the Moscow dominated Soviet Regime which ignored and obfus-

**POINT OF VIEW** *continued on page 15*

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Margaret Mead

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