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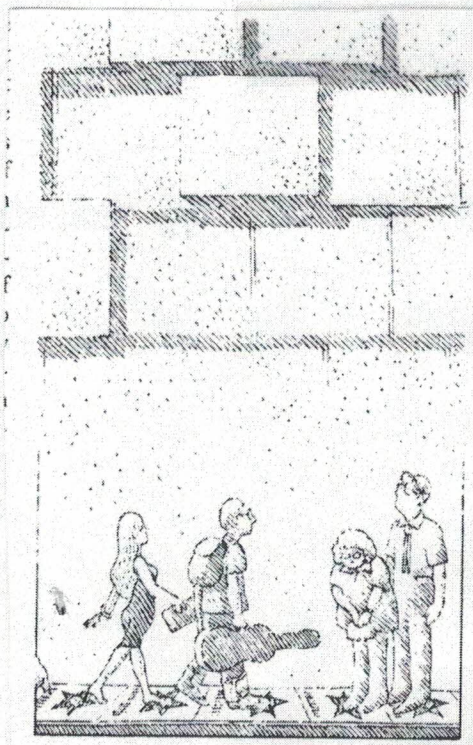


ENVIRONMENT

FIGHTING FOR CLEANER AIR

The use of automobiles must be regulated if Los Angeles is to win its war against smog

AMONG THE FIRST things to suffer was the parsley crop in the Los Angeles Basin during the Second World War. The leaves turned bronze and withered. Orange trees in the area began to produce less fruit at about the same time. And, perhaps most disturbing of all, rubber automobile tires began to crack while they were still new.

The prime suspect was the brownish haze that during the summers in the 1940s had begun to sting people's eyes and shroud the mountains surrounding the basin. The haze, which looked like a mixture of smoke and fog, was dubbed smog. Many Southern Californians put the blame on the region's huge refineries and their smoldering effusion. More than a decade passed—and the problem grew so serious that eye-irritation forecasts were the lead item in daily weather reports—before the experts agreed that smog's key ingredients were supplied in abundance by automobiles.

The term *smog* has stuck, though the air pollution plaguing most American cities is now known to consist of several different problems, including carbon monoxide, particulates, and, most intractable of all, ozone, a highly reactive form of oxygen that hampers lung performance and destroys the molecular bonds in leaves, plastics, and other materials. This colorless gas is a secondary pollutant, produced photochemically: it emerges in the atmosphere when sunlight irradiates a mixture of hydrocarbons and oxides of nitrogen, which are both among the major components of exhaust from engines fueled by gasoline. Smog contains hundreds of other, minor constituents. The chemical stew cooks in the sun, spinning off new substances in chain reactions that go on for days. Researchers so far have catalogued about a thousand different reactions in smog. These, combined with the vagaries of the weather, make smog a phenomenon so complex that supercomputers can only crudely simulate its behavior.

With its burgeoning population and perpetual sunshine, Los Angeles will most likely never be displaced as the smoggiest city in the nation. But the air in the basin today is cleaner than it has been in half a century. Lead and the compounds that made stinging eyes a hallmark of life in Los Angeles in the 1950s have been virtually eliminated. And in 1986 and 1987 only one inland suburb was hit with a second-stage smog alert—signifying a seriously health-threatening condition that occurs when the ozone level slips above .35 parts per million parts of air (ppm). In 1980 alone twenty-one such alerts occurred. The ozone level is so consistently high, however, that for five months out of every year some inland parts of the basin exceed the maximum federal ozone standard of .12 ppm.

Ozone is not nearly so severe a problem in any other city in the United States, but in 1987 sixty-eight urban areas had ozone levels in excess of the federal standard, which all cities were

supposed to have met by the end of the year, under an extended deadline of the Clean Air Act. Sunny, vehicle-clogged foreign metropolises like Mexico City and Athens now have the world's worst air. In Latin America and Europe, where cars are still largely exempt from emissions controls, automobile exhaust is a far greater contributor to the overall air-pollution problem than it is in the United States, according to Michael Walsh, a former director of the Environmental Protection Agency's motor-vehicle program and now an international air-pollution consultant.

Environmental regulators everywhere have found that smog is a wily adversary. It is so complex that some "solutions" have been found to exacerbate problems downwind. Even more troublesome, the single most important source of smog is the widely beloved automobile.

The machine itself—though not by a long shot those who drive it—was first brought under control in California. The California Motor Vehicle Control Board and later the California Air Resources Board forced the automobile industry to enter the unexplored world of crankcase blowback devices, afterburners, and catalytic converters; the Environmental Protection Agency eventually adopted California's tough emissions-control regimen. The cleanup has cut sharply emissions of nitrogen oxides and carbon monoxide. And the eight million vehicles in the Los Angeles Basin today emit no more hydrocarbons than two and a half million vehicles in the basin emitted in 1954.

SUCH PROGRESS DIDN'T come easily. From the days of the first discoveries about smog, scientists and regulators in Los Angeles and elsewhere have had to fight against public sentiment—often encouraged by the oil and automobile industries—which sought to exonerate the automobile.

Louis McCabe, Los Angeles's first smog commissioner, epitomized the spirit of the day. Formerly the "smoke commissioner" in St. Louis, McCabe was lured west in 1947, to become the first director of the newly created Los Angeles County Air Pollution Control District. He mounted a spirited attack on refineries, and then moved on to a new job after two years, confident that he had set the city on a course that would soon free it from smog. The burgeoning number of cars didn't matter, he believed. "I do not mean to imply that

improperly operated and obsolete motor vehicles should be allowed to pollute the atmosphere; they should not," McCabe said at the first National Air Pollution Symposium, held in Pasadena in 1949, shortly after he had become the chief of the Office of Air and Stream Pollution for the Bureau of Mines. "But neither should folklore be encouraged that will place the onus of metropolitan-area atmospheric pollution on the automobile, without proof."

McCabe's actions during his tenure as smog commissioner were nonetheless beneficial. By 1954 the refineries in the Los Angeles Basin were exuding 250 tons of hydrocarbons a day, down from 650 tons a day in the 1940s. The smog, however, was much worse. Automobiles were producing four times more hydrocarbon emissions than oil-industry facilities. Still, few accepted the bitter truth about smog.

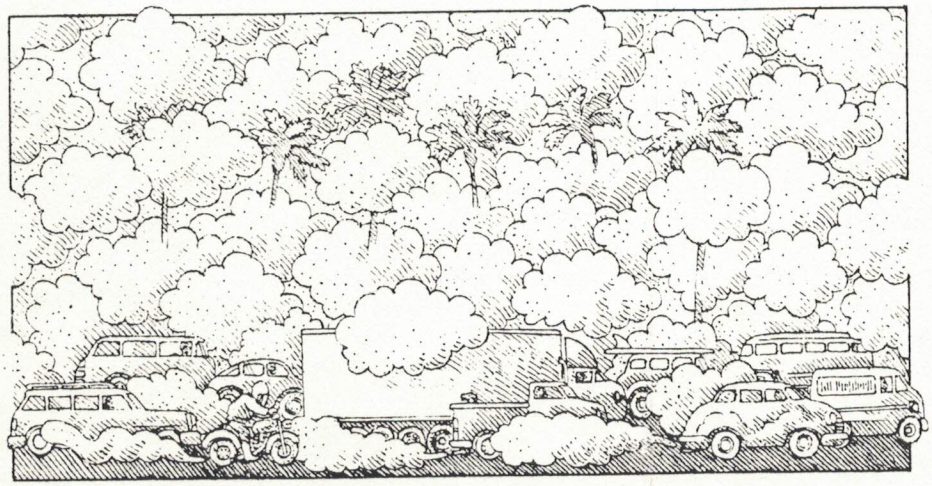
The basics of smog formation were first described in 1950, by Arie Jan Haagen-Smit, a chemist at the California Institute of Technology. Haagen-Smit had suspected early on that the haze wasn't emitted by anything but instead was created in the atmosphere. He mixed combinations of chemicals in flasks and placed them in the sun in a quest for the recipe for smog. When bent strips of rubber placed in flasks containing a concoction of hydrocarbons and nitrogen oxides cracked within minutes of exposure to the sun, Haagen-Smit knew he had found what he was looking for.

At the time, many other experts were unconvinced by Haagen-Smit's theory about the photochemical origins of smog. Vance Jenkins, the research supervisor for the Union Oil Company of California, warned at a meeting of the American Petroleum Institute in 1952 that this "unproved speculation" of Haagen-Smit's would bring nothing but grief to the oil industry and, further, that it should be immediately abandoned in favor of a theory that "correctly evaluates the contributions of automotive exhausts" to smog. "Don't look now, but that shadow you see is not from a smoking stack," Jenkins said in an address to members of the API's refining division. "It is the shadow of the policeman who already has his hand on the shoulder of the petroleum industry in Los Angeles County."

By the mid-1950s, however, the evidence supporting Haagen-Smit's theory was unequivocal. The theory received unanimous support at scientific confer-

ences in 1955 and 1956. But neither that development nor the worst-ever smog siege, in October of 1954, which caused children's eyes to swell and brought angry housewives with placards and gas masks into the streets of Pasadena, stopped the search for a magic cure that would leave the automobile untouched.

Some visionaries insisted that the smog could be disposed of simply by breaking the temperature inversion that hangs over Los Angeles like a lid of hot air, created by the sunshine and held in place by the high-pressure zone that prevails for three quarters of the year. Morris Neiburger, the senior meteorologist at the Air Pollution Foundation, and later the chairman of the meteorology department at UCLA, brought the promoters of such grandiose plans to reality. You could break the inversion by shooting cool air down through it with helicopters, Neiburger said, in a paper published in 1957, referring to one proposal for doing away with smog, among the dozens he had carefully studied. But to reduce the concentration of pollutants by half would take ten large helicopters per square kilometer across the 4,000-square-kilometer basin.



Neiburger's arithmetic also put to rest notions about deploying huge fans to suck the smog out of the basin through "smoqueducts" over, or tunnels through, the mountains. Neiburger estimated that the polluted air beneath the inversion could weigh anywhere from 200 million to two billion tons, depending on how low the base of the inversion dipped on a given day. This meant that every day the fans would have to move smog weighing at least twice as much as all the steel produced in the United States in a year.

Among a scattered band of smog researchers the search continues for an ultimate solution. Julian Heicklen, a well-respected atmospheric chemist at Pennsylvania State University, has suggested that a smog-inhibiting chemical could be released into the air to upset the photochemistry of ozone formation. But his idea has never gotten a practical field test. "Many of us have a somewhat negative reaction to a proposal to release something into the air to solve a problem caused by releasing something into the air in the first place," Derek C. Montague, an atmospheric scientist at the University of Wyoming, observes.

SMOG REGULATORS and scientists have developed enough respect for smog to know that it should be attacked warily. Some of the first attempts at fighting it were disasters. For example, air pumps, required for the first time, in California, on 1966-model cars, were designed to produce hotter combustion that would leave fewer unburned hydrocarbons as waste. Indeed, that's what happened. But the output of nitrogen oxides—created in larger quantities by high-temperature combustion—doubled. (Chemists later learned that one of the nitrogen oxides undergoes a photochemical reaction in the atmosphere to form nitric acid, a substance that forms a brand of acid rain and fog as destructive in some areas as the more-familiar sulfuric-acid variety.)

The mistakes didn't deter California regulators from trying new ideas. The California Air Resources Board was created in 1967 to set emissions standards for mobile sources of pollution. Its increasingly stringent requirements eventually forced most automakers wishing to do business in California after 1975 to equip their cars with catalytic converters designed to cut hydrocarbon emissions. One vehement opponent of the proposed standards was the oil industry—which faced having to scour every bit of lead from tanks and pipelines in order to produce the pure unleaded fuel the devices needed. "I saw a president of a major oil company sit there and say we couldn't use catalysts because the oil industry couldn't switch to unleaded fuel—he said it couldn't be done," recalls an atmospheric chemist who served on a panel of advisers for the ARB when the tough new standards were proposed. "Well, guess what? That company, which shall remain unnamed, sells unleaded fuel."

The three-way catalytic converters now required throughout the United States and Canada, and in several other countries, have drawbacks—primarily the need for regular checkups to be sure they are working, and the expense of replacement if they aren't. But they do cut emissions of hydrocarbons, nitrogen oxides, and carbon monoxide. Catalytic converters may well have saved the city of Los Angeles. "If all the cars on the road today were 1950s cars," says Art Davidson, a spokesman for the South Coast Air Quality Management District, parts of Los Angeles "would actually be uninhabitable in the summer when the ventilation is bad."

Some cities elsewhere in the world are rapidly heading toward that point. "It's hard to get precise air-quality data, but it appears that Mexico City exceeds our federal ozone standard every day of the year," says Michael Walsh, the former director of the EPA's motor-vehicles program. During the temperature inversions that frequently hover over the city in winter, ozone levels soar above the .40 ppm level. "Many people in Mexico City suffer from air pollution," Walsh says. "We're not talking about subtle effects, either."

A number of other cities fall into the same class as Mexico City—Athens, Bangkok, and Santiago, Chile, for example. Many others, including New Delhi, aren't far behind. The streets of the Indian capital are clogged with more than a million vehicles, and 300 more join the throng each day. Their exhaust is every bit as noxious as that produced by the American cars of thirty or forty years ago. "It's getting worse every day," Jag Pravesh Chandra, the head of the Delhi Executive Council and the top elected official in New Delhi, recently told *The New York Times*. "At this rate, Delhi will

become an unlivable city." Though half the air pollution in New Delhi is attributable to vehicle exhaust, India has no auto-emissions regulations at all.

Most of the countries of Europe, where sulfates from burning coal have traditionally been the most troublesome air pollutant, have also long hesitated to attack their significant automotive-smog problems. The European Community just last December capped years of debate on auto-emissions controls by adopting an advisory measure recommending that each member country require three-way catalytic converters on cars with engines of two liters or more—but only about 10 percent of the cars on the road in Europe have engines that large.

CALIFORNIA'S AIR-pollution-control rules remain the most comprehensive in the world. In more than two decades of steadily tougher auto-emissions regulations almost all of the pollution that can economically be squeezed out of gasoline-powered-engine exhaust has been removed. The South Coast Air Quality Management District was the first agency to mandate such things as vapor-recovery systems on gasoline pumps and emissions controls for dry-cleaning shops. It is now zeroing in on smog-producing emissions from bakeries, swimming-pool heaters, and open-pit barbecues.

In an aggressive new program, launched last January by the AQMD's governing board (which consists of eleven representatives selected by governmental entities in the region), fleet operators, such as bus companies and rental-car firms, will be required to buy cars running on electricity or cleaner-burning fuels starting in 1993. However, methanol, the best alternative currently available, is far from a panacea. Methanol-fueled vehicles emit the same quantity of nitrogen oxides that gasoline-powered ones do. And in lieu of hydrocarbons they spew aldehydes, which are quite reactive photochemically and also probably carcinogenic. Refinements of methanol-fueled engines may mitigate these problems.

The array of technological controls, for the most part already implemented and proved effective in Los Angeles, is good news for cities around the world that have only recently acknowledged their smog problem and that have just begun searching for solutions. But Los Angeles has lost confidence that purely technological solutions will be enough. From now on, the air can only get worse—population growth in the basin over the next twenty years is projected at four to five million—unless the AQMD plunges into a new frontier of regulatory behavior.

Another bold initiative launched by the AQMD board in January promises to shift the brunt of regulatory attention from cars onto their drivers. Controls on driving are old hat in other parts of the world, where cars have never become most people's sole means of urban transportation. Singapore, for example, bans most private vehicles from large sections of its downtown. Santiago uses a license-plate code system to keep 20 percent of all cars off the roads on any given day. In Los Angeles this past summer, phase one of a car-pool rule was scheduled to begin. Aimed at increasing the car-occupancy rate, hitherto 1.1 passengers per car, the rule forced every business with a hundred or more employees to set up a ride-sharing program and offer its employees positive incentives to join a car pool, take public transportation, or ride a bicycle. The future will hold far more than that in the way of controls on driving. Regulators are discussing the possibility of ordering staggered work hours, banning drive-through service at fast-food restaurants, and even suing the state department of transportation to force it to set aside more freeway lanes for cars with more than one occupant (after considerable wrangling, some lanes have recently been set aside on a few of the most crowded freeways).

Angelenos won't readily give up the mobility that the automobile offers. Previous AQMD boards have shied away from car-pool rules, multi-passenger (or "diamond") lanes, and other controls that would constrain the Southern California life-style. But the region's smog regulators have overcome difficult obstacles in the past. And the current board, goaded by the threat of sanctions, including growth controls, if the region doesn't continue to move toward meeting the EPA's guidelines, appears undaunted by the toughest opposition yet, in its latest campaign. "We're interested in. . . creating a situation where people do less driving to live their lives," said James Lents, the AQMD executive director, at a press conference last fall. "It's a very new area for us . . . and one that will touch every aspect of life in the Los Angeles Basin."

—Mark Thompson