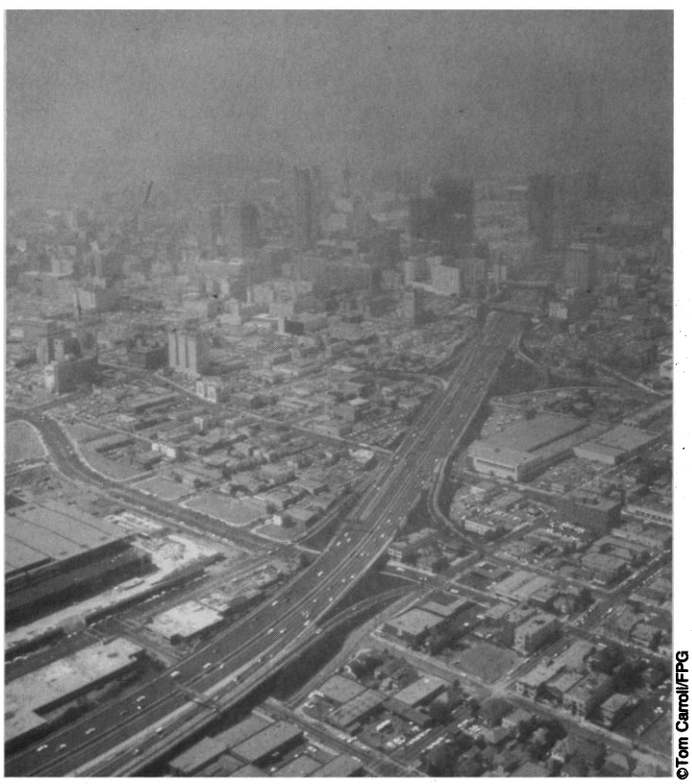
Clean Air? Don't Hold Your Breath

Over the next few months, Congress will try to rewrite the Clean Air Act. Economists argue that existing smog standards are already too costly, while researchers raise new health concerns

PERHAPS LOS ANGELENOS will give up their patio torches, stop driving solo on the freeway, quit buying underarm sprays that use petrochemicals, build no more drive-through banks or restaurants, renounce charcoal lighter fluid, even surrender the backyard charcoal grill. Perhaps.

These and other graces of Southern California life are endangered by a radical new proposal to clean up the city's air. A regional board last month actually adopted a plan that would require inhabitants of Los Angeles to change their ways, stirring hope among environmentalists of achieving some long-neglected goals of the Clean Air Act—a law that has been violated since its enactment in 1970.

Los Angeles, which has the nation's dirtiest air, is the law's worst violator. But it is not the only one. Most big cities cannot meet the federal limit on ozone, the key ingredient in smog. By one estimate, about 20 cities would have to undergo a wrenching overhaul like the one proposed for Los Angeles if they were to try to meet the law in 5 years. The reality is that urban America is not remotely within reach of the standards in the Clean Air Act.



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Los Angeles smog. *A cleanup plan for the city, hailed by some as a model for the rest of the nation, could cost $12 billion a year by 2000 and force Los Angelenos to change their life-styles.*

This stark fact, some economists say, calls not for a drastic revision of life-styles, but for a revision of the law. The law should be rewritten, they argue, to allow the Environmental Protection Agency (EPA) to weigh the costs and benefits of controlling pollutants like ozone and to defer action when meeting the health standard is not urgent. Right now, the law provides no such flexibility.

Just the opposite message comes from EPA's animal research labs in North Carolina and from specialists on lung disease at academic medical centers around the country. The most recent data, collected by Donald Horstman, Lawrence Folinsbee, and William McDonnell in EPA's large air chamber on the Chapel Hill campus of the University of North Carolina, show that the biological effects of ozone can be detected in humans at lower concentrations than ever seen before, well below the federal "enforcement" standard of 0.12 part per million (ppm). And James Crapo at Duke University, using a sophisticated new kind of pathology, found evidence of inflammation and fibrosis in rat lungs after the animals had lived for 18 months in an air-ozone mixture like the summer breezes of Los Angeles.

Most health researchers decline to say what policy implications they see in these findings. Indeed, a scientific advisory committee to EPA could not reach agreement recently on whether to recommend that the existing ozone standards should be toughened in light of the new evidence.

The economists likewise skitter away from the science. At times, the two professional groups seem to talk right past one another, making it hard for lay persons like those who govern the country to know what to make of all the information.

Like it or not, the Bush Administration and Congress will become expert in these technical subtleties over the next few months, for they are facing a deadline on renewal of the Clean Air Act, an action that has already been delayed 2 years (see box on page 518).

On one point, at least, all sides seem to agree: the air in Los Angeles—where ozone sometimes hits triple the federal limit—is so bad that a cleanup should begin immediately. Washington will be watching what happens in Southern California closely.

A jab from environmentalists in the form of a lawsuit started the region moving toward cleaner air this spring. On 17 March, California's South Coast Air Quality Management District voted overwhelmingly to adopt a new attack on ozone, a highly reactive form of oxygen.

Paints, glues, and pesticides would be reformulated to reduce volatile hydrocarbons. Buses and cars would be electrified. New transit systems would be built. Fleets of methanol- and ethanol-fueled autos would be deployed. (These fuels contain more oxygen than gasoline and burn more completely.) Major new controls would be imposed on all kinds of public and private activities, at the rate of 30 to 40 significant measures per year for the next 20 years, according to a regional EPA official. This seems to be the only way to achieve the 70 to 80% decrease in emissions that will be needed to meet U.S. pollution standards.

The Los Angeles plan has been hailed as a guide to the rest of the nation, as the *New York Times* editorialized, "a model and an inspiration to Washington." But there are some tough questions about its feasibility, about the commitment of local governments to carry it out, and about its cost.

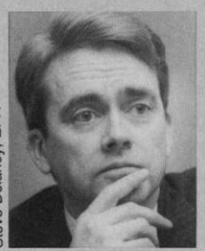
Paul Portney, an economist at Resources

The Political Battle Over Clean Air

Some of the nation's most powerful lobbies will be battling it out this summer, as Congress takes on the Herculean task of rewriting the Clean Air Act, the basic law that sets the ground rules for combating air pollution. Billions of dollars will rest on how lawmakers deal with issues on which scientists, economists, industrialists, and environmentalists give conflicting advice.

The Reagan Administration never came up with any proposals for rewriting the act, and Congress last year failed to produce a bill of its own. The law technically expired last August. This year, everybody involved claims it will be different.

The Bush Administration has promised to produce a draft bill by the end of May. It is being written in the White House by a team that includes William Reilly, administrator of the Environmental Protection Agency (EPA), White House Counsel C. Boyden Gray, Robert Grady of the Office of Management and Budget, and Nancy Maloley of the President's Domestic Policy Council staff. Little information about it has leaked out, aside from the fact, according to Grady, that it will seek to use "market incentives" to steer industry in a less polluting direction. It will also promote the use of methanol and ethanol as clean-burning substitutes for gasoline.



Steve Delaney, EPA

William Reilly

On Capitol Hill, a motley crew of public health advocates, coal state members, environmentalists, and friends of the oil and auto industries will try to make a single law out of a variety of concerns. Key players among the dozen who will steer the debate are Senators George Mitchell (D–ME), the majority leader and a strong environmentalist, Max Baucus (D–MT), chairman of the Senate subcommittee on environmental protection, and coal state leaders such as Robert Byrd (D–WV). Leaders in the House include Representatives Henry Waxman (D–CA), chairman of the House energy subcommittee on health, and John Dingell (D–MI), chairman of the House Energy Committee.

The bill will focus on three broad classes of pollutants, as follows:

■ **The "Criteria Pollutants."** Ozone at low altitude in smog is the outstanding problem to be addressed in this category, which includes six chemicals tagged for attention in the Clean Air Act 19 years ago. The other five are lead, carbon monoxide, nitrogen oxides, sulfur dioxide, and airborne particulates.

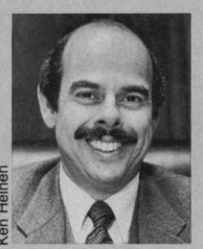
Ozone is the most troublesome because it is the only one that has not yielded substantially to previous controls. In 1988, 96 districts and more than one-third of the U.S. population were in areas that violate the federal safe standard for ozone. (Many of the same areas violate the carbon monoxide limit.) The challenge will be to go after sources of volatile organic compounds that have not already been regulated. This means moving from controls on big, impersonal items—the design of petroleum refineries, gas stations, and car engines—to small sources that are part of peoples' daily lives—such as compelling car owners to keep engines tuned and banning the use of charcoal lighter fluid. The debate may focus not just on the degree of new enforcement needed but on the justification for it (see accompanying story).

Apart from ozone, EPA reports that it has made progress in controlling most criteria pollutants. In March, the agency reported that between 1978 and 1987, its monitoring program showed that the level of airborne lead was down 88%; carbon monoxide 32%; nitrogen oxides, 12%; sulfur dioxide, 35%; and particulate matter, 21%.

■ **Air Toxics.** Members of Congress are jostling to be the leader in the attack on this beast, introducing bills that would control 200 hazardous industrial chemicals not specifically identified in the law. The movement began several years ago after a gas leak at a Union Carbide plant in Bhopal, India, killed more than 2000 people.

Representative Henry Waxman (D–CA) in March gave out the results of a 1987 EPA survey—the first of its kind—covering 300 types of industrial chemicals in the United States. About 2.4 billion pounds of these toxic compounds were released into the air in 1987, including many carcinogens and neurotoxins. "The magnitude of the problem exceeds our worst fears," Waxman said. EPA has authority to control these chemicals, but has issued regulations only on seven.

This figure understates the progress so far, EPA officials claim. Don Clay, EPA's number two air quality official, says that controls on the old criteria pollutants have already reduced toxic emissions by 40% in the last decade. EPA thinks the trend would continue to improve even if there were no new legislation. The pace of regulation in the past has been slowed, Clay says, by a requirement in the Clean Air Act that EPA proceed on a chemical-by-chemical basis. The agency will ask for a change in the law permitting it to go forward on an industry-by-industry basis, controlling in one action all the emissions at each site. Bills in Congress take a broader approach, requiring that the "best available control technology" be installed at all industrial polluters above a certain size.



Ken Heinen

Henry Waxman

Three years ago, EPA took a quick look at the problem by examining the theoretical cancer risks posed by 45 airborne toxic chemicals. The findings: air toxics may have caused as many as 2000 cases of cancer that year—less than 0.01% of the total cases. The largest single clump of risk was associated with "products of incomplete combustion," including auto exhaust. Most of the sources were small and widely dispersed, but the study found that a small number of people live near some big, high-risk polluters.

■ **Acid Rain.** Both the President and EPA chief Reilly have said that the time for analysis is over and that the Administration will work to reduce emissions of sulfur dioxide and nitrogen oxides more rapidly. This idea is more popular than ozone control because it focuses the attack on utilities and industries, not on consumers.

Its scientific basis lies in evidence collected during half a century which shows that water and sediments in eastern lakes have become more acid at the same time that industrial sulfur emissions increased. The change in water chemistry, the National Research Council reported in a 1986 study, appears to be killing off acid-sensitive fish. It reported that forests may be suffering as well, but the evidence here is equivocal.

Environmentalists have set as their goal a minimum reduction in annual sulfur dioxide emissions of 12 million tons by 2000. The Bush Administration pledges only that the number will be "millions of tons." ■ **E.M.**

Steve Delaney, EPA

The "brute force method" of control may exacerbate the problem.

—Milton Russell

for the Future, a Washington, D.C., think tank, made this point at a recent meeting in Boston attended by health researchers. The Los Angeles plan is structured in three tiers, only the first of which has been costed out, in part. This tier would take the city one-third of the way toward compliance with the ozone standard. Portney told the Boston crowd that it would cost about $4 billion per year, and that each successive tier would be more radical and perhaps more expensive than the one before. By 2000, it would cost Californians $12 billion a year. "Think of what you can get for $12 billion," Portney says. He suggests the money might be put into other pro-health accounts such as food stamps (1989 national cost: $12.8 billion), infant food supplements ($1.9 billion), child nutrition programs ($4.6 billion), or community health centers ($400 million). When Portney said this in Boston, "People went bonkers," he recalls.

Milton Russell, another economist, quotes Office of Technology Assessment numbers suggesting that it could cost the nation $10 billion to $20 billion per year to put into force a modest plan to meet existing standards. This is more than the acid rain control bills in Congress are expected to cost. Tightening the ozone standard, as some members of EPA's Clean Air Scientific Advisory Committee are recommending, would raise the cost further.

Russell, who headed EPA's policy office in the mid-1980s and now works at the University of Tennessee and Oak Ridge National Laboratory, wrote in a report last fall that the "brute-force" method of lowering ozone precursor emissions across the nation "may exacerbate rather than improve the problem." If local officials see no clear advantage in complying with the law and balk, it could "set the government on a course of failure," leading to scorn for environmental controls in general. He pleads for realism, or at least some relaxation of the rigid health standards of the Clean Air Act.

According to law, the ozone concentration should not exceed 0.12 ppm, averaged over 1 hour, on more than 3 days in 3 years. This standard, set in 1979, is based on research done in the 1970s that reported ozone effects in humans at 0.15 ppm. The official limit was set a smidgen lower for the "margin of safety" required by law. A duration of 1 hour was chosen because it seemed the best way to focus attention on acute exposure of the kind in Los Angeles, where the ozone concentration quickly reaches high peaks in the rush hour, then drops.

The effects of low ozone doses were established by watching athletes perform in a smoggy atmosphere at the University of California at Davis in the 1970s. Those early measurements have been confirmed and strengthened by air chamber studies. Until recently, the procedure usually called for a volunteer—often a young athlete—to exercise near the top of capacity in an air and ozone mixture for an hour. (Later studies use less ozone and run longer, with plans now for a marathon 8-hour test.) Afterward, the subject blows into a tube attached to a meter. The consistent result: the volunteer cannot take as deep a breath after the ozone dose as before. If the exposure is repeated a second day, the effect increases.

There is a distinct group of people who are particularly sensitive to ozone, as recent research shows, not necessarily the same ones who suffer from asthma, allergies, or other lung diseases. Some asthmatic are affected strongly by ozone; others are not. The evidence from the lab does not seem to link ozone to any particular disease, although some epidemiological studies indicate that asthmatics are admitted to hospitals more frequently during heavy pollution.

The sensitive people show marked symptoms after a moderate dose of ozone—burning in the chest, coughing, wheezing, and sometimes sharp pain. Their loss of deep breathing capacity, or "lung function," can be 25% or so. The more common response to low doses of ozone among nonsensitive people is a lung capacity loss of less than 10%.

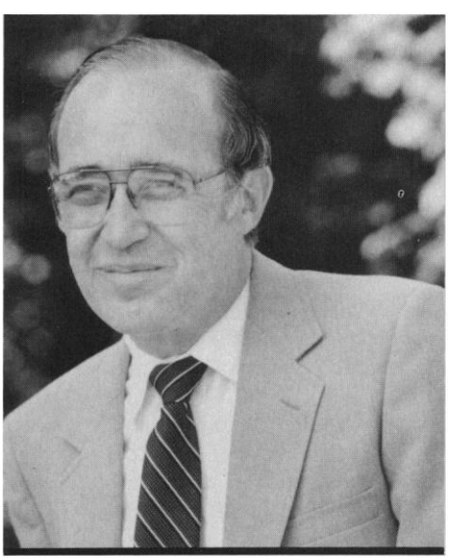
If the ozone exposure is continued through 4 or 5 days, a puzzling thing happens. The lungs seem to toughen or adapt, and breathing returns to normal. Lab animals follow much the same pattern. Weeks later, if the volunteer has been kept off ozone and is re-exposed, the cycle goes back to day one, revealing a loss of lung function again.

This effect is easiest to detect in healthy, heavily exercising young people. Cigarette smokers, for example, do not seem to be affected. Nor do older people exhibit a striking response, perhaps because their lungs are stiffer, a result of aging.

To some, this suggests that the lungs of the youthful ozone initiate are just being toughened up to meet the real challenges of life, in the way muscle fibers are torn during exercise, leading to greater strength.

Kenneth Gross, a physiologist in General Motors' biomedical research department, says: "Change doesn't necessarily mean there is an adverse health effect. If you consider change to be adverse, then living is adverse to your health." He continues: "A small change in lung function that can't be perceived by the person and is reversible in a couple of hours—I'm not sure what that means for public health."

But other data, particularly studies of animal lungs, support a different view. The short-term loss, although reversible, may be part of a pattern that leads to stiffer, less efficient lungs earlier in life. Bernard Goldstein, former chief of research at EPA, now at Rutgers University, says it may be analogous to "scratching yourself in the same place over and over again; you're going to



"We haven't got the foggiest idea how to meet the existing standard."

—Bernard Goldstein

get scar formation."

Evidence on this side of the argument comes from the Duke University laboratory of James Crapo, who made a close—and his colleagues say, "elegant"—analysis of changes in the small airway region of rat lungs. The test animals lived in a chamber for 18 months where the ozone concentrations resembled Los Angeles' worst. He used a highly quantitative form of pathology, "morphometric analysis," to look at changes in the lungs. He found a response that increased with time of exposure consisting of changes in epithelial "type one" cells, along with a slight increase in fibrotic tissue in the lung interstitium. It suggests that the changes may be cumulative and irreversible. Says Crapo: "It raises a measure of concern that we need to follow up on."

The data are not directly applicable to human health standards, however, because rats are different from people. Research at EPA is now focused on finding out just how different they are in their response to ozone, which will make the data more useful.

Meanwhile, clinical experiments with humans are moving in a new direction. Goldstein says: "What's new is a focus on the fact that in reality people are being exposed for longer than 1 hour because the ozone levels persist through the day. We in the scientific community have been remiss in focusing on short-term standards."

Morton Lippmann of the New York University Medical Center took a new tack in field research, his peers say, when he went to summer camps in New Jersey in 1985 and tested children exercising each day in a smoggy environment. The surprising result: the loss of lung function in these kids was almost as large as for volunteers exercising in air chambers for 6 hours. Lippmann thinks that ozone's effects may be cumulative. He also suspects that something in the real environment—probably suspended acid—works with ozone to stress the lung doubly.

This finding is questioned by Gross, the GM researcher, who says other summer camp studies in California reveal a smaller, but still a detectable, loss of lung function.

Recently, research on human volunteers at the EPA labs in North Carolina used a longer (6.6-hour) exposure in chambers to mimic the duration of a bad ozone day on the East Coast. The result: a loss of lung function is being detected at lower ozone concentrations, down to about 0.08 ppm.

Citing these results, Lippmann argues that the long, moderate smog storms typical of the eastern summer may be as threatening—particularly because of their high acid content—as the short, severe blasts in Los Angeles. Lippmann and Goldstein argue that the old 1-hour standard should be replaced with an 8-hour version, even though it would be harder and more expensive to meet. Goldstein says: "Since we haven't got the foggiest idea of how to meet the existing standard, we might as well have the right target to shoot at."

Epidemiological studies suggest that people living for many years in a high-ozone area may experience a slightly more rapid aging of the lungs. One much cited study by Roger Detels at the University of California at Los Angeles found a slight deterioration of lung function among residents of the smoggy Glendora neighborhood after 5 years. But, his colleagues say, there are methodological flaws in the study. Robert Frank of the Johns Hopkins University School of Public Health says: "I have felt that in an area like Los Angeles . . . these people are very much at risk for accelerated aging of their lungs. But even if that were true, our epidemiologic instruments to date have been so blunt that they couldn't have detected it."

The EPA's Clean Air Scientific Advisory Committee looked at these issues last winter and found it could not agree on whether to tighten the ozone standard or leave it alone. No one proposed to relax it. Unable to reach a consensus, "We wrote a unique closure letter to the administrator" of EPA, says Roger McClellan, president of the Chemical Industry Institute of Toxicology and the committee's chairman. "We told him that the data are still evolving and that there was a range of opinion on the committee." Half the members wanted to reduce the upper limit from 0.12 ppm to 0.10 ppm, and half insisted on keeping it at 0.12 ppm. However, the group did agree to ask EPA to consider shifting to an 8-hour standard in the future and to investigate the health risks of acid aerosols.

Opinion is divided even among the toxicologists. This makes it hard on Congress which has twice put off action and delayed deadlines for bringing states into compliance with the Clean Air Act. The last deadline expired in August 1988.

If Congress is at a loss, regulators are further out to sea. "We really have no guidance for what we're supposed to do," says David Howekamp, an EPA regional official in California. "We're supposed to pick a new date" for compliance, but Congress has given no inkling of what it should be.

EPA is being forced to take action in California in any case, because several environmental groups sued on grounds that the agency had ignored the Clean Air Act. They won a federal decision ordering EPA to step in with its own air control plan for Los Angeles. A draft is due in April 1990.

The suit may have helped spur the local planning board to action in an attempt to retain local control of the situation. Scores of other cities are waiting to hear from Congress whether they, too, will be asked to adopt the rigorous approach of the Los Angeles plan. It looks as though Congress will have to steel itself to make a decision.

■ ELIOT MARSHALL

NIH Reopens Baltimore Inquiry

Saying that it has new information in the controversy over a 1986 paper in *Cell* coauthored by Nobel laureate David Baltimore, the National Institutes of Health decided last week to reopen its investigation of the case. NIH's decision comes just days before Representative John Dingell (D–MI) will hold a congressional hearing on the controversy (*Science*, 28 April, p. 412).

NIH director James B. Wyngaarden told *Science* that allegations by postdoc Margot O'Toole have escalated and "become more precise." In fact, Wyngaarden says, "in at least one striking instance" there appear to be no data to back up one of the points on a published graph.

Earlier this year, a three-member panel of immunologists appointed by NIH exonerated Baltimore and his collaborators of fraud or misconduct. However, the panel did report finding "significant errors" in the paper that affected the details but not the general drift of the experimental results. The panel, chaired by Joseph M. Davie of Searle, "did not do a point by point audit" of the data, Wyngaarden acknowledged. Rather, panel members scrutinized the data in lab notebooks that pertained to the central scientific message of the paper—namely that immune cell production in the Black mouse is affected by a transgene from a BALB/c mouse. Now, the panel will be reconvened to conduct a thorough audit of the data.

Baltimore has been briefed by Dingell's staff of what to expect at the hearings. "The subcommittee has a good dog and pony show," Baltimore says, "but it doesn't change my view about the overall validity of the paper one bit." But Dingell is expected to want to know why the missing data were not spotted before now, since the case has been under investigation for the past 2 years.

■ BARBARA J. CULLITON