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Causes and health consequences of environmental degradation and social injustice

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Abstract

Worldwide the greatest effects on the health of individuals and populations results from environmental degradation and social injustice, operating in consort. This paper describes the national and global causes and health consequences of these phenomena. Causes include overpopulation, pollution, deforestation, global warming, unsustainable agricultural and fishing practices, overconsumption, maldistribution of wealth, the rise of the corporation, the Third World debt crisis, and militarization and wars. Consequences include increased poverty, overcrowding, famine, weather extremes, species loss, acute and chronic medical illnesses, war and human rights abuses, and an increasingly unstable global situation that portends Malthusian chaos and disaster.

Because of their scientific training, and due to their privileged socioeconomic status, physicians are in a unique position to recognize these phenomena and to act at all levels, from interactions with their patients, to volunteerism, to service and intervention in areas of great need, to direct political activism and involvement. Specific suggestions for action are discussed.

Keywords: Environmental degradation; Social injustice; Pollution; Poverty; Activism

Introduction

Worldwide the greatest effects on the health of individuals and populations result from environmental degradation and social injustice. The two operate in consort. In this paper, I describe the national and global causes and consequences of environmental degradation and social injustice. Causes include overpopulation, air and water pollution, deforestation, global warming, unsustainable agricultural and fishing practices, overconsumption ("affluenza"), maldistribution of wealth, the rise of the corporation, the Third World debt crisis, and militarization and wars. Consequences include increased poverty, overcrowding, famine, weather extremes, species loss, acute and chronic medical illnesses, war and human rights abuses, and an increasingly unstable global situation that portends Malthusian chaos and disaster. Unfortunately, most of the world's governments, guided by self-interest (or self-preservation) have adapted too slowly to environmental changes and as such face decreasing internal stability, their health care systems in crisis.

Because of their scientific training, and due to their privileged socioeconomic status, physicians are in a unique position to recognize the causes and consequences of environmental degradation and social injustice and to act at all levels, from their interactions with individual patients, to volunteerism, to service and intervention in areas of great need, to direct political activism and involvement.

Overpopulation

The world's population has grown exponentially, from 1 billion people in 1800, to 2.2 billion in 1950, to 6 billion in 1999, and is estimated to reach 8–10 billion by the year 2150 (Bongaarts, 1994; DeLacroix, 2000).

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More people have been added to the planet in the last 40 years than in all previous recorded history. The areas most affected by overpopulation are Africa, Asia, and Latin America. Causes include poverty, impaired access to reproductive health care services, and the social, legal, educational, economic and political marginalization of women. Accompanying the explosive growth in population is an increasing trend toward urbanization; 20–30 million people per year leave rural for urban areas. In this country, since the 1960s metropolitan areas have been consuming land at a rate four times faster than population growth; we pave over 46 acres of prime farm land per hour (Amicus Journal Staff, 1999c). Finally, there is presently a world migrant population of almost 50 million individuals (National Geographic Staff, 1998), including refugees from environmental catastrophies (McConahay, 2000) and 39 million individuals displaced by one of the 250 wars that took place in the 20th century (Doctors Without Borders Staff, 2000; Bacon, 2000).

Air pollution

Industry and automobiles are the primary and secondary contributors to air pollution worldwide (Kay, 1999); I will focus on automobiles. For every gallon of gasoline manufactured, distributed, and then burned in a vehicle, 25 pounds of carbon dioxide are produced, along with carbon monoxides, sulfur dioxide, nitrogen dioxide, and particulate matter; these emissions contribute to increased global warming (Alexander & Kanner, 1995; Mark, 1997). In the United States, there is one car for every two people, in Mexico one for every eight, and in China one for every 100. The global auto population is expected to double in the next 25–50 years (Mark, 1997). The average number of miles traveled/car/year in the United States has more than doubled, from 4570 in 1965 to 11,400 in 1999 (Amicus Journal Staff, 1999a). The average fuel efficiency of US automobiles has decreased over the last few years, due in part to stagnant fuel economy standards, relatively low oil prices, and a growing market for low efficiency pick-ups, mini-vans and sports utility vehicles (SUVs, which now outsell cars) (Mark, 1997). Current standards are 27.5 miles per gallon (MPG) for passenger cars and 20.7 MPG for light trucks and SUVs (Sierra Magazine Staff, 1997b; PSR Environment & Health Update, 1999a). The nation's 3.3 million diesel trucks and buses, rolling smokestacks, account for almost 3/4 of the estimated cancer risk from auto-related air pollution (Mark & Morey, 2000). In 1997, the Environmental Protection Agency (EPA) proposed new rules that will require diesel manufacturers to build cleaner engines and the oil industry to produce much cleaner fuel. Under these rules, the minimal mile-per-gallon requirements for SUVs could soon match those of automobiles (Kluger, 1999), although the current administration has opposed these changes.

Levels of air pollution in major US metropolitan areas put the health of almost 133 million Americans at risk (Nation's Health Staff, 2000a). High ambient levels of air pollution have been linked to infant mortality and hospital admissions for cardiac, pulmonary, and cerebral vascular disease (Ponka & Virtanen, 1996; Morgan, Corbett, & Wlodarczyk, 1998; Morris, Naumara & Muasmghe, 1995). After adjusting for smoking (itself a major toxic pollutant responsible for increasing, widespread death and disability) and other risk factors, Dockery et al. (1993) found a strong association between fine dust particulate air pollution and mortality from lung cancer and cardiopulmonary diseases. Samet et al. (2000) recently found an association between the levels of fine particulate matter and the risk of death from all causes and from cardiovascular and respiratory illnesses in 20 US cities. The global increase in asthma prevalence has been attributed to increasing urbanization and poverty, with greater exposure to indoor allergens such as dust mite and cockroach antigens, as well as to outdoor air pollution (Dockery et al., 1993; Aligne, Byrd, & Weitzman, 2000). The US EPA has estimated that 250,000 cases of aggravated asthma and 15,000 deaths from cardiopulmonary diseases could be eliminated each year if the agency's proposed new standards for ozone and particulates are implemented (Physicians for Social Responsibility Staff, 1998; Alexander & Kanner, 1995). Unfortunately, implementation has been blocked by heavy lobbying by oil, gas, and other industries; the battle has now reached the Supreme Court. The problem is even greater in other parts of the world; for instance, air pollution kills 40,000 people prematurely each year in India (DeLacroix, 2000).

Due to pollution-induced destruction of ozone in the upper atmosphere, cataracts secondary to ultraviolet damage are on the rise, and melanoma incidence increased 83% between 1990 and 1997. The lifetime melanoma risk of an individual born in 1930 was 1/1500, while that of an individual born in 1998 is projected to be 1/75 (Whited & Grichnik, 1998).

The United States has refused to ratify the Kyoto Protocol, an international treaty which would legally bind developed nations to limit their output of fossil fuel emissions and other harmful gases in the upcoming century, and it has not formulated a workable plan to achieve the goals of the Protocol (PSR Environment & Health Update Staff, 1999b).

Water pollution

Today 40% of US waters are unfit for fishing or swimming, and levels of mercury in fish in 40 states

exceeds safety standards for pregnant women (PSR Environment and Health Update Staff, 2000). Except for the Mississippi and a few others, free-flowing rivers have ceased to exist. For instance, the former Columbia River is now a series of 75 dammed lakes. While the Clean Water Act of 1972 requires states to publish a list of all bodies of water that fail to meet water quality standards, and for the states to set pollution limits and scale back pollution in watersheds until standards are met, compliance is negligible and enforcement weak. Congress is strongly considering rollbacks and even elimination of the Act (PSR Environment and Health Update Staff, 2000). While tap water is subject to treatment and is required to meet detailed testing and purity standards, it is not always disinfected of diarrhea-inducing microorganisms, as illustrated by waterborne disease outbreaks such as that caused by *Cryptosporidium* in Milwaukie in 1993, which affected over 400,000 people. Furthermore, fecal coliforms are not prohibited in bottled water (Nation Staff, 1996), and water bottled and sold within the same state is not subject to Food and Drug Administration standards (Gross, 1999). In a National Resources Defense Council study of the quality of bottled water (Nation Staff, 1996), approximately one-fifth of samples exceeded bacterial purity guidelines and/or safe levels of arsenic or other synthetic organic chemicals (Amicus Journal Staff, 2000a). Between 25% and 40% of bottled water was merely repackaged municipal tap water (Nation Staff, 1996).

Garbage

In 1997, Americans produced over 430 billion pounds of garbage, amounting to 1600 pounds per person (Sierra Magazine Staff, 1997c; Amato, 1999; Gavzer, 1999). The composition of the garbage in the 2300 landfills in the United States is as follows: paper and paperboard products, 39%; yard waste, 13%; food waste, 10%; plastics, 10%; metal, 8%; glass, 6%; and wood, 5% (Gavzer, 1999). Many of our 2300 municipal landfills are reaching the saturation point. Fresh Kills Landfill on Staten Island, the main depository for New York City's garbage, is expected to be full by next year. The city unsuccessfully attempted to export its garbage to less-developed nations on a giant barge in 1987. Currently, New York spends over 70 million dollars per year to export its trash to other states, where it, along with local trash, is deposited in landfills or burned in incinerators. Landfills produce millions of gallons of leechate (''garbage juice''), which can enter the water supply contributing to water pollution (Gavzer, 1999). One hundred and ten incinerator plants in the United States convert garbage to fuel, steam, and electricity. However, these also produce bottom ash and fly ash which, due to incomplete filtering, contribute to air pollution (Gavzer, 1999).

US recycling rates in 1997 were as follows: tires, 22%; plastic containers, 23%; glass containers, 28%; yard waste, 41%; paper and paper board packaging, 42%; aluminum packaging, 54%; steel cans, 60%; and auto batteries, 93% (Gavzer, 1999).

Toxic pollutants

Every year 25 billion pounds of toxic pollutants are added to the environment by US factories and mines (Fagin & Lavelle, 1999). Additionally, 2.2 billion pounds per year of pesticides (eight pounds per citizen) are sprayed on our crops (Natural Resources Defense Council Staff, 1995). Certain pesticides that are illegal in the United States are used in other countries on food which is then imported back into the US, exposing Americans to the same health risks faced by individuals in those other countries (Satcher, 2000). Annual world production of synthetic organic chemicals has grown exponentially since the early 20 century. The vast majority of artificial chemicals have never been screened for toxicity. Chemical manufacturers are not required to prove safety; instead the legal burden is on the government to prove that a product is dangerous, and testing is only done after a substance has been impugned.

Two million children in the United States are at risk of neurological damage due to elevated lead levels (Hattam, 1998). African–Americans living in inner cities are at high risk (Weintraub, 1997; Friedrich, 2000). While the US outlawed leaded gasoline in 1976, many other nations continue to use it, putting large numbers of citizens at high risk for chronic lead toxicity (e.g., over 60% affected in parts of Russia) (Kittman, 2000). The US government also actively promotes, even subsidizes, tobacco sales overseas (Hammond, 2000). Other toxic pollutants include dioxin, a by-product of the manufacturer of defoliants such as ''Agent Orange'', which is currently produced largely as a byproduct of medical incineration of polyvinyl chloride in intravenous bags and tubing; polychlorinated biphenyls; nitrates and nitrites, mercury and methylmercury; arsenic; trichloroethylene; and vinyl chloride. ''Agent Orange'' has been lined to diabetes, chloracne, porphyria cutanea tarda, soft-tissue carcinomas, Hodgkin's and non-Hodgkin's lymphomas, multiple myeloma, and lung and prostate cancers (Maugh, 2000).

Forty-five million US citizens live within 4 miles of one of the 1193 Superfund sites (Pope, 1994). These sites, as well as waste dumps and incinerators, are more common in lower socioeconomic status neighborhoods, such as the ''Cancer Belt'' between Baton Rouge and New Orleans, Louisiana (Mackillop, Zhang-Salomons,

Boyd, & Groome, 2000). The United States has 16,000 active landfills and four million underground waste-storage tanks. Furthermore, it is legal to dispose of hazardous and radioactive waste by turning it into fertilizer and even household products (Public Citizen News Staff, 2000; Wilson, 1998; Public Citizen News Staff, 1999; Hauter, 2000). Uranium-laced fertilizer has been found in Oklahoma, lead-laced fertilizer in Southwest Washington, and mixtures containing arsenic, cadmium and dioxins in other areas. Due to a loophole in the hazardous waste laws, there is no requirement that these toxins be listed on ingredient labels (Wilson, 1998; Public Citizen News Staff, 1999).

The EPA estimates that US farm workers suffer up to 300,000 pesticide-related acute illnesses and injuries per year, mostly cholinergic symptoms from anticholinesterases and lung disease from airborne exposure (Hansen & Donohoe, 2002; Mellon, Rissler, & McCamant, 1995). Some pesticides are classified as persistent organic pollutants. These are toxic, remain in the environment long-term, resist degradation, and can travel long distances. They bioaccumulate in the food chain, can disrupt animals' endocrine systems, and may be responsible in part for the halving of male sperm counts per ejaculate from 1950 to 1990 (Solomon, 1997). They have been linked to Parkinson's Disease (Stephenson, 2000) and malignancies (Hunter, Hanikinson, & Laden, 1997). The National Academy of Sciences estimates that pesticides in food could cause up to 1 million cancers in the current generation of Americans. The United Nation's Environmental Program is currently organizing a worldwide phase-out of the top 12 persistent organic pollutants which include DDT, chlordane, heptachlor, dioxins and polychlorinated biphenyls (PSR Reports Staff, 1999).

Practices such as copper (Dobb, 1996) and "cyanide heap leach" gold mining (Duncan, 1998; Solnit, 2000) contribute further to the buildup of toxic waste in our environment. Most of the 16,000 US golf courses, which cover an area three times the size of Rhode Island, are heavy users of insecticides, fungicides and herbicides, as well as water, leading to toxic runoffs into local streams (PSR Reports Staff, 1999). The rise of the computer also contributes to pollution. There are 400 million personal computers (PCs) worldwide. Producing one PC consumes 2800 gallons of water, uses 700 chemical compounds (half of which are hazardous), and creates 7 pounds of toxic waste. One-third of the United States 150 million PCs are left on overnight and on weekends draining energy, and 20 million computers are discarded each year (Bergman, 1999). The average computer lifespan is <3 years. Disposable diapers result in 12,000 tons of waste per day. While cloth diapers are less expensive, four times as much energy is involved in their manufacture, packaging and disposal, and twice as much water is required to clean them. The solution for the eco-friendly parent is to use cotton diapers at home and disposable diapers for travel (Hamilton, 1997). Drycleaning, which utilizes perchloroethylene, an airplane-parts degreaser linked to cancer and reproductive disorders, contributes 300 million pounds of toxic waste per year in the United States and Canada. Drycleaners have seven times the background rate of esophageal cancer and two times the background rate of bladder cancer. Wetcleaning is a safer yet more expensive and underutilized alternative (Erickson, 1998a, b).

The 6000 US hospitals also contribute to our waste stream, generating 2 million tons of garbage per year (Environmental Working Group Staff, 1997). Eight hundred and fifty thousand tons of waste are incinerated annually, increasing levels of dioxins, mercury, cadmium and lead in local environments (Amicus Journal Staff, 1998). Only the 15% of hospital waste which is truly infectious requires incineration; waste segregation and alternatives to incineration would cost only 93 cents per patient per day (Environmental Working Group Staff, 1997).

While most of the health consequences of toxic pollution accumulate slowly, such as Minimata Disease from methyl mercury poisoning in Japan (Powell, 1991), some industrial disasters have led to more immediate widespread suffering. These include the leak of methyl isocyanate gas during a factory explosion in Bhopal, India, which led to 3300 deaths and over 20,000 injuries (Kumar, 1993); the nuclear power plant explosion in Chernobyl, which caused hundreds to thousands of acute deaths and injuries and is likely to cause up to a million late thyroid cancers (Time Magazine Staff, 2000), and the massive Exxon Valdez oil spill of 1989, which caused 5 billion dollars worth of wildlife devastation in Alaska (Amicus Journal Staff, 1999b). In the wake of the September 11 2001 terrorist attacks, some policymakers fear that toxic waste dumps and nuclear power plants represent potential terrorist targets.

Deforestation

Tropical forest constitutes seven percent of world land surface area, yet contains over 50% of all plant and animal species. Half of all tropical forests have been destroyed; by 2010, three-quarters may be lost. Additionally, 20–50% of global wetlands have been destroyed (54% thus far in the US, with an additional 115,000 acres/year), (Sierra Club Staff, 2000). Loss of old growth forest has recently particularly affected the Pacific Northwest and British Columbia, known as the "Brazil of the North", an allusion to the devastation wrought by the unsustainable, rapacious logging practices of multinational corporations in the Amazon. One famous historical example of deforestation is the

desertification of Easter Island (Papich, 1999). After its settlement 1500 years ago, the expanding population slashed and burned forest for farmland and to obtain logs to transport large stone statues to the coast. Ultimately, the population outstripped the island's resources, the soil was depleted of nutrients, and internecine warfare among the starving decimated the island's population. Other (in)famous examples of deforestation include the Middle East and the United States Southwest, where deforestation may have contributed to the dispersal and "disappearance" of the Anasazi Indians. Today, Mauritania, Ethiopia and Haiti are deforested (Loewen, 1995). The Philippines and Thailand are net importers of forest products, primarily from Latin America (Shapiro, 1993).

The factors that lead to deforestation are the need for new agricultural settlements, spurred by overpopulation, poverty, and unsustainable farming practices, and in the United States, urban sprawl, which consumes 400,000 acres of undeveloped land each year (Sierra Club Staff, 2000); logging for building materials and paper; cattle ranching; and, to a small extent, drug cultivation in Peru, Bolivia, and Columbia. Since 1950, lumber use has increased three-fold and is expected to double again over the next 15 years. Paper use is up six-fold (Shapiro, 1993). Despite the growth of electronic media, the number of printed words is doubling every 10 years. On a smaller yet still important scale, excessive pharmaceutical sample packaging contributes to paper-product overuse (Donohoe & Matthews, 1999).

US taxpayers fund over 370,000 miles of logging roads, a subsidy to the forest service products industry; these roads contribute to sediment runoff into streams, and are considered the number one cause of aquatic habitat degradation in the Pacific Northwest (Lennard, 1998; Cosgroves, 1999). While logging may represent a short-term economic fix for poor rural areas, most profits flow to corporate headquarters and not back to the communities themselves. For every dollar generated by logging in national forests, recreation there contributes $40 to the US economy and creates 30 times as many jobs (Cosgroves, 1999).

Global warming

Since industrialization began, there has been a 29% increase in atmospheric carbon dioxide, with current annual production reaching 6–8 billion tons (Natural Resources Defense Council Staff, 1995). The top one-fifth of the world's nations account for 63% of global CO_2 emissions; the lowest 1/5, just 2%. US production reaches 5 tons/person/year, versus 1.5 tons/person/year in Sweden, a country with an equivalent standard of living. Carbon dioxide, methane, chlorofluorocarbons (in refrigerants and in some metered-dose inhalers) (McDonald & Martin, 2000) and nitrous oxides contribute to the greenhouse effect, which has caused average worldwide temperatures to increase at least 1° over the last hundred years (Trefil, 1999), and the annual incidence of deadly heat waves to increase dramatically (PSR Reports Staff, 2000). Temperatures are expected to further increase by 2.7–11° over the next 100 years (Hebert, 1999).

Consequences of global warming include the melting of polar icecaps and glaciers and the rise of global sea levels, which may threaten low lying countries like Bangladesh and could potentially destroy aquifers in New Orleans and San Francisco (PSR Reports Staff, 2000). Global warming may also augment the effects of extreme weather patterns such as El Niño and La Niña, and may have contributed to the recent dramatic increase in costly flood damage in the United States (Nash, 2000a; Brown, 1999). With higher temperatures come more heat waves (Physicians for Social Responsibility Staff, 2000a), resulting in more deaths from hyperthermia, although deaths from hypothermia should drop. Finally, due to the additive effects of global warming, overpopulation, and water pollution, we are running out of fresh water, a substance over which future wars may be fought (Leslie, 2000).

Agriculture

Today, soil erosion exceeds soil formation (Amicus Journal Staff, 2000b). Even so, 26 million additional tons of grain per year are needed to feed our world's growing population. Crop diversity has decreased, leading to local limits in genetic diversity and increasing vulnerability of agricultural products to disease, risking large-scale famine such as that which occurred in Ireland in the mid-19th century. Nearly 40% of farmland worldwide is seriously degraded as a result of destructive agricultural practices (Rivera, 2000). Water use has tripled since 1950, depleting aquifers. The Three Gorges Dam, a large-scale irrigation project, will displace 1.3 million Chinese and destroy valuable family farmland and important archeological sites (Sierra Magazine Staff, 2000b). Pollution and pesticide use are increasing. A growing number of factory farms, which generate 1.4 billion tons of large untreated sewage per year, have replaced industrial factories as the number one polluters of American waterways, contributing to pollution, fish kills and *Pfisteria Pescii* infections in humans (Silverstein, 1999; Harrison, 2000). Agriculture now accounts for 40% of US antibiotic use and is the dominant source of antibiotic resistance among food-borne organisms (e.g. fluoroquine-resistant *Campylobacter*, vancomycin-resistant *Enterococcus faecium*) (Smith, Besser, & Hedberg, 1999; Marwick, 1999).

Out of a desire to feed the world's growing population and find new ways to profit from agriculture, biotechnology companies have increased production of genetically engineered foods (Lappe & Bailey, 1998; Nash, 2000b). Genetically modified seeds are now being used to plant 25% of America's corn crop and 30% of its soybeans. At least 60% of convenience foods now sold in the US contain genetically-altered ingredients. No labeling is required. Genetically-modified foods (and fish) threaten biodiversity; altered genes could potentially cross-contaminate other organisms, with unpredictable effects on the environment (Snell, 2001). Some European nations have called for bans on testing and production of genetically modified organisms, as scientists have raised concerns about the effects of these organisms on entire ecosystems, including the possibility of increased species extinction.

Regrettably, World Bank and International Monetary Fund lending policies encourage farmers in developing nations to produce profitable cash crops for export, rather than much-needed food crops for local consumption. The problem of hunger is not so much inadequate global food production as it is what is grown and how that food is produced and distributed (Snell, 2001).

Over-fishing of the World's Oceans

Today, one-third of fish species are threatened with extinction, caused in part by the explosive increase in large factory trawlers trailing enormous nets (Benchley, 1999). Newfoundland cod fisheries have collapsed. In the Pacific Northwest, peak salmon harvest prior to 1920 was 240 million pounds per year. Over the last decade, it has dropped to 10 million pounds per year (Duncan, 2000). Declines in catch/person result in higher fish prices. Today 25% of all fish consumed in the United States is farmed, including almost all catfish and trout, half of all shrimp, and a third of all salmon (Goldburg, 1999). Consequences include decreased genetic diversity, increased sewage causing damage to local estuaries and birds of prey, and human diseases resulting from eutrophication due to phosphates in land- and ocean-based sewage, harbor dredging, coastal development and deforestation. Worldwide, cyanides and dynamite-fishing have led to the destruction of 10% of the world's reefs, and have left 30% in critical condition (Chadwick, 1999; Nash, 1996).

The maldistribution of wealth and the "Booming Economy"

The wealthy, particularly those in large industrialized countries such as the US, are the greatest contributors to worldwide environmental degradation. While the United States contains just 5% of the world's population, it is responsible for 25% of the world's energy consumption, 33% of its paper use, and 72% of hazardous waste production (1 ton/person/year) (Natural Resources Defense Council Staff, 1995). Today, the richest 1% of the United States' population owns 48% of the country's wealth, while the poorest 80% owns just 6%. Ours is the widest gap of any industrialized nation. Worldwide, the top 358 billionaires are worth the combined income of the bottom 2.5 billion people (or 45% of the world's population). The worldwide gap between rich and poor doubled between 1960 and 1991 and continues to grow, resulting in an increasing mortality disparity between rich and poor (Pappas, Queen, & Hadden, 1993; Lantz, House, & Lepkowsky, 1998; Adler, Boyce, & Chesney, 1993). Since 1950, average home size has more than doubled while average family size has dropped. Personal savings are down, annual bankruptcy claims are up, and stress levels continue to grow while satisfaction with life decreases (Oregon Public Broadcasting, 1997).

Despite incessant media images of a booming economy, in 1997 the inflation-adjusted net worth of the median US household was $49,000, compared to $54,600 in 1989 (Oregon Public Broadcasting, 1997; Mokhiber & Weissman, 1999). Weekly wages for the average American worker are 12% below what they were in 1973, despite productivity increases of up to 33%. While the average American is doing more and making less, Chief Executive Officer salaries are up 500% since 1980 (Mokhiber & Weissman, 1998). Job security is down, with American workers receiving fewer benefits and possessing less retirement savings. An increasing number lack health, life, and disability insurance; more and more elderly are facing financial crises due to lack of coverage for increasingly costly prescription drugs (Starfield, 2000). Household debt as a percentage of personal income has grown from 58% in 1973 to 85% in 1997, and total credit card debt has more than doubled over the last decade. Average household debt is now nearly equivalent to disposable income (Passaro, 1998; Mokhiber & Weissman, 1999).

The "Global Economy"

In 1999, for the first time ever a majority of the world's largest economies were private corporations rather than countries (Montague, 1997). General Motors (GM) is now larger than Denmark, Thailand, Hong Kong and Turkey; Wal-Mart is larger than Israel and Greece; American Telephone & Telegraph is larger than Malaysia and Ireland. The combined revenues of GM and Ford exceed the combined gross domestic product (GDP) of all sub-Saharan Africa. Prior to recent market disruptions, one man (Bill Gates of Microsoft) was

worth more than the gross national product (GNP) of Central America, Jamaica, and Bolivia combined (Montague, 1997).

Ninety percent of transnational corporations are located in the Northern Hemisphere, exacerbating the wealth and resource disparity between Northern and Southern Hemispheres. As corporations merge, they acquire greater authority. US corporations receive more annually in government subsides than they pay in taxes. In 1997 alone, corporations paid $60 billion less in income taxes than they would have if they had paid taxes at the same rate as in 1990. In contrast, individuals paid $80 billion more than in 1990 (Johnston, 2000). A majority of corporations operating in the United States pay no income tax, due to tax law loopholes and the transfer of assets overseas (Bartlett & Steele, 1998). Furthermore, while we lose 4 billion dollars to burglary and robbery each year, we lose an estimated 200 billion dollars to corporate fraud (Bartlett & Steele, 1998). Increasing corporate power weakens democratic institutions via lobbying and campaign contributions and through increasing corporate control of fewer and fewer media outlets, which limit public debate on topics of environmental importance. Fines for corporate environmental and social abuses are often miniscule and are considered a "cost of doing business" that does not severely impact the overall balance sheet (Chernoff, 1993). Certain corporations have been linked directly to human rights abuses, and many heavily lobby Congress to weaken environmental and occupational safety and health standards and to dismantle social legislation designed to protect the public's health.

The Third World debt crisis

The increasing wealth disparity between the First and Third Worlds has contributed to a debt crisis which has impeded the attempts of developing world governments to escape the poverty in which they are mired. Over 40 of the poorest countries in Africa, Latin America and Asia owe the US and other First World countries a total of almost 250 billion dollars in foreign debt (Ramo, 2000; Jubilee 2000 Campaign, 2000a, b). These countries borrowed money when loans were cheap and easy to obtain. The money was often lent to corrupt and undemocratic governments during the Cold War, and frequently supported the production of crops and other items for export. As world prices for these products declined, governments obtained new loans at higher interest rates to pay interest on the original debts.

Current debt constitutes between 100% and 200% of the GDP for many countries in sub-Saharan Africa and Central America (Jubilee 2000 Campaign, 2000b). These countries spend more each year repaying their debts than on education and health care. In response to the debt crisis, debtor nations have drastically cut wages, slowing their economies further and decreasing purchases of US imports, ultimately making US jobs less secure. Currency gets devalued, making imports more expensive and exports cheaper. Government price controls are eliminated, resulting in higher prices for essential goods. Governments cut spending on social service programs and reduce food, fuel and farming subsidies. Attempting to meet their payments, poor countries deplete and sell their national resources, which leads to increased global pollution and further local poverty (Pooley, 2000). Despite high levels of Third World debt, First World countries send a miniscule fraction of their GNP overseas as foreign aid. The US ranks 21st in foreign aid as a percentage of GNP, sending 0.15% of its GNP abroad each year (Time Magazine Staff, 1995). Over one-third of this is military aid, one-quarter economic, and only one-third for food and development. Most of this aid benefits US corporations, which have moved overseas to take advantage of lax environmental and occupational safety and health standards (Ellsworth & Cassel, 1992; Loewen, 1995). Regrettably, many life-saving programs for people in the world's poorest countries are now withering due to a lack of charitable donations (Nation's Health Staff, 2000b).

Militarization and environmental destruction

Together, the world's militaries are the planet's single largest polluter, responsible for 8% of global air pollution, 6% of raw material use, and almost all high- and low-level nuclear waste (Renner, 1991; Sidel & Shahi, 1997). The US Defense Department is the world's largest consumer of oil and the Pentagon generates half a billion tons of toxic waste per year, more than the top five chemical companies combined (Thomas, 1995). Up to 15,000 military sites are contaminated; many EPA and Occupational Safety and Health Administration rules do not apply to military bases. Of the more than 11,000 hazardous waste dumps at the Pentagon's 900-plus sites in the US, <400 have been cleaned up. The costs to detoxify these areas are immense. Given the Pentagon's much greater focus on weapons development, testing, and procurement, and its poor record of restoring degraded environments thus far, full cleanup and detoxification are likely never to be completed (Thomas, 1995).

Over the last century, international conflicts have killed an increasing portion of civilians (Garfield & Neuget, 1991). Landmines dot the globe, causing over 25,000 deaths and many more injuries each year (US Committee to Ban Land Mines, 2000). The threat of chemical and biological warfare looms larger, especially in light of recent anthrax cases in the US, and the specter

of nuclear holocaust (either deliberate or accidental) remains ever-present (Orient, 1989; Forrow, Blair, & Helfand, 1998; Forrow & Sidel, 1998). There is currently a global stockpile of 36,000 nuclear weapons, with 10 pounds of plutonium per weapon (Physicians for Social Responsibility Staff, 2000b). Thirteen thousand US and Russian nuclear weapons are actively deployed; five thousand remain on high alert, meaning that they can be fired within 15 min and reach their target cities in another 30 min. China, France, the United Kingdom, India, Pakistan, Israel, and possibly Iraq, Iran, and North Korea also possess nuclear weapons (Physicians for Social Responsibility Staff, 2000b). From 1981 to 1996, the US sold the world more than $117 billion worth of arms, about 45% of the global total (McGowan, 2000).

In the US, approximately 50% of our discretionary tax dollars go to the military (Thompson, 1998; National Priorities Project Staff, 1998). While most would agree that a stable, strong military is necessary to preserve our democratic freedoms, we would be wise to heed the advise of Dwight Eisenhower, who said: "The problem in defense spending is to figure out how far you should go without destroying from within which you are trying to defend from without." Eisenhower recognized that excessive military spending resulted in the diversion of resources away from the country's educational, social, and health care needs. He wrote: "Every gun that is made, every warship launched, every rocket fired, signifies in the final sense a theft from those who hunger and are not fed, those who are cold and not clothed." Today, 3 h of world arms spending is equal to the annual World Health Organization budget; one-half day of world arms spending would provide full immunizations for all the world's children; 3 days of US military spending is equivalent to the amount our country spends on health, education and welfare programs for children in 1 year; and, 3 weeks of world arms spending per year could provide primary health care for all individuals in poor countries, including safe water and full immunizations (Sidel, 1999; Toole & Waldman, 1993; Ris, 1998). Even though just 20 terrorists armed with box cutters destroyed the World Trade Center towers and a portion of the Pentagon on September 11 2001, the US remains committed to a so-called missile defense shield, despite spectacular test failures, the objections of numerous scientists, and a price tag that could ultimately reach $100 billion.

Poverty, hunger and infectious diseases

A major consequence of environmental destruction and the maldistribution of the world's resources is a rise in poverty, overcrowding, and famine. Worldwide, 1 billion people live in abject poverty, consuming <2150 calories/day or earning $<\$500$/year. Over 1 billion people have no access to clean drinking water, which contributes to 2 million child deaths per year (Ackerman, 1999). Two billion people have no electricity and 3 billion lack adequate sanitation services. Hunger-related causes kill as many people in 2 days as the atomic bomb killed at Hiroshima. In the United States, 20–25% of children live in poverty, 4 million go hungry daily, and an additional 10 million are at risk of hunger each year (Ackerman, 1999). Forty-three million lack health insurance, and on many major health indicators, we rank below other industrialized nations (Starfield, 2000).

Overpopulation, poverty, malnutrition, and social and economic instability have contributed to increasing morbidity and mortality due to infectious diseases. Global warming and deforestation are expected to contribute to an additional 50–80 million malaria cases per year by 2100. Other infectious diseases undergoing or expected to undergo a resurgence include multi-drug resistant tuberculosis, viral encephalitis, cholera, hantavirus, schistosomiasis, influenza, trypanosomiasis, dengue, leishmanasis, rabies, hookwarm and yellow fever (Patz, Epstein, Burke, & Bulbus, 1996; National Geographic Staff, 1998). The aquired immunodeficiency syndrome (AIDS) is decimating the African subcontinent, where poverty, cultural practices, and impaired access to medications has resulted in widespread suffering and loss of life (Lemonick, 2000).

The disproportionate suffering of women

Women suffer disproportionately from the effects of poverty, famine, and human rights abuses through impaired access to employment, education, and reproductive and other basic health services; salary inequities; political and legal marginalization; divorce restrictions; and direct violence (Heise, Raikes, Watts, & Zwi, 1994). More than two-thirds of the world's poorest citizens are women (Sierra Magazine Staff, 2000a). Worldwide at least one woman in three has been beaten, forced into sex, or otherwise abused in her lifetime (Heise et al., 1994). One hundred million women, most in Sub-Saharan Africa, have been subjected to female genital mutilation (Toubia, 1994).

Species loss

We are currently living in the midst of the largest species extinction since that of the dinosaurs 65 million years ago (Quammen, 1998). Estimates of species loss range from 4000 to 6000/year, with some estimates as high as four species per hour. This is over 1000 times the background rate of extinction. Of the 50,000 vertabrate species, 7/10 of birds, 1/4 of mammals, half of the 232

primate species, a third of fish species, and between 1/5 and 1/4 of reptile and amphibian species are threatened with extinction (Wilson, 2000; Worldwatch Institute, 1998).

Causes of species loss include habitat destruction from overpopulation, unsustainable agricultural practices, logging, hunting, chemical pollution, exotic species invasions, nutraceutical production (Donohoe, 2000), and the $10 billion black market in endangered animals (which in monetary terms is equivalent to the smuggled arms market and second only to the contraband drug market when illegal economies are compared) (Webster, 1997). The body parts of one Siberian tiger are worth up to 5 million dollars; only 4000 remain in the wild. Tiger penis, bear gallbladders, elephant ivory, sea turtle shells, whale products, and shark fins are used for medicinal and decorative purposes (Webster, 1997). A global Convention on International Trade in Endangered Species exists, but national enforcement budgets are limited. Other threats to species-at-risk include recent attempts in Congress to gut the Endangered Species Act; environmental audit laws designed to reduce penalties for corporate polluters (Public Citizen News Staff, 1998a); strategic lawsuits against private parties (SLAPP suits), designed to harass environmental groups and deplete their financial resources through threatened or actual litigation (Nader & Smith, 1996); and the increasing power of the World Trade Organization to overturn member-nations' environmental laws (Public Citizen News Staff, 1998b).

One consequence of mass extinction is the loss of a potentially valuable pharmacopoeia. More than one half of the top 150 prescription drugs contain an active compound derived from or patterned after natural products (e.g., digoxine, vincristine, aspirin, paclitaxel, and paralytic agents), yet of the more than 250,000 known flowering species, $<0.5\%$ have been surveyed for their medicinal value (Grifo & Rosenthal, 1997).

Environmental ignorance and greenwash

US public education is in disarray (Lapham, 2000; Sagan, 1996). Our public schools are ranked the lowest among western nations; a quarter have no library (Edwards, 1998); teachers are paid less today, adjusted for inflation, than they received in 1972 (Dollars & Sense Magazine Staff, 2000). The education gap between rich and poor is growing (MacEwan, 2000). Due to a dearth of curricular time to cover the environmental sciences and a lack of quality curricula, Americans suffer from environmental ignorance. A majority of Americans believe that electricity in our country is produced in non-polluting ways; only 25% are aware that the majority (70%) comes from oil, coal, and wood (McManus, 2000).

Many environmental scientists believe that there is a dearth of quality environmental coverage in the media, and that this may be in part a consequence of major news outlets being owned by, supported through advertising revenue by, or sharing members of their boards of directors with, corporations with histories of environmentally unsound practices (Lewis, 1998). In both print and television, the last few decades have seen an increasing number of mergers and the consolidation of these venues, with the power to shape public opinion concentrated among fewer and fewer companies (Solomon, 1999). For 3 years, the United States has had no national limits on how many radio stations a single corporation can own and the Federal Communications Commission recently ruled that one company can own two television stations in the same city (Solomon, 1999). Among broadcast TV markets, 1/7 are monopolies, 1/4 are duopolies. In a 2000 PEW Center for the People and the Press poll of 287 reporters, editors and news executives, about 1/3 of respondents said that news that would 'hurt the financial interests' of the media organization or an advertiser goes unreported. Forty-one percent said they themselves have avoided stories, or softened their tone, to benefit their media company's interests. Among investigative reporters, a majority (61%) thought that corporate owners exert at least a fair amount of influence on news decisions. And in a survey of investigative reporters and editors at TV stations, published by Fairness in Accuracy and Reporting (FAIR, 2001), nearly 3/4 of the respondents reported that advertisers had 'tried to influence the content' of news at their stations. Sixty percent said that advertisers had attempted to kill stories. Fifty-six percent had felt pressure from within the station to produce new stories to please advertisers.

To fill the void left by the absence of environmental education programs, corporations have distributed free, sponsored environmental educational materials to public schools. Examples include Exxon's "Energy Cube", which states, "gasoline is simply solar power hidden in decayed matter" and "offshore drilling creates reefs for fish." International Paper's materials proclaim, "Clear cutting promotes the growth of trees that require full sunlight and allows efficient site preparation for the next crop." The American Nuclear Society's "Activities with the Atoms' Family" and Dow's "Chemipalooza" appeal to older children (Selcraig, 1998; Beers & Capellaro, 1991). These curricular materials are supplemented by "greenwash", public relations and advertising campaigns designed to present corporations as eco-friendly; grants of large amounts of money to those few scientists who still challenge environmental warnings; the creation of corporate front groups such as the American Council on Science and Health and the Foundation for Clean Air Progress; and astro-turfing, the creation of artificial

"grass roots coalitions", which may only contain a few members (Beder, 1997).

Solutions to the problem and hope for the future

While the preceding information paints a grim picture of our planet's current social and environmental situation, certain positive trends provide hope that we may be able to slow or even reverse the current pace of environmental destruction. For instance, the majority of US citizens fear environmental health risks, rate the environment as one of the most important issues facing the country, think the government is doing too little to safeguard the environment, and favor environmental protection over economic expansion (Sierra Magazine Staff, 1997a; League of Conservation Voters, 2000). The power and voice of green groups is increasing. International agreements, such as the Montreal Protocol to phase out of chloroflourocarbons, and international "earth summits" in Rio De Janiero and Kyoto represent the beginnings of global cooperation.

A multi-faceted approach to the problems of environmental degradation and social injustice would include a shift from a throw-away economy to a reuse/recycle economy. Stronger clean air and water standards and the elimination of fossil fuel industry tax breaks and subsidies could save billions of dollars and thousands of lives each year. Tax breaks and subsidies for research and development of renewable energy should be increased, and the tax system restructured to decrease taxes on work and savings and increase taxes on destructive activities, such as carbon emissions and toxic waste generation. Alternatives to electrical-, coal-, oil-, nuclear-, and natural gas-based power include solar energy, wind turbines, geothermal power, tidal/wave power, hydropower and co-generation (harnessing waste heat), all of which would decrease air pollution and the risk of accidental or deliberate catastrophies. Safer storage of nuclear wastes, promotion of bioprospecting and ecotourism, and vigorous prosecution of environmental scofflaws are all part of the solution (Chernoff, 1993; McQuiston, Zakos, & Loomis, 1998). Streamlining the EPA could save approximately three billion dollars per year.

Automobiles should be supported. These include electric cars and electric trolley systems;[1] natural gas and/or gasohol (which generates less carbon dioxide than regular gasoline); solar cars; and hydrogen-powered cars, whose by-product is water. Trains, which are 15 times more energy-efficient per passenger than automobiles, should be utilized more. Unfortunately Amtrak, our national rail system, receives one-third the amount of federal funding (adjusted for inflation) that it received 20 years ago (Baker, 1998). Some individuals elect car pooling and car sharing, while 11,000,000 Americans telecommute, working at home. Telecommuting leads to decreased absenteeism and need for office space, improved worker productivity, decreased job turnover, and saves between $6000 and $12,000/worker/year (Erickson, 1998a, b). Still others ride bicycles or walk to work.

Improvements in the status of women, including the strengthening of family planning programs and improved/equal access to educational opportunities and legal and political representation would produce a more equitable world and likely decrease the demand for large families which spurs overpopulation (Heise et al., 1994; Union of Concerned Scientists Staff, 1994; Briggs, 1993). Forgiveness of Third World debt and support of local economies, which produce food and other items essential to self-sufficiency, would improve global equity, increase international stability, and in turn benefit the First World. Citizens need to take a more active role by avoiding over-fished species (Benchley, 1999; Speer, 2000) and eating less meat; purchasing organic fruits and vegetables; using less paper; avoiding gas-guzzling vehicles; shunning gold and silver products produced in countries known for civil and human rights abuses, and supporting international efforts to limit trade in diamonds mined under repressive conditions (Physicians for Human Rights' Record Staff, 2000); supporting "green" products and organizations, financially and through volunteerism; and even by electing a green burial (Kaufman, 1999). They can invest in "socially responsible" or "green" mutual funds (Rose, 2000) and select "green electricity" for their homes (Nogee, 1998; Clemmer, 1998; Asmus, 2000).

Americans should exercise their rights to full participation in the political process. Today only 20% of 20-year-olds vote, compared with 70% of 70-year-olds (Sidel, 2000). Only 30% of those earning 0 to $25,000/year vote, versus 60% of those earning more than $60,000/year (Sidel, 2000). Whites are more likely to vote than Blacks and Hispanics (Sidel, 2000). A shift toward proportional representation could increase the power and voice of green groups, and campaign finance reform diminish the role of corporations in influencing national and local elections (Bartlett & Steele, 1998).

Because of their scientific backgrounds, social standing in their communities, and access to individual patients (and in some cases, the media), physicians can play an important role in combating environmental destruction and social injustice (McCally and Cassel, 1990; Guidotti, Hancock, & Bell, 1998; Kleinman,

[1] Electric cars were marginalized and electric trolley systems dismantled, as was much of the existing public transportation and network, by a triumvirate of oil, chemical, and tire companies in the early 20th century. Their actions led to their convictions under the Sherman Anti-Trust Act (Weissman, 1999).

Table 1
Suggested actions for health professionals to combat environmental degradation and social injustice

1.	Self-education: via books, websites of major environmental groups, public health-orientated journals
2.	Patient education
3.	Volunteer to teach students in junior high and high schools on Earth Day
4.	Teach medical, nursing, and public health students; provide articles on rounds; design elective courses
5.	Write op-ed pieces for the local paper on environmental health issues
6.	Lobby legislators by phone, fax, or in-person (e-mail is less effective)
7.	Work with hospital's waste management department to promote reduction, reuse, recycling, and limits on toxic waste production
8.	Vote; encourage colleagues and patients to vote
9.	Walk, bike, or utilize public transportation when possible; car pool; sell SUV and purchase electric or hybrid car
10.	Advocate for women's rights; screen for domestic violence and discuss reproductive health care with all patients
11.	Promote peace and decreased militarization; attend and speak at rallies
12.	Advocate universal health insurance coverage
13.	Care for the poor; volunteer at a clinic for the underserved
14.	Develop and teach clinical cultural competency
15.	Support eco-friendly products; shun gold and diamonds
16.	Invest in socially responsible stocks and mutual funds; divest military, tobacco, and gun manufacturer holdings
17.	Donate to groups fighting for environmental preservation and social justice

1991). Through increased environmental education, we can help combat the widespread environmental and geographic ignorance that is fueled by greenwash. Physicians should counsel their patients about the effects of environmental degradation and social injustice on health: e.g., toxic waste, air pollution on asthma, toxic waste on birth defects, impaired access to contraception and unwanted pregnancy, etc. They can also inform patients of the consequences of their lifestyle and health choices on the local and global environment. Other suggestions for action by health professionals are listed in Table 1.

Hospitals should improve medical waste management through better segregation of infectious material, worker safety training, safer disposal, reuse and recycling, and phaseout of mercury- and polyvinyl chloride-containing compounds (Nightingale Institute for Health and the Environment, 1997; Tieszen & Gruenberg, 1992; Rosenblatt, Ariyan, & Silverman, 1993). Medical schools must respond more aggressively to the Institute of Medicine's recommendations to increase the amount of training in the prevention and treatment of diseases related to the environment (Pope, 1994). Social responsibility should be a core component of the medical curriculum (Ozonoff, 1995; Faulkner & McCurdy, 2000). Individuals and health care institutions should support evidence-based humanitarian interventions (Lamont-Gregory, Henry, & Ryan, 1995) and work toward solutions to poverty (such as replacement of the minimum wage by a federally-mandated living wage) and un/under-insurance (such as universal coverage) (Schroeder, 1999). Health care organizations should divest themselves of stock holdings in harmful products, such as tobacco (Himmelstein, Woolhandler, & Boyd, 2000).

All physicians should promote peace, decreased militarization, and increased international cooperation (Cassel, 1983; Wong, 1994). Advocacy for peace and environmental justice are particularly needed now. The recent terrorist attacks and the war in Afghanistan have prompted calls by the President and many in Congress to further gut environmental legislation and to open the Arctic National Wildlife Reserve to oil drilling.

Physicians must advocate for the poor, the uninsured, and the disenfranchised, for whom we are "natural attorneys", and heed the advice of Rudolph Virchow: "If medicine is really to accomplish its great task, it must intervene in political and social life. It must point out the hindrances that impede the normal social functioning of vital processes, and effect their removal" (Nuland, 1988). We should devote ourselves wholeheartedly to these efforts, for ourselves, and (more importantly) for our progeny, for "we have not inherited the Earth from our ancestors, but have borrowed it from our children."

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References

Ackerman, S. (1999). The ever-present yet nonexistent poor. *Extra!*, January/February, pp. 9–10.

Adler, N. E., Boyce, T., & Chesney, M. A. (1993). Socioeconomic inequalities in health: No easy solution. *Journal of the American Medical Association*, *269*, 3140–3145.

Alexander, G. J., & Kanner, R. E. (1995). Air pollution: From irritating to life-threatening. *IM* (*Internal Medicine*) October, 41–53.

Aligne, A. C., Byrd, R. S., & Weitzman, M. C. (2000). Risk factors for pediatric asthma: Contributions of poverty, race, and urban residence. *American Journal of Respiration and Critical Care Medicine*, *162*(3), 873–877.

Amato, I. (1999). Can we make garbage disappear? *Time*, November 8.

Amicus Journal Staff (1998). Natural Resources Defense Council Staff. Rx for toxic trouble. *The Amicus Journal*. Spring, p. 47.

Amicus Journal Staff (1999a). Driving ourselves crazy. *The Amicus Journal*, Summer, 21.

Amicus Journal Staff (1999b). Natural resources defense council staff. Exxon Valdez (ten years later). *The Amicus Journal*, Summer, 10.

Amicus Journal Staff (1999c). Sprawl: A twentieth-century plague. *The Amicus Journal*, Summer, 5.

Amicus Journal Staff (2000a). Natural resources defense council staff. Arsenic and old laws. *The Amicus Journal*, Summer, 44.

Amicus Journal Staff (2000b). Land. *The Amicus Journal*, Winter, 26.

Asmus, P. (2000). Getting religion. *The Amicus Journal*, Fall, 32–33.

Bacon, D. (2000). Editorial on refugees. *The Nation*, March 20, p. 7.

Baker, L. (1998). Derailing Amtrak. *Sierra*, November/December, pp. 18, 21.

Bartlett, D. L., & Steele, J. B. (1998). Corporate welfare. *Time*, November 9, pp. 36–79.

Beder, S. (1997). *Global spin: The corporate assault on environmentalism*. White River Junction, Vermont: Green Books & Chelsea Green Publishing Company.

Beers, D., & Capellaro, D. (1991). Greenwash! The eco-biz. *Mother Jones*, March/April.

Benchley, P. (1999). What will be the catch of the day? *Time*, November 8, pp. 104–105.

Bergman, B. J. (1999). The hidden life of computers. *Sierra*, July/August, pp. 32–33.

Bongaarts, J. (1994). Population policy options in the developing world. *Science*, *263*, 771–776.

Briggs, N. (1993). Illiteracy and maternal health: Educate or die. *Lancet*, *341*, 1063–1064.

Brown, L. (1999). *Vital signs*. New York: W.W. Norton.

Cassel, C. K. (1983). War, peace and professional responsibility. *Social Science & Medicine*, *17*(16), 1199–1203.

Chadwick, D. H. (1999). Coral in peril. *National Geographic*, January, pp. 31–37.

Chernoff, P. A. (1993). Sentencing environmental offenders. *The PSR Quarterly*, *3*, 183–186.

Clemmer, S. (1998). State of play. *Nucleus*, Spring, 2.

Cosgroves, Z. B. (1999). Logging our legacy. Our national forests belong to us. So why are they on the auction block? *Sierra*, July/August, pp. 63–66.

DeLacroix, M. (2000). Planet earth. *Blue*, *3*(2), 65–69.

Dobb, E. (1996). Pennies from hell. *Harper's Magazine*, October, pp. 39–54.

Dockery, D. W., Pope, C. A., & Xu, X., et al. (1993). An association between air pollution and mortality in six US cities. *New England Journal of Medicine*, *329*(24), 1753–1759.

Doctors Without Borders (2000). Lives on hold. URL: http://www.doctorswithoutborders.org. Accessed 9/5/00.

Dollars and Sense Magazine Staff (2000). Put up or shut up. September/October, p. 4.

Donohoe, M. T. (2000). Glucosamine, chondroitin, and shark cartilage. *Journal of the American Medical Association (letter)*, *284* (10), 1241.

Donohoe, M. T., & Matthews, H. (1999). Wasted paper in pharmaceutical samples. *New England Journal of Medicine*, *340*, 1600.

Duncan, D. J. (1998). In search of river-safe gold. *Sierra*, May/June, p. 48.

Duncan, D. J. (2000). Salmon's second coming. *Sierra*, March/April, pp. 30–41.

Edwards, T. M. (1998). What Johnny can't read. *Time*, December 21, p. 46.

Ellsworth, G. A., & Cassel, C. K. (1992). International arms trade: A barrier to democracy and to public health. *PSR Quarterly*, *2*, 223–228.

Environmental Working Group Staff (1997). Environmental working Group. First, do no harm. URL: http://www.ewg.org/pub/home/hcwe/hcwh.html. Accessed 12/4/97.

Erickson, K. (1998a). Greener cleaners: nontoxic technology throws cold water on dry cleaning. *Sierra*, September/October, pp. 32, 35.

Erickson, K. (1998b). Home work. The green routine of telecommuting. *Sierra*, November/December, pp. 26–28.

FAIR Staff (2001). Fear and favor 2000: how power shapes the news. March 12. http://www.fair.org/ff2000.html.

Fagin, D., Lavelle, M., & The Center for Public Integrity (1999). Toxic deception: How the chemical industry manipulates science, bends the law and endangers your health. *American Journal of Public Health*, 89 (7), 1120–1121.

Faulkner, L. R., & McCurdy, R. L. (2000). Teaching medical students social responsibility: The right thing to do. *Academic Medicine*, *75*, 346–350.

Forrow, L., Blair, B. G., & Helfand, I., et al. (1998). Accidental nuclear war—a post-cold war assessment. *New England Journal of Medicine*, *338*, 1326–1331.

Forrow, L., & Sidel, V. W. (1998). Medicine and nuclear war: From Hiroshima to mutual assured destruction to abolition 2000. *Journal of the American Medical Association*, *280*(5), 456–461.

Friedrich, M. J. (2000). Poor children subject to environmental injustice. *Journal of the American Medical Association*, *283*(23), 3057–3058.

Garfield, R. M., & Neuget, A. I. (1991). Epidemiologic analysis of warfare: A historical review. *Journal of the American Medical Association*, *266*, 688–692.

Gavzer, B. (1999). Take out the trash, and put it…where? *Parade Magazine*, June, pp. 4–6.

Goldburg, R. J. (1999). Old McDonald had a fish. *Environmental Defense Fund Newsletter*, p. 7.

Grifo, F., & Rosenthal, J. (Eds.). (1997). *Biodiversity and human health*. Washington, DC: Island Press.

Gross, L. (1999). The hidden life of bottled. *Sierra*, May/June, pp. 66–67.

Guidotti, T. L., Hancock, T., & Bell, W. (1998). Physicians and environmental change: What is our role and why should

anyone listen to us? *Perspectives in Biology and Medicine*, *41*(4), 591–604.
Hamilton, S. (1997). Bringing up baby: Start 'em off right in a healthful environment. *Sierra*, November/December, pp. 26–29.
Hammond, R. (2000). *Addicted to profit: Big tobacco's expanding global reach*. Washington, DC: Essential Action.
Hansen, E., & Donohoe, M. T. (2002). Health issues of migrant and seasonal farm workers (in revision for J. Health Care for the Poor and Underserved, April 2002).
Harrison, P., et al. (2000). Surveillance for possible estuary-associated syndrome—six states, 1998–1999. *Morbidity and Mortality Weekly Report*, *49*, 372–374.
Hattam, J. (1998). Get the lead out. *Sierra*, April/May, pp. 21–25.
Hauter, W. (2000). Federal nuke waste plan: Make it into products. *Public Citizen News*, January/February, p. 5.
Hebert, H. J. (1999). *Pollution adds to global warming*. Associated Press, October 25. URL: http://www.ncar.ucar.edu
Heise, L. L., Raikes, A., Watts, C. H., & Zwi, A. B. (1994). Violence against women: A neglected public health issue in less developed countries. *Social Science & Medicine*, *39*, 1165–1179.
Himmelstein, D. U., Woolhandler, S., & Boyd, J. W. (2000). Investment of health insurers and mutual funds in tobacco stocks. *Journal of the American Medical Association*, *284*(6), 697.
Hunter, D. J., Hanikinson, S. E., & Laden, F., et al. (1997). Plasma organochlorine levels and the risk of breast cancer. *New England Journal of Medicine*, *337*, 1253–1258.
Johnston, D. C. (2000). Corporations' taxes are falling even as individuals' burden rises. *New York Times*, February.
Jubilee 2000 Campaign (2000a). Bread for the world; chains around Africa. URL: http://www.j2000usa.org. Accessed 5/5/00.
Jubilee 2000 Campaign (2000b). URL: http://www.j2000usa.org. Accessed 5/5/00.
Kaufman, M. (1999). Life after death. *Sierra*, January/February, p. 16.
Kay, J. H. (1999). Car sick country. *Sierra*, July/August, pp. 42–43, 77.
Kittman, J. L. (2000). The secret history of lead. *The Nation*, March, pp. 11–44.
Kleinman, L. C. (1991). Health care in crisis: A proposed role for the individual physician as advocate. *Journal of the American Medical Association*, *265*, 1991–1992.
Kluger, J. (1999). Light trucks and dirty air. *Time*, December, p. 222.
Kumar, S. (1993). India: The second Bhopal tragedy. *The Lancet*, *341*, 1205–1206.
Lamont-Gregory, E., Henry, C. J., & Ryan, T. J. (1995). Evidence-based humanitarian relief interventions. *The Lancet*, *346*, 312–313.
Lantz, P. M., House, J. S., & Lepkowsky, J. M., et al. (1998). Socioeconomic factors, health behaviors, and mortality. *Journal of the American Medical Association*, *279*, 1703–1708.
Lapham, L. H. (2000). Notebook: School bells. *Harper's Magazine*, August, pp. 7–9.
Lappe, M., & Bailey, B. (1998). *Against the grain. Biotechnology and the corporate takeover of your food*. Maine: Common Courage Press.
League of Conservation Voters, Survey (2000). URL: http://www.voteenvironment.org. Accessed 10/20/00.
Lemonick, M. D. (2000). Little hope, less help. *Time*, July, pp. 38–39.
Lennard, S. (1998). Roads destroy ecosystems. *Oregon Conifer*, July/August, pp. 1–3.
Leslie, J. (2000). Running dry. What happens when the world no longer has enough freshwater? *Harper's Magazine*, July, pp. 37–52.
Lewis, C. (1998). Media money: How corporate spending blocked political ad reform and other stories of influence. *Columbia Journalism Review* 1998.
Loewen, J. W. (1995). *Lies my teacher told me: Everything your American history textbook got wrong*. New York: Touchstone/Simon & Schuster.
MacEwan, A. (2000). Ask Dr. Dollar. *Dollars and Sense*, September/October, p. 52.
Mackillop, W. J., Zhang-Salomons, J., Boyd, C. J., & Groome, P. A. (2000). Associations between community income and cancer incidence in Canada and the United States. *Cancer*, *89*, 901–912.
Mark, J. (1997). Cool moves. *Nucleus*, Fall, 4.
Mark, J., & Morey, C. (2000). Rolling smokestacks. *Nucleus*, Summer, 1–3.
Marwick, C. (1999). Animal feed antibiotic use raises drug resistance fear. *Journal of the American Medical Association*, *282*(2), 120–122.
Maugh, T. H. (2000). Panel implicates agent orange in diabetes. *Los Angeles Times*, October, p. B3.
McCally, M., & Cassel, C. K. (1990). Medical responsibility and global environmental change. *Annals of Internal Medicine*, *113*, 467–473.
McConahay, M.J. (2000). No place to call home. *Sierra*, November/December, pp. 66–72.
McDonald, K. J., & Martin, G. P. (2000). Transition to CFC-free metered dose inhalers—into the new millenium. *International Journal of Pharmaceutics*, *201*(1), 89–107.
McGowan, D. (2000). *Derailing democracy: The America the media don't want you to see*. Monroe, Maine: Common Courage Press.
McManus, R. (2000). Popular fiction. *Sierra*, p. 21.
McQuiston, T. H., Zakos, R. C., & Loomis, D. (1998). The case for stronger OSHA enforcement-evidence from evaluation research. *American Journal of Public Health*, *88*(7), 1022–1024.
Mellon, M., Rissler, J., & McCamant, F. (1995). Sustainable agriculture. Briefing Paper, *Union of Concerned Scientists*, May.
Mokhiber, R., & Weissman, R. (1998). *Corporate predators. The hunt for mega-profits and the attack on democracy*. Maine: Common Courage Press.
Mokhiber, R., & Weissman, R. (1999). Taken for a ride. Focus on the corporation, July 25, 2000. http://www.corporate-predators.org.
Montague, P. (1997). Taking a giant step. *Center for Health, Environment and Justice Newsletter*, Winter, pp. 8–9.
Morgan, G., Corbett, S., & Wlodarczyk, J. (1998). Air pollution and hospital admissions in Sydney, Australia,

1990 to 1994. *American Journal of Public Health*, *88*(12), 1761–1766.
Morris, R. D., Naumara, E. N., & Muasmghe, R. L. (1995). Ambient air pollution and hospitalization for congestive heart failure among elderly people in seven large US cities. *American Journal of Public Health*, *85*(10), 1361–1365.
Nader, R., & Smith, W. J. (1996). *No contest. Corporate lawyers and the perversion of justice in America*. New York: Random House.
Nash, J. M. (1996). Wrecking the reefs. *Time*, September 30, pp. 60–61.
Nash, J. M. (2000a). The fury of El Niño. *Time*, February 16, pp. 67–73.
Nash, J. M. (2000b). Grains of hope. *Time*, July 31, pp. 39–45.
Nation Staff, The (1996). How pure and safe is bottled water? Advocates call for tougher regulations. May, p. 6.
National Geographic Staff (1998). Making tracks: Migration in the 1990s. October issue.
National Priorities Project Staff (1998). Why excessive Pentagon spending threatens our security and what we can do about it. URL: http://www.natprior.org/archives/html/pentagon_budget.html. Accessed 5/13/98.
Nation's Health Staff (2000a). Many metropolitan areas given an 'F' for air quality. July, p. 6.
Nation's Health Staff (2000b). Lack of donations hurting world's poorest countries. October, p. 14.
Natural Resources Defense Council Staff (1995). 25 Year Report. New York: NRDC.
Nightingale Institute for Health and the Environment (1997). Eleven recommendations for improving medical waste management, December 1997. URL: http://www.nihe.org/elevreng.html. Accessed 9/1/00.
Nogee, A. (1998). Buy green power. *Nucleus*, Spring, 4.
Nuland, S. B. (1988). *DoctorsThe biography of medicine.*. New York: Vintage Books.
Oregon Public Broadcasting (1997). Affluenza. Public Broadcasting System (PBS), televised 9/20/97.
Orient, J. M. (1989). Chemical and biological warfare: Should defenses be research and deployed? *Journal of the American Medical Association*, *262*, 644–648.
Ozonoff, D. (1995). Environmental medicine for all: Getting there from here. *The Lancet*, *346*, 860.
Papich, B. (1999). A heady adventure (Easter Island). *Los Angeles Times*, October 24, pp. L1, L11–L13.
Pappas, G., Queen, S., & Hadden, W., et al. (1993). The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. *New England Journal of Medicine*, *329*, 103–109.
Passaro, V. (1998). Who'll stop the drain? *Harper's Magazine*, August, pp. 35–42.
Patz, J. A., Epstein, P. R., Burke, T. A., & Bulbus, J. M. (1996). Global climate change and emerging infectious disease. *Journal of the American Medical Association*, *275*(3), 217–223.
Physicians for Human Rights Staff (2000). *Sierra Leone*, October, pp. 1, 5.
Physicians for Social Responsibility Staff (1998). *Asthma and the role of air pollution. What the primary care physician should know; PSR Report*, pp. 1–5.
Physicians for Social Responsibility Staff (2000a). Heat waves and hot nights are on the rise in the United States. URL: http://www.psr.org/heatsheet.html. Accessed 7/15/00.
Physicians for Social Responsibility Staff (2000b). 5000 nuclear weapons on hair-trigger alert. URL: http://www.psr.org. Accessed 9/5/00.
Ponka, A., & Virtanen, M. (1996). Low-level air pollution and hospital admissions for cardiac and cerebrovascular diseases in Helsinki. *American Journal of Public Health*, *86*(9), 1273–1280.
Pooley, E. (2000). The IMF: Dr. death? *Time*, April 24.
Pope, A. M. (1994). Environmental medicine and the medical school curriculum. *Journal of the American Medical Association*, *271*(6), 417.
Powell, P. P. (1991). Minamata disease: A story of mercury's malevolence. *Southern Medical Journal*, *84*, 1352–1358.
PSR Environment & Health Update Staff (1999a). April 1999. http://www.psr.org
PSR Environment & Health Update Staff (1999b). April 1999. http://www.psr.org. Accessed 4/5/00.
PSR Environment & Health Update Staff (2000). July 2000. http://www.psr.org
PSR Reports Staff (1999). How green is your golf course? Herbicides, pesticides draw doctors' attention. 20 (1), 1–2.
PSR Reports Staff (2000). Death by degrees drives climate change education. 21 (4), 1, 3.
Public Citizen News Staff (1998a). A code of secrecy and immunity. January/February, 18 (1), 7.
Public Citizen News Staff (1998b). Trade body threatens democracy. January/February, 18 (1), 1, 8.
Public Citizen News Staff (1999). Ruling allows radioactive metal in household products. September/October, p. 5.
Public Citizen News Staff (2000). Tainted process on radioactive recycling continues. July/August, 12.
Quammen, D. (1998). Planet of weeds. Tallying the losses of earth's animals and plants. *Harper's Magazine*, October, pp. 57–68.
Ramo, J. C. (2000). The real agenda of debt relief. *Time*, July 24, p. 40.
Renner, M. (1991). Assessing the military's war on the environment. In L. Brown, et al. (Ed.), *State of the world 1991*. New York: Worldwatch Institute.
Ris, H. W. (1998). Effects of the arms race on health and human services. *Journal of Adolescent Health Care*, *9*, 235–240.
Rivera, R. F. (2000). *The Amicus Journal*, Fall, 8.
Rose, S. (2000). Responsible investing. Is it living up to its promise? *Sierra*, November/December, pp. 26, 28–93.
Rosenblatt, W. H., Ariyan, C., & Silverman, D. G. (1993). Case-by-case assessment of recoverable materials for overseas donation from 1318 surgical procedures. *Journal of the American Medical Association*, *269*, 2647–2649.
Sagan, C. (1996). *The demon-haunted world: Science as a candle in the dark*. New York: Random House.
Samet, J. M., Dominici, F., & Curriero, F. C., et al. (2000). Fine particulate air pollution and mortality in 20 US cities, 1987–1994. *New England Journal of Medicine*, *343*(24), 1742–1749.
Satcher, D. (2000). Food safety: A growing global health problem. *Journal of the American Medical Association*, *283*(14), 1817.
Schroeder, S. A. (1999). Understanding health behavior and speaking out on the uninsured: Two leadership opportunities. *Accademia Medica*, *74*(11), 1163–1171.

Selcraig, B. (1998). Mining. *Sierra*, May/June, pp. 60–65, 86, 89–91.

Shapiro, R. L. (1993). The effects of tropical deforestation on human health. *The PSR Quarterly*, *3*(3), 126–135.

Sidel, V. (2000). Physicians as social activists. URL: http://www.bsd.uchicago.edu/~s-nagle/sidel/slide87.html. Accessed 9/5/00.

Sidel, V. W. (1999). Farewell to arms: The impact of the arms race on the human condition. *PSR Quarterly*, *3*, 18–26.

Sidel, V. W., & Shahi, G. S. (1997). The impact of military activities on development, environment, and health. In: G. S. Shahi, B. S. Levy, A. Binger, T. Kjeustrom, & R. Lawrence (Eds). *International perspectives on environment, development, and health: Toward a sustainable world*. New York: Springer Publishing Company.

Sierra Club Staff (2000). 2000 year in review & action plan 2001.

Sierra Magazine Staff (1997a). Faces of environmentalism. September/October, p. 27.

Sierra Magazine Staff (1997b). Save the Clunkers! November/December, p. 32.

Sierra Magazine Staff (1997c). Dirty politics, clean power. November/December, p. 74.

Sierra Magazine Staff (2000a). Women's health, earth's health. November/December, p. 74.

Sierra Magazine Staff (2000b). China drowns? November/December, p. 92.

Silverstein, K. (1999). Meat factories. *Sierra*, January/February, pp. 28–35 110–112.

Smith, K. E., Besser, J. M., & Hedberg, C. W., et al. (1999). Quinolone-resistant *Campylobachter jejuni* infections in Minnesota, 1992–1998. *New England Journal of Medicine*, *40*(20), 1525–1532.

Snell, M. D. (2001). Against the grain: Why poor nations would lose in a biotech war on Hunger. *Sierra Magazine*, July/August, pp. 30–33.

Solnit, R. (2000). The new gold rush. *Sierra*, July/August, pp. 50–57, 86.

Solomon, G. (1997). *Endocrine disruptors: A new public health problem?* San Francisco: National Resources Defense Council, Briefing Paper.

Solomon, N. (1999). Broadcasting democracy: Like oil and water. *Fairness and Accuracy in Reporting Media Beat*, August 12. http://www.fair.org/mediabeat.990812.html.

Speer, L. (2000). Feeding frenzy. *The Amicus Journal*, Spring, 47.

Starfield, B. (2000). Is US health care really the best in the world? *Journal of the American Medical Association*, *284*(4), 483–485.

Stephenson, J. (2000). Exposure to home pesticides linked to Parkinson's Disease. *Journal of the American Medical Association*, *283*(23), 3055–3056.

Thomas, W. (1995). *Scorched earth: The military's assault on the environment*. Philadelphia: New Society Publishers.

Thompson, A. (1998). US Budget Data. *International Physicians for the Prevention of Nuclear War*.

Tieszen, M. E., & Gruenberg, J. C. (1992). A quanti tative, qualitative, and critical assessment of surgical waste. *Journal of the American Medical Association*, *267*, 2765–2768.

Time Magazine Staff (1995). Organization for Economic Cooperation and Development. June 5, p. 20.

Time Magazine Staff (2000). Numbers Section. May 8, p. 33.

Toole, M. J., & Waldman, R. J. (1993). Refugees and displaced persons: War, hunger, and public health. *Journal of the American Medical Association*, *270*, 600–605.

Toubia, N. (1994). Female circumcision as a public health issue. *New England Journal of Medicine*, *331*(11), 712–716.

Trefil, J. (1999). How hot. *Time*, November 8.

Union of Concerned Scientists Staff (1994). Women and the environment in developing countries. June.

US Committee to Ban Land Mines (2000). URL: http://www.banminesusa.org. Accessed 11/14/00.

Webster, D. (1997). Inside the $10 billion black market in endangered animals. *New York Times Magazine*, February 16, pp. 26–33, 49, 53, 61.

Weintraub, M. (1997). Racism and lead poisoning. *American Journal of Public Health*, *87*(11), 1871.

Whited, J. D., & Grichnik, J. M. (1998). Does this patient have a mole of a melanoma? *Journal of the American Medical Association*, *279*(9), 696–701.

Wilson, D. (1998). Wasteland: every day, hazardous waste is made into crop fertilizer. And there is not a law in place to make sure it is safe. *The Amicus Journal*, Spring, 34–38.

Wilson, E. O. (2000). Vanishing before our eyes. *Time*, April–May, pp. 29–34.

Wong, Y. (1994). Importance and intransigence: State behavior in the throes of deepening global crisis. *Politics and Life Sciences*, *13*(1), 3–14.

Worldwatch Institute (1998). *State of the world*. New York: WW Norton.