fear that a free, Western, capitalist culture would infect the soldiers and officials who remained in the South as an army of occupation. As Toai shrewdly notes:

> Most of [the northern soldiers] were simple country people who had firmly believed the crude whip-and-slave propaganda that had been their only information about conditions in the South. Now they saw not only that quite ordinary people had refrigerators and cars, but that the farmers used tractors and the fishermen motorboats. As these revelations sank in, you could see their zeal almost visibly crumbling. An epidemic of cynicism began to take hold, its most conspicuous symptom being the uncontrollable hunger for goods.

The disintegration of political faith had its most palpable reflection in the widespread corruption at all levels of government. It goes without saying that corruption is endemic to any system where rewards are apportioned on the basis of politics, rather than merit or the market. Previous Communist societies, however, had undergone an initial period when the ideals of the revolution are taken with the utmost seriousness by party members, when party workers are convinced they are building a system morally superior to all that had come before it. South Vietnam never experienced this period of revolutionary euphoria.

The old Saigon corruption—prostitutes, bars, shady business dealings—was supplanted by a distinctly Communist brand of corruption. Officially, practically nothing was available; for a bribe, many things could be accomplished, including the most coveted thing of all: flight to freedom. In fact, corruption became semi-officially inscribed in national policy. By law, fleeing the country without permission was illegal, and permission was rarely granted. Unofficially, emigration was allowed, for a price. What was never permitted was open, orderly, safe emigration. The regime desperately wanted the "exit fees" it extorted from the boat people, which in one year was estimated to be 2.5 percent of Vietnam's GNP. The authorities also found it useful to rid the country of those who would not adjust to the new social arrangements. An additional benefit for the new regime of the chaotic mass exodus was the resulting turmoil in neighboring Asian states.

Along with corruption came a new class system, based on political connection, that was even more rigid than the old one based on wealth. For example, the regime established six distinct categories for the ration system, ranging from ministers at the top to ordinary citizens at the bottom. Medical care was similarly organized, with separate hospitals for party members and government officials. For the average resident of Saigon, the health care privileges afforded party members were particularly galling, since medical care in general deteriorated under the Communists. In addition to the shortages of drugs, ordinary Vietnamese were forced to run a bureaucratic gauntlet in order to gain admission to a hospital, even in cases of serious illness. There were even certain medicines reserved for party members which were unavailable to the public.

What, then, is the lesson of Vietnam? For the people, and especially the elites, of other Third World countries, the most important lesson is the Communist success in politically disarming the South Vietnamese through a cleverly packaged set of lies: lies about private property, the rights of peasants, freedom, and national independence. Doan Van Toai describes the South Vietnamese attitude towards Communism—his early attitude as well—as one of "deadly naiveté." Regrettably, Toai and his countrymen are paying dearly for the naiveté; not so those Americans who, having once welcomed a Communist victory in Vietnam, now blithely wish a similar fate on other luckless people in distant lands around the world. □

Dixy Lee Ray

THE GREAT ACID RAIN DEBATE

No one in Washington (or Ottawa) knows what he's talking about.

The Great Acid Rain Debate has been going on for more than a decade. Public alarm in the United States probably dates from a widely publicized 1974 report which concluded that "the northeastern U.S. has an extensive and severe acid precipitation problem." Does it? Probably not. Is rain really acidic? Yes. Does acid rain, or preferably, acid precipitation, really damage forests, lakes and streams, fish, buildings and monuments? Yes, in some instances, but not as the primary or only cause. Can the adverse environmental effects that have been attributed to acid rain—whatever the real cause—be mitigated by reducing the amount of sulfur dioxide emitted to the atmosphere from industrial sources? No, what evidence there is suggests that it cannot be. Is enough known, and understood, about acid precipitation to warrant spending billions of dollars of public funds on supposed corrective measures? Certainly not.

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Clearly, the U.S. Environmental Protection Agency agrees with this assessment, for the agency's administrator, Lee M. Thomas, said in 1986: "Current scientific data suggests that environmental damage would not worsen materially if acidic emissions continued at their present levels for ten or twenty more years. Acid rain is a serious problem, but it is not an emergency."

That rain is acidic has been known for a long time. Among the first records are a reference to acid rain in Sweden in 1848 and a discussion on the chemistry of English rain in 1872. Sulfur dioxide was established as a possible cause of damage to trees and other plants in Germany in 1867. The commonly repeated alarm that rainfall has become increasingly acidic over the past twenty-five years rests for its validity on an influential and oft-cited series of articles by G. E. Likens and his co-workers published in the 1970s. Careful evaluation by a group of scientists at Environmental Research and Technology Inc. reveals that Likens's research suffered from problems in data collection and analysis, errors in calculations, questionable averaging of some data, selection of results to support the desired conclusions, and failure to consider all the available data. In a more recent study, Vaclav Smil of the University of Manitoba reached similar conclusions. Besides analyzing Likens's methods of determining rain acidity, Smil examined maps of the distribution of acid precipitation in the eastern U.S. between the mid-1950s and the mid-1960s, prepared by Likens et al. and publicized as providing "unassailable proofs" of rising acidity. "In reality," Smil concludes, "the measurement errors, incompatibility of collection and analytical procedures, inappropriate extrapolations, weather effects and local interferences, makes such maps very dubious."

Rain forms when molecules of water vapor condense on ice crystals or salt crystals or minute particles of dust in clouds and then coalesce to form droplets that respond to the force of gravity. As rain falls through the atmosphere it can "pick up" or "wash out" chemicals or other foreign materials or pollutants that may be present. Because water is such a good solvent, even in the cleanest air, rainwater dissolves some of the naturally present carbon dioxide, forming carbonic acid. Hence, rainwater is *always acidic* or if you like, acid rain is normal. There is no such thing as naturally neutral rainwater. Scientific studies generally distinguish between "acid rain," i.e., the acidity of rainwater itself, and "acid deposition," i.e., the fallout

of sulfates, nitrates, and other acidic substances. Acid deposition may be "wet" if washed out of the atmosphere with rain, or "dry" if gases or particles simply settle out.

How acidic is pure water? Despite the fact that water molecules are very stable, with a chemical composition of two parts hydrogen to one part oxygen (H_2O), the molecular structure or architecture is somewhat asymmetrical; the molecules tend both to clump and to dissociate in response to intermolecular forces. Dissociation leads to a few hydrogen ions carrying a positive charge and an equal number of OH or hydroxyl ions with a negative charge. Under normal conditions, in pure distilled water only a few molecules are dissociated, in fact, about two-ten millionths of one percent. Now 2/10,000,000 of 1 percent is an awkward numerical expression. Therefore, for greater ease in expressing the number of dissociated molecules, which is the measure of relative acidity, a method called pH has been adopted. The pH of pure water is 7, the numerical expression of neutrality. Any pH measure below 7 is acidic, any above 7 is basic or alkaline. The pH scale is logarithmic (like the Richter scale for measuring intensity of earthquakes); therefore a change of one pH unit, for example, from pH 5 to pH 6, is a ten-fold change.

Water in the atmosphere normally contains some carbonic acid from dissolved carbon dioxide, and the pH of clean rainwater even in pristine regions of the earth is about pH 5.0 to 5.5.[1]

[1]The pH of clean rainwater compares to that of carrots (pH 5.0), and lies between the acidity of spinach (pH 5.4) and bananas (pH 4.6). Rainwater is far less acidic, for example, than cola drinks (pH 2.2).

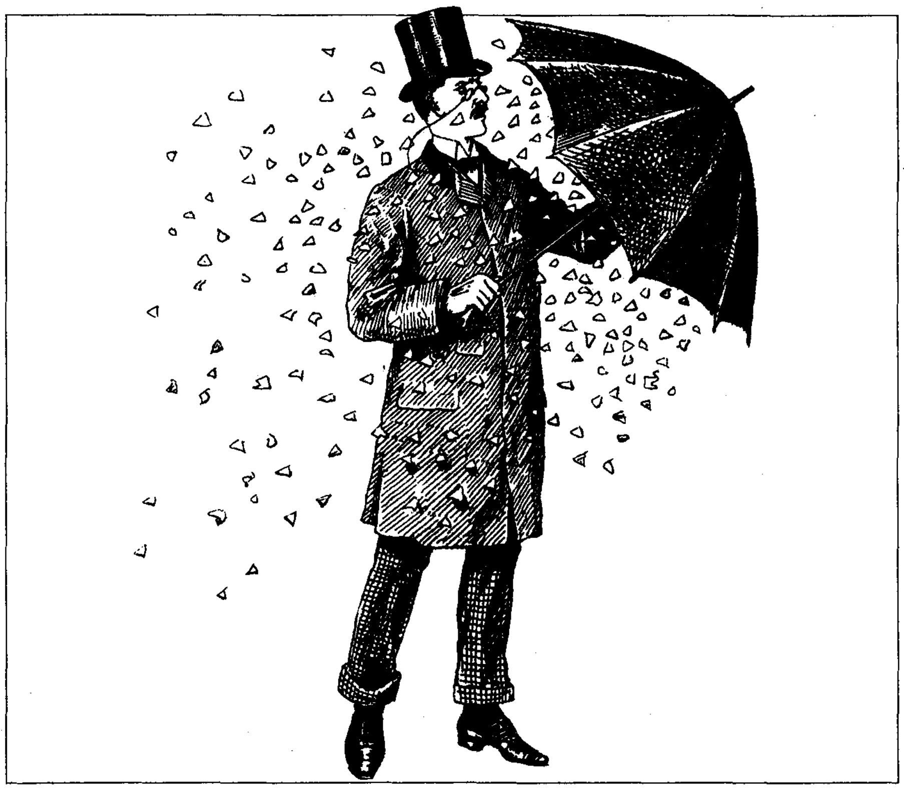
Any lower pH is believed to be environmentally damaging. Lakes, streams, rivers, ponds, indeed all bodies of fresh water may and usually do receive dissolved material, either acidic or alkaline, from runoff and from the soil or earthen basin in which the water stands or flows. Both acid and alkaline lakes are natural phenomena, and exist without intervention by humans.

Getting an accurate measure of the pH of rainwater is more difficult than storm will give a pH reading different from that taken during and at the end of the rainfall; that measurements may differ widely at different locales within a region; and that weather and climate affect the results. With regard to this last phenomenon, it may be that the more alkaline results reported by Likens for the northeast U.S. in the 1950s were related to the drought conditions that prevailed during those years. By contrast, the 1960s were rainy.

Is enough known about acid precipitation to warrant spending billions of dollars of public funds on supposed corrective measures?

it may at first seem. Certainly it is no simple litmus test; accurate procedures require careful laboratory analyses. For example, early work—that is, measurements taken before 1968—generally used soft glass containers; it is now known that even when the containers were carefully cleaned and when the analysis was done very soon after collection, the soft glass contributed alkalinity to the sample, and this increased with time in storage. Indeed the range of error attributable to the use of soft glass is sufficient so that it might account for the difference in pH measurements between 1955-56 and 1965-66 reported by Coghill and Likens. Rainwater collection made in metal gauges, a common procedure before the 1960s, also influenced the results. An experiment to test this difference, using a dilute solution of sulfuric acid with a pH of 4.39, gave a reading of pH 5.9 when held for a short time in a metal gauge.

It is also now known that a rainwater sample taken at the beginning of a



When dry conditions persist, dust particles are more prevalent, and if they are present in the rain samples, they can neutralize some of the acidity and shift the pH toward the alkaline end of the scale.

For several reasons, then, it now appears that the historical data, on which so much of the alarm and worry has been based, are of insufficient quality and quantity to establish as indisputable a trend toward higher acidity in the rainfall of the northeastern United States.

Complicating the acid rain picture still further are results of samples recently collected from ice frozen in the geological past, and from rainfall in remote regions of the earth. These results suggest that the relationship between acidity and the industrial production of sulfur dioxide emissions is at best extremely tenuous.

Analysis of ice pack samples in the Antarctic and in the Himalayas indicates that precipitation deposited at intervals hundreds and thousands of years ago in those pristine environments had a pH value of 4.4 to 4.8. Some measurements were as low as 4.2. Examination of Greenland icepack samples shows that many times in the last 7,000 years the acidity of the rain was as high as pH 4.4. In some cases the periods of extremely high acidity lasted for a year or more. Coal burning utilities spewing out sulfur dioxide could not have been responsible, but these periods of high acidity do correspond to times of major volcanic eruptions. Also remarkable is the period of low acidity in the ice lasting from 1920 to 1960, when no major volcanic eruptions occurred but industrial pollution increased.

Recent measurements taken by the National Oceanic and Atmospheric Administration on Mauna Loa in Hawaii at 3,500 meters above sea level gave average pH values of 4.9 regardless of wind direction. Moreover, sampling at Cape Matatula on American Samoa, a monitoring site selected for its extreme cleanliness, resulted in measurements from pH 4.5 to 6.0 in the rainwater.

To gather more systematic data on the pH of rain in remote areas, a Global Precipitation Chemistry Project was set up in 1979. Samples of rainwater were tested from five sites: Northern Australia, Southern Venezuela, Central Alaska, Bermuda, and Amsterdam Island in the southern Indian Ocean halfway between Africa and Australia. The first results were published in 1982. Precipitation was everywhere acidic, pH values averaging between 4.8 and 5.0. Now it is possible to imagine that the Bermuda results could have been affected by long range transport of sulfate aerosols or other atmospheric pollution from the U.S., or that Alaskan atmosphere is polluted from coal burning in the Midwest, but that does not appear to be reasonable. At the remaining sites, including American Samoa, clearly man-made emissions could not have caused the measured acidity.

Conversely, in some areas where one might expect a low pH, actual measurements of the rainwater reveal higher than anticipated pH values. Twelve sites in Mexico, for example, measured pH 6.2 to 6.8; nine inland sites in India gave a median pH of 7.5 (range 5.8 to 8.9). It turns out that the expected natural acidity of the rain is neutralized by suspended alkaline particles, mainly dust from dry fields, unpaved streets, and so on.

In China seventy percent of the basic energy comes from burning coal; sulfur dioxide releases are very high, particularly in urban areas. Rainwater in Peking is nevertheless close to neutral, most values falling between pH 6.0 and 7.0. Interestingly, the same samples have heavy concentrations of sulfate and nitrate ions as well as suspended alkaline matter, probably dust blown from desert regions. The pH is determined by complex interaction among these aerosols, ions, and particles.

Acid rain can also be buffered or neutralized by soil conditions. Recent studies at nearly 200 sites in the United States show that in the northern Great Plains high levels of calcium and magnesium ions occur, along with ammonia associated with animal husbandry and fertilizers. These combine to neutralize acidic precipitation. In the western half of North America 75 to 96 percent of all acid anions are so neutralized. By way of contrast, in the northeastern U.S. 52 percent of all acid anions are not so neutralized.

It might be that lower levels of alkaline dust, especially in the northeast, are a consequence of successful

air pollution control, resulting in the effective capture of particulate matter from industrial smoke. This possibility was investigated in 1985 by Smil, who reports a great loss of airborne alkaline material between the mid-1950s and mid-1960s. This loss resulted from large scale replacement of coal as fuel for homes, transportation, and industrial boilers, as well as highly efficient removal of fly ash from flue gases. Although exact and accurate calculations are not possible, reasonable estimates of the largely alkaline particulate emissions were about nine million tons annually in the 1950s; this fell to about four million tons by 1975. Actually the total loss of man-made alkaline material over the northeast was probably much larger than the estimates indicate since emission controls were also applied to the iron, steel, and cement industries. And the amount of barren, dusty land shrank with advancing settlements, paved roads, lawns, and considerable re-growth of forests. Another contributing factor to loss of alkaline materials may have been the practice of prompt extinction of forest fires. Wildfires, when left to burn themselves out, result in an accumulation of alkaline ash, which, together with the minerals it contains, acts to buffer natural acidity in the soil and redress the mineral imbalance.

One final point should be made about natural acidity and alkalinity. Soils along the North Pacific coast tend to be quite acidic, a usual feature in areas that had been glaciated. Peat bogs are common; cranberries, huckleberries, blueberries, and Douglas Fir trees—all requiring acid soil—are abundant. For comparison, soils in the arid west and southwest are alkaline, and rarely measure a pH below 9.0. By contrast the soils in New England are among the most acid in the world. Representative Adirondack soil measures pH 3.4. Soils in southeast Canada are similar. That region also was glaciated, and the thin poor soil overlays acid granitic material. In other words, the soils of the northeast United States are by nature acidic, and always have been, environmentalist claims notwithstanding.

There is an extensive and growing body of scientific literature on atmospheric chemistry, much of it highly technical. Gradually, understanding is also growing, but many areas of uncertainty remain. Experts are divided on exactly how acids are formed in clouds, in rainwater, and upon deposition. There is some disagreement too on the relative amount and importance of acid precursors from man-made versus natural sources. Most knowledgeable scientists tend to take a middle view, that the amount of pollutants in the air, particularly of sulfates and nitrates, on a global scale comes about equally from natural and human sources, but even this is a supposition or educated guess.

Natural Sources

Sulfur and nitrogen compounds—the "acid" in acid rain—are produced naturally by the decay of organic matter in swamps, wetlands, intertidal areas, and shallow waters of the oceans. How much is contributed to the atmosphere from these sources is not known for certain, but it is considerable. Estimates of naturally produced sulfates and other sulfur compounds are from 35 percent to 85 percent of the total—a rather wide range!—and naturally occurring nitrogen compounds are generally believed to be 40 percent to 60 percent of the total. Some experts go further and claim that nature contributes over 90 percent of the global nitrogen. Considering the additional sulfur that emanates from volcanoes and fumaroles and hot springs and ocean spray, and the nitrogen fixed by lightning, the generally accepted contribution from natural sources may be underestimated.

The contribution of lightning to the acidity of rain is significant. Two strokes of lightning over one square kilometer (four-tenths of a square mile) produce enough nitric acid to make eight-tenths of an inch of rain with a pH of 3.5. In fact, it has been estimated that lightning creates enough nitric acid so that annual rainfall over the world's land surfaces would average pH 5.0 even without taking into account other natural sources of acidity.

The contribution of volcanoes to atmospheric sulfur dioxide seems never to have been taken seriously; acknowledged, yes—but then dismissed as trivial. Perhaps this is related to the fact that volcanoes are studied by geologists and vulcanologists rather than by atmospheric scientists. Or perhaps it's because volcanic mountains tend to be where meteorologists are not. Predicting exactly when an eruption will occur is notoriously undependable, and obtaining direct measurements or samples of ejecta during eruptions is dangerous and can be fatal. During the daylong eruption of Mt. St. Helens on May 18, 1980, over four billion tons of material were ejected. Although large quantities of gases, including sulfur dioxide, were released to the atmosphere, no direct measurements could be made during the major eruption itself. Before May 18, in the period March 29 to May 14, spectroscopic measurements revealed about forty tons per day of sulfur dioxide. By May 25 measuring was resumed and showed 130 to 260 tons per day. On June 6 this increased abruptly to 1,000 tons per day. From the end of June through December of that year the rates of sulfur dioxide ranged from 500 tons per day to 3,400 tons per day. Sulfur dioxide, hydrogen sulfide, carbon disulfide, and other sulfur compounds continue to be released from the crater floor and dome, and arise also from fumaroles and the debris of pyroclastic flows.

That rain is acidic has been known for a long time. Among the first records are a reference to acid rain in Sweden in 1848 and a discussion on the chemistry of English rain in 1872.

El Chicon, an exceptionally acidic and sulfurous mountain in Mexico, erupted in early 1982, far more violently than Mt. St. Helens. Materials ejected reached the stratosphere and will probably affect the atmosphere for many years. Again no direct measurements were possible, but it is estimated that twenty million tons of sulfur dioxide were released. Also in the northern hemisphere, Mt. St. Augustine in Alaska erupted twice in 1986 with sulfur fumes detectable in Anchorage many miles away. Sulfur fumes continue to seep from both El Chicon and St. Augustine.

In 1973 two scientists, Stoiber and Jepson, reported data on sulfur dioxide emissions from Central American volcanoes, obtained both by remote sensing and by calculation. They conclude that 10,000 metric tons of sulfur dioxide are released to the atmosphere daily. Extrapolating world-wide, they calculate that volcanoes are responsible for emitting annually about 100 million metric tons of sulfur compounds. Thus nature is responsible for putting large quantities of sulfates and nitrates into the atmosphere.

Man-Made Sources

But so, of course, is man. Industrial activity, transportation, and burning fossil fuel for commercial and domestic purposes all contribute sulfate, nitrates, and other pollutants to the atmosphere. Since passage of the Clean Air Act in 1970 there has been an overall reduction of more than 40 percent in factory and utility sulfur dioxide production. But as sulfur dioxide emissions decrease, nitrogen emissions are increasing, primarily from oil burning and oil used in transportation. Industrial society also produces other air pollutants, including volatile organic compounds, ammonia, and hydrocarbons. Any of these may contribute to the formation of acid rain, either singly or in combination. Further, some man-made pollutants can undergo photo-oxidation in sunlight, leading, for example, to the conversion of sulfur dioxide to highly toxic sulfur trioxide. But even this compound, should it be deposited over the ocean, loses its toxicity due to the extraordinarily high buffering capacity of sea water.

Another photo oxidant, ozone, is possibly the most damaging of all air pollutants derived from human activity. Ozone accumulates in quantities toxic to vegetation in all industrial regions of the world. Ozone is a product of photochemical oxidation be-

tween oxides of nitrogen and volatile organic substances. The latter may be unburned hydrocarbons (e.g., from automobile exhaust in cars not equipped with catalytic converters) or various organic solvents. Ozone is known to cause severe injury and even death to certain forest trees. The best known cases are the decline of white pine in much of eastern North America and ponderosa and Jeffrey pine in the San Bernardino Mountains of California. Ozone acts synergistically with other pollutants and has been shown to cause damage to agricultural crops when exposure occurs along with sulfur and nitrogen oxides.

Thus, singling out sulfur dioxide produced by human activities as the major cause of acid rain is not only a gross over-simplification, but probably wrong.

The soils of the northeast United States are by nature acidic, and always have been.

Effects on Forests

What about the dying forests? Here again the acid rain activists blame sulfur dioxide produced by industry.

Trees, like every other living thing, are not immortal. They too grow old and die. The decline of a forest may be part of the slow but natural process of plant succession, or it may be initiated by any of several stress-causing factors. Each forest and each tree species responds differently to environmental insults, whether natural or human. As Professor Paul D. Mannion of the State University of New York has said: "If one recognizes the complex array of factors that can contribute to the decline of trees, it is difficult to accept the hypothesis that air pollutants are the basis of our tree decline problems today . . . [although] to question the popular opinion on the cause of our decline problems is not to suggest that pollutants do not produce any effect."

Widespread mortality of forest trees has occurred at times and places where pollution stress was probably not a factor. Declines of western white pine in the 1930s and yellow birch in the 1940s and fifties, for example, were induced by drought, while secondary invasion by insects or other disease organisms is most often the ultimate cause of fatality.

Currently the most widely publicized forest decline problem in the U.S. is the red spruce forest in the northern Appalachian Mountains. Few people now cite the widespread mortality in red spruce between 1871 and 1890. The dieback occurred at roughly the same time in West Virginia, New York, Vermont, New Hampshire, Maine, and New Brunswick, and was then attributed to the invasion of a spruce beetle that followed some other stress. What that was is not clear.

Today the dieback symptoms of the red spruce are most pronounced above 900 meters in an environment that is subject to natural stresses such as wind, winter cold, nutrient-poor soils, and possible high levels of pollutants, heavy metals, and acidity in the clouds that often envelop the forest. The relative importance of each of these stresses has not been rigorously investigated.

The affected trees grow in one of the windiest locations in North America. It is known that wind can dry out or even remove red spruce foliage, especially if rime ice has formed; it can also cause root damage by excessive tree movements. Tree ring analyses indicate a possible relation between recent cold winters and decline. The abnormal cold extending into spring may have caused the trees to be more susceptible to the adverse effects of pollutants. Arthur H. Johnson and Samuel B. MacLaughlin, who have studied tree rings and the red spruce forest decline, conclude in *Acid Deposition: Long Term Trends* (National Academy Press, 1986) that "there is no indication now that acidic deposition is an important factor in red spruce decline. . . . The abrupt and synchronous changes in ring width and wood density patterns across such a wide area seem more likely to be related to climate than to air pollution." Air borne chemicals might play a role, but they will have to be further assessed.

And then there are the dying forests of Germany. Whereas originally the focus was on acid precipitation and deposition of sulfur dioxide and to a lesser extent nitrogen oxides, emphasis has now shifted to the oxides of nitrogen, hydrocarbons, soil minerals such as aluminum and magnesium, and photo oxidants, chiefly ozone. Sulfur dioxide emissions have been declining in Germany since the mid-1970s, due mainly to the substitution of nuclear energy for coal burning in the production of electricity. But this decline was not accompanied by improvement in the health of forests, suggesting that other factors may be implicated. It is now believed that only in exceptional cases does sulfur dioxide cause direct damage to forests in Germany. But motor vehicle pollution from more than 27 million autos and trucks is among the highest in the world in density per area, and is considered to be a contributing factor to the formation of ozone. Indeed, ozone levels in Germany's damaged forests are often remarkably high. Long-term measurements indicate that the mean value of ozone concentration has increased by one-third over the last twenty years. And the investigators at the Norwegian Forest Research Institute have reached similar conclusions about the importance of ozone in forest declines.

The adoption of the catalytic converter for automobiles in America was primarily to control the release of unburned hydrocarbons in order to reduce the photochemical production of ozone. In this it has functioned well, although it has also led to formation of formaldehyde and larger amounts of acid, especially sulfuric acid. But there is another source of atmospheric hydrocarbons that has not been controlled—cows! American cows burp about fifty million tons of hydrocarbons to the atmosphere annually! There is no known control technology for these emissions. Whether they contribute to ozone formation is also not known, but their presence helps to emphasize the complexity of atmospheric chemistry.

Effects on Lakes and Fish

There are three kinds of naturally occurring acidic lakes: 1) those associated with inorganic acids in geothermal areas (i.e., Yellowstone Park) and sulfur springs (pH 2.0 to 3.0); 2) those found in peat lands, cypress swamps, and rain forests where the acidity is derived from organic acids leached from humus and decaying vegetation (pH 3.5 to 5.0); and 3) those located in areas of weather resistant granitic or silicious bedrock. Only the last-named are involved in the acid rain question. In these lakes and streams, the absence of carbonate rocks means little natural buffering capacity. This type of naturally acidic lake is common in large areas of eastern Canada and the northeastern United States, where glaciers exposed granitic bedrock during the last period of glaciation. The lakes are called "sensitive" because they may readily become further acidified with adverse impacts on aquatic organisms, of which fish are the most important to man. Indeed the most widely proclaimed complaint about the consequence of acid deposition is the reduction or elimination of fish populations in response to surface water acidification.

But again, this is not a recent phenomenon. Dead lakes are not new. A study by the New York State Department of Environmental Conservation reveals that the stocking of fish in twelve lakes was attempted and failed as early as the 1920s. Of course, many people did catch fish in the 1920s and 1930s in lakes where fish are not available today. But the fact is that during those years many of the Adirondack lakes were being stocked annually by the Fish and Game Commission; fish did not propagate, and the stocking program was discontinued about 1940.

In the United States 219 lakes have been identified as too acidic to support fish. Two hundred and six of these lakes are in the Adirondacks, but they account for only four percent of the lake surface of New York state alone. This, then, is hardly a national problem; it is local. The same applies to southeast Canada, where the highest percentage of acid lakes is located.

Uncertainty continues whether these acid lakes have always had a low pH or whether human activities have reduced the neutralizing capability of the waters, or the lake basin. A range of human activities could be to blame: use of chemical pesticides to control spruce budworm or black fly infestations, changes in fish hatchery production, change in angler pressure, lumbering, burning of watersheds. On the other hand, declining fish populations were noted in some New York lakes as early as 1918, and bottom sediments deposited eight hundred years ago in Scandinavian lakes are more acid than today's sediments.

To conclude that a decline in fish population is caused by atmospheric acid deposition, it must be established that the lake formerly supported a viable fish population; one or more species of fish formerly present has been reduced or lost; the lake is more acidic now than it was when the fish were present; the increased acid level was not caused by local factors; and other factors, e.g., toxic chemicals, are not present or are unimportant.

Such data are rare. Studies on three lakes in the Adirondacks—Panther, Sagamore, and Woods Lake, which are remote but close enough together to be affected by the same rainfall—disclosed radically different degrees of acidity, large differences that can be ac-

counted for by the varying geological makeup of the three lake beds and local, surrounding soils and vegetation.

Outside the Adirondack Mountains and New York state, many emotional claims have been made about fish kills in Canada, Norway, and Sweden. Most of the losses are reported in the spring; in Scandinavia fish kills have been reported annually in the springtime for more than one hundred years. This recurring natural phenomenon is likely due to oxygen depletion or to snow melt and rain runoff carrying sudden high concentrations of many materials into lakes and streams, and in fact, the acidity of most waters is greatest in the spring. Modern findings call into question the claim that distant sources of sulfur dioxide are responsible for the growing acidity of waters hundreds of miles away.

Using trace elements, Dr. Kenneth Rahn of the University of Rhode Island has found that it is local pollution sources, mostly residual fuel oil burned for domestic, commercial, and industrial purposes in New England, that are the main cause of added acidity in rain and snow. A meteorological team from the University of Stockholm cautioned the Swedish people not to blame acid rain on emissions from England; they found that local sources accounted for local acid rain. Great Britain, incidentally, has reduced sulfur dioxide emissions by more than 30 percent since 1970 with no effect whatever on the acidity of lakes or rain in Scandinavia. In New York City, EPA scientists traced elevated sulfur dioxide and sulfuric acid in the wintertime to the burning of oil in the 35,000 oil burners of the city's apartment houses. European scientists at the Organization for Economic and Cooperative Development, in Paris, have reached the same conclusion; the most revealing result of an extensive project is that every source region affects itself more than any other region.

Effects on Man-Made Structures

The impact of air borne pollutants and acid rain on deterioration of buildings, monuments, and man-made materials is also predominantly a local phenomenon. It is at least as complex as the effects on the natural environment. And, like forests and lakes, every site is specific and every material different. Few generalizations are possible; fewer still stand up under careful scrutiny. Of course metals corrode, marble and limestone weather, masonry and concrete deteriorate, paint erodes, and so on; but the conditions and substances that lead to loss of integrity vary widely. Perhaps the only statement that can be made is that moisture is essential, that deterioration results more from acid deposition than from acid rain, and that local sources are more important than possible long-range transport of pollutants.

Yet belief persists that acid rain from "someplace else" is destroying cultural monuments. Perhaps the most egregious example is the damage to the granite Egyptian obelisk, "Cleopatra's Needle," located since 1881 in New York City's Central Park. It has been claimed that "the city's atmosphere has done more damage than three and one half millennia in the desert, and in another dozen years the hieroglyphs will probably disappear." A careful study of the monument's complex history, however, makes it clear that the damage can be attributed to advanced salt decay, the high humidity of the New York climate, and unfortunate attempts at preservation. There is no question but that acid deposition causes incremental damage to materials, but far more research is needed before reliable surface protection systems can be developed.

The decline of a forest may be part of the slow but natural process of plant succession, or it may be initiated by any of several stress-causing factors.

At the very least, the historical record of dramatic fluctuations in rain acidity, and episodes of environmental damage that cannot be attributed to industrial pollution; the evidence that natural events such as drought and abnormal cold can be important factors in environmental deterioration; the probability that compounds other than sulfur dioxide (e.g., ozone) are responsible for causing damage to plant life; the complex interactions among the many chemicals, aerosols, and other substances in the atmosphere and upon deposition; the likelihood that local sources are responsible for local effects; and the fact that there is no real, direct evidence that long distance transport of sulfur dioxide causes acid rain problems in New England, should make Congress very cautious about committing public funds to ill-conceived "solutions" to an ill-defined problem. At best, proposed federal programs constitute, in the words of Dr. S. Fred Singer of the National Advisory Committee on Oceans and Atmosphere, a multibillion dollar solution to a multimillion dollar problem.

One federal program that fits this description is a plan developed last summer by Drew Lewis and William Davis, special envoys for the United States and Canada, respectively. Under this plan, the U.S. will spend $2.5 billion of federal funds and $2.5 billion from U.S. industry to demonstrate how to burn high sulfur coal and release less sulfur dioxide to the atmosphere. Burning low sulfur coal was not proposed because that would "impose significant socioeconomic costs on high sulfur coal miners, their families and their communities." According to EPA administrator Lee N. Thomas, the $5 billion program will be a proper "first step toward the goal of a solution to North America's acid rain problem."[2] There is no reason to believe that the proposed solution will solve or even contribute to solving the perceived problem.

Despite reports to the contrary in the popular press, the Committee on Atmosphere and Biosphere of the National Research Council–National Academy of Sciences did *not* conclude in its 1981 report that a 50 percent reduction in sulfur dioxide from factories and utilities in the Midwest would significantly reduce environmental problems attributed to acid rain in the northeast. This misinterpretation was pointed out in the 1983 NRC-NAS report for the Environmental Studies Board, which concluded: "The relative contributions of such long range effects and of more local regional effects are currently unknown and cannot be reliably estimated using currently available models." The only change since this position was reached is the growing evidence of the past three years that local sources predominantly influence local effects.

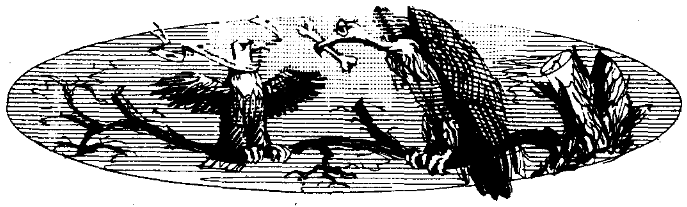
Nevertheless, industrial activities generally and coal burning in particular put pollutants into the atmosphere, and what goes up must come down—somewhere. It is reasonable therefore to require, as the Clean Air Act does, that emissions of sulfur dioxide and other pollutants be reduced. It is also reasonable to spend federal funds to collect accurate data and to continue efforts to understand the problem of acid deposition in all its complexity. What is not reasonable is the requirement by a Congress impatient for immediate results that all coal-burning utilities must use expensive flue gas scrubbers regardless of whether the coal complies with federal standards or not. With even less reason the 1977 amendments to the Clean Air Act require that the sulfur content of all coal be reduced by the same specified percentage. It seems not to matter, under this law, that low sulfur western coal still goes into the scrubbers cleaner than high sulfur eastern coal comes out of them. What apparently does matter is that the top eight polluting states have large high sulfur coal reserves and high economic dependence on mining it. They are represented in the House of Representatives by about 105 votes. By contrast western, low sulfur coal is dominated by two states, Montana with two votes and Wyoming with one.

But even this pales to insignificance beside legislation considered by the 99th Congress, HR 4567. This bill had about 160 co-sponsors and was approved by the House Energy Subcommittee on Health and the Environment on July 20, 1986. It called for significant further reductions of sulfur dioxide emissions from utilities, industries, and motor vehicles, and nitrogen oxides were also to be reduced along with hydrocarbons, particulates, and carbon monoxide. The greatest burden would have fallen on utilities, and therefore the greatest effect would have been to drive up electricity rates. For this reason subsidies were to be provided to keep rates from rising more than 10 percent. Also proposed was a nationwide fee on all electrical generation. Department of Energy estimates put the cost of HR 4567 at a minimum of $2.5 billion to $8 billion annually. Others calculated that the costs could exceed $15 billion a year. TVA reported that the bill would drive up their electric rates by 12-14 percent, while Ohio Power's residential customers would pay 34 percent more and industry 44 percent more. The bill was opposed by the Administration, utilities, industry including coal mining, automobile manufacturers, and some members of Congress. Although the 99th Congress adjourned without taking action on this or other acid rain bills, the sponsors have vowed to try again when the new Congress convenes in January.

Department of Energy Secretary Herrington, in testimony before Congress in June 1986, pointed out (as have all responsible scientific reports) that "there is no evidence to suggest that the problem [of acid rain] is urgent or getting worse." Why then the big push to spend billions—not on research so that we may know what we're doing, but on supposed controls that no one can say will be effective? The Great Acid Rain Debate goes on . . . and on. ☐

[2]This statement, which appeared in the *EPA Journal* (June/July 1986), is particularly curious, since in the same article Mr. Thomas also says: ". . . it is difficult, if not impossible, to predict with any certainty to what extent acid deposition in any specific area would be reduced by emission controls on any specific sources."

THE NATION'S PULSE



REPUBLICANS ARE STUPID

by Fred Barnes

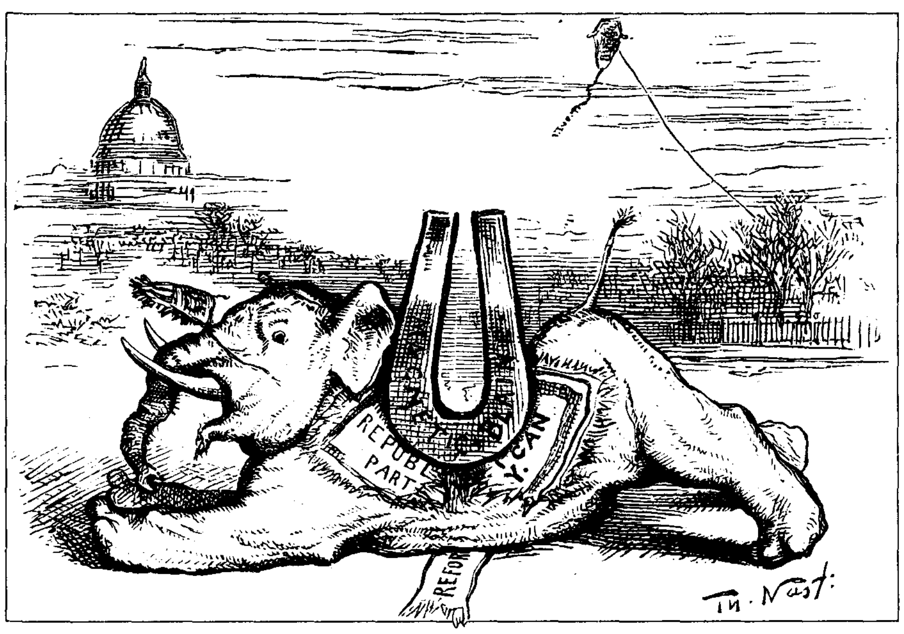
Maybe the dumbest thing said about the 1986 election was that the spate of negative ads on television turned off the voters and drove down turnout to the lowest point in four decades, a measly 37.3 percent of eligible voters. On the contrary, attack ads were practically all there was in the campaign to keep up voters' interest. Imagine how low the turnout in Wisconsin might have dipped if Republican Senator Bob Kasten hadn't gone on the air with a commercial accusing Democrat Ed Garvey of creative bookkeeping as director of the National Football League Players Association, and if Garvey hadn't fired back with an ad consisting of testimonials on his behalf by NFL veterans. The NFL dispute was certainly weightier than much of the campaign dialogue in Wisconsin, which included such bones of contention as Kasten's refusal to hold a joint press conference after a debate with Garvey, the hiring by Garveyites of a gumshoe to investigate Kasten, and Ralph Nader's heroic and high-toned entry into the campaign with the charge that Kasten, once arrested for drunk driving, needed to be "rehabilitated," not re-elected. Compared to this stuff, the thirty-second spots were downright Socratic.

The next dumbest thing said about the campaign was that it was a victory for conservatives and Republicans. True, it wasn't a big setback for the right. The new ideological baseline in American politics established by Ronald Reagan was confirmed once again in the election. America is conservative, but we knew that already. Since voters aren't veering to the left, liberals and Democrats didn't offer up a fresh vision of new spending programs (except for more costly farm subsidies) and an expanded federal government. These people are not suicidal, after all. They craved control of the Senate and did what it took to achieve that. For Republicans, the pain of losing the Senate was eased a bit by gains in governorships. Only a bit, though. In a moment of unwarranted optimism, Donald Regan, the White House chief of staff, noted that the twenty-four states with GOP governors have 270 electoral votes. Big deal. This does not assure a Republican presidential win in 1988. Democrats held the governorships in states with many more than 270 electoral votes in 1980 and 1984, and what good did it do them? Frankly, I was most impressed with the GOP's success in holding down House losses to five. Still, it's hard for Republicans to claim that the eighty-one-vote margin now held by Democrats in the House (258-177) represents a big victory for the GOP. It could have been worse, I admit, but a victory it ain't.

The sad fact of life for Republicans is that Democrats are far better at politics than they are—smarter, quicker on their feet, more flexible, more personally appealing, and I could go on. The conservative trend in America has endured for nearly two decades, and yet the party of welfarism and isolationism hasn't been driven into minority status. Why not? Democrats simply adjust well to whatever political situation faces them. They learn the correct political lessons, sometimes the hard way. Walter Mondale ran on a platform of more taxes and a bigger government in 1984, and lost ignominiously. Democrats weren't about to copy him in 1986.

They made two important decisions in 1985 that aided them immeasurably in the election. One was to give up the idea of trying to impose a tax increase on Reagan. The other was to go along with Reagan's plan for tax reform, though many Democrats had a visceral dislike for dropping the top rate on individual income to 28 percent. In passing tax reform over the objection of the corporate class, Republicans thought they were inoculating themselves against the charge that they represent big business instead of the people. But it turned out that Democrats did the inoculating, freeing themselves from the charge that they are high taxers. And tax reform, rather than being a realigning issue for Republicans, was "the dog that didn't bark" in the 1986 campaign, as Jeffrey Bell of Citizens for America has aptly put it. Look at the House race in Wilkes-Barre, Pennsylvania, where Republican Marc Holtzman spent $1 million against incumbent Democrat Paul Kanjorski. Holtzman rattled Kanjorski with a TV spot saying the congressman had backed "the Democratic tax increase of 1986." This was based on Kanjorski's vote for a budget resolution that called for unspecified new revenues. Since he'd voted for tax reform, Kanjorski had a terrific response. He aired an ad that showed both himself and Reagan, and said: Come on, Marc, the President and I were lowering tax rates in 1986, not raising them. Kanjorski won 71-29 percent.

The most resourceful Democrat of all was Terry Sanford of North Carolina. He saw what happened to James Hunt in the 1984 Senate race, namely that Senator Jesse Helms linked Hunt to the liberal leadership of the national Democratic party. Sanford campaigned *against* the national party. And when Republican James Broyhill revived the old charge that Sanford, as governor in 1961, had imposed a "food tax," Sanford had a strong comeback. He called it a "school tax," saying the money went to improve schools. He thus aligned himself with the ever-popular education reform movement. Better still, Sanford outflanked Broyhill on the supply side. He blamed Broyhill in a TV ad for having voted for "the biggest tax increase in American history" in 1982. The ad worked wonders, mainly because the charge was true. Sanford, a liberal by North Carolina standards, won, and he did it without trying to make those hardy perennials of Democratic campaigns, compassion and giveaway programs, the focal point of the election.



Republicans are stupid. They are always looking for some gimmick to help them win elections. This year, the gimmicks were coattails, technology, and two frivolous issues (drugs and terrorism). For years now, Republicans have failed to understand that it doesn't work to use motherhood issues against Democrats. Economic and national security issues often work, but it's not credible to suggest that Democrats are soft on drug traffickers and terrorists. Democrats only had to list the number of antidrug and antiterrorist bills they'd sponsored. Senator Alan Cranston of California ran an ad consisting entirely of the names of antidrug bills he'd backed. In 1970, Republicans tried the

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