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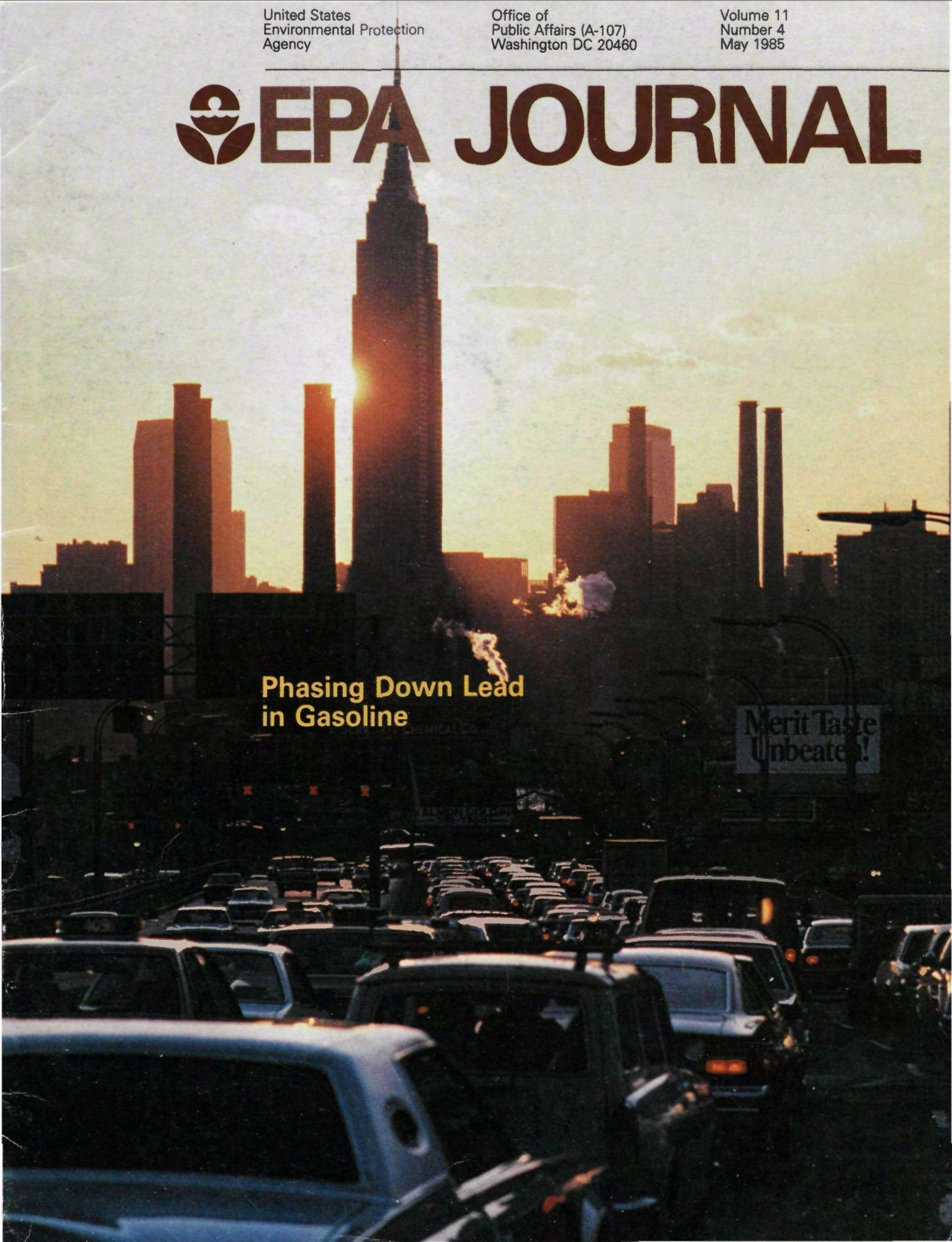

Phasing Down Lead in Gasoline

Gene Young, D. C. Dept. of Recreation

EPA's decision to lower the lead content of U.S. gasoline will help protect children, who are most susceptible to lead poisoning.

Phasing Down Lead in Gasoline

In a far-reaching action to protect public health and the environment, EPA is phasing down lead in gasoline. In this issue, *EPA Journal* explores the step and what it means to Americans.

The first article explains the lead phasedown decision. The second story reports on two major factors motivating the decision—fuel switching and engine tampering. The third article discusses the phase-down's benefits and costs to society and how they were analyzed and weighed at EPA.

In an interview, a key EPA official explains the strong and still accumulating evidence on the health dangers from lead in gasoline. The next feature reports on the close relationship between lead levels in gasoline and the lead count in blood.

The popular but often disastrous use of lead from ancient times to the automobile age is traced in a special report putting lead's dangers in historical perspective. Another article explains how some other nations are phasing down use of the compound in automobile fuel.

Focusing on other topics, the *Journal* chronicles a day in the life of EPA Administrator Lee M. Thomas. This is another in a series in the magazine profiling various figures at EPA. Also included is a story by an experienced observer reflecting on the history of the nation's air cleanup effort and recommending future steps. Another article on air quality reports on steps EPA Region 9 is taking to deal with the tenacious smog in Los Angeles.

An article from EPA Region 2 reports on the steps taken to deal with a recent ground-water pollution emergency on Long Island. The piece is the eighth in a *Journal* series on actions by the agency's regional offices.

Concluding the issue are two regular features—Update and Appointments at EPA. □

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EPA's Lead Phasedown Action

by Richard Wilson

EPA experts predict that the standard will, in 1986 alone, spare 172,000 children from adverse health effects.

EPA's recently announced decision to lower the lead content of U.S. gasoline by 90 percent is the greatest single step the agency has taken toward the ultimate goal of eliminating lead in gasoline as a public health hazard. And that goal is, in itself, one of the most important and challenging EPA has pursued in its 15-year history.

At a press conference on March 4, EPA Administrator Lee Thomas announced the timetable for the latest initiative in the agency's decade-long effort to phase down the lead content of U.S. gasoline. EPA's current standard is 1.1 grams per leaded gallon (gplg) of gasoline. That will drop to 0.5 gplg on July 1, 1985. On January 1, 1986, the standard will go down to 0.1 gplg, a level 90 percent lower than the current standard.

"There is no doubt in my mind," Thomas told the media, "that lead in the environment is still a major public health problem, and that leaded gasoline is a major contributor to lead exposure. Our goal today is to reduce this threat to the health of Americans everywhere, especially our children, as quickly as possible."

Health Effects

The positive health effects of the lowered lead standard are extremely compelling. EPA experts predict that the 0.1 gplg standard will, in 1986 alone, spare 172,000 children from adverse health effects ranging from anemia and behavior disorders to mental retardation and nerve damage. That is the number of children whose blood lead levels will drop below 25 micrograms per deciliter (ug/dl). Twenty-five ug/dl is the blood lead level the federal Centers for Disease Control recently set as the dividing line above which further testing and possible medical treatment are indicated and below which they are not.

(Wilson is Director of EPA's Office of Mobile Sources.)

Adults have a greater tolerance for lead than children since their bodies and organs are fully developed. However, the adverse effects known to result when adults are exposed to lead are not always minor. Symptoms range from headaches and irritability at low blood lead levels to stupor, coma, and brain damage at blood lead levels above 100 ug/dl. Fortunately, there is some evidence that the ill effects of lead intoxication are reversible, at least among adults, once the source of the poison is removed.

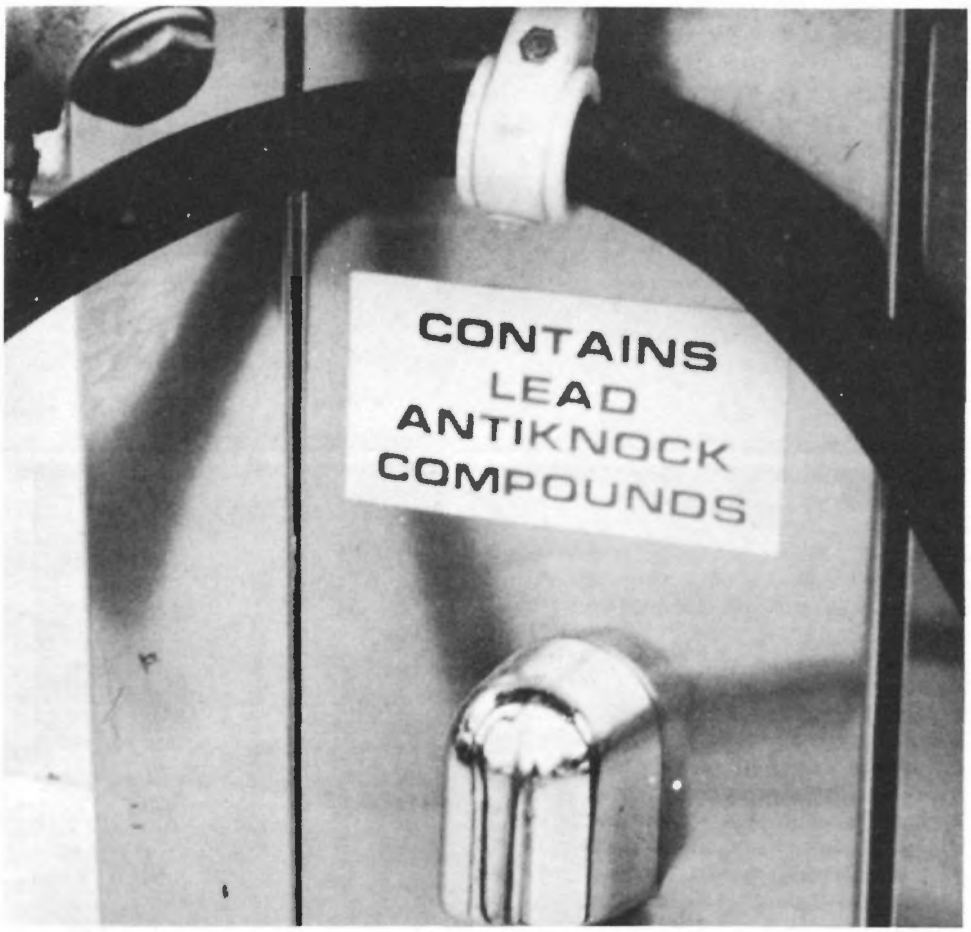
The positive effects of phasing down the lead content of gasoline must be considered in the larger context of lead pollution in the United States. Automobile exhaust from vehicles burning leaded gas is by no means the only—or perhaps even the major—cause of severe cases of lead poisoning.

Other Lead Pollution

For example, children who are known to have ingested leaded paint, most often found on the peeling walls of inner-city ghettos, account for the most extreme instances of juvenile lead poisoning. The Department of Housing and Urban Development monitors this problem under the authority of the Lead Paint Poison Prevention Act. Similarly, inhabitants of communities adjacent to lead smelters had abnormally high blood lead levels before EPA began regulating emissions from these factories under the Clean Air Act.

Pervasive, low-level lead pollution—not acute lead poisoning—is the target of EPA's phasedown of lead in gasoline. The agency estimates that 80 percent of all lead in the atmosphere comes from the exhaust pipes of vehicles burning leaded fuel. Bioaccumulation of airborne lead particles, inhaled day in and day out, can tip the balance toward severe lead intoxication in children and adults exposed to lead from other sources. There is also reason to suspect that even the lowest levels of lead intoxication are harmful to mind and body.

All of these health considerations gain added force when yet another factor is



Leaded fuel has been flowing through American gas pumps for more than half a century. EPA's action means use of lead in gasoline will decline dramatically.

taken into account. Hydrocarbon, carbon monoxide, and nitrogen oxide emissions increase dramatically when catalytic converters are disabled as the result of pumping leaded gas into vehicles designed to run on unleaded fuel.

Carbon monoxide, which can be lethal in heavy doses, impairs mental and visual acuity and interferes with the transfer of oxygen from the lungs to the cells. Hydrocarbons and nitrogen oxides, on the other hand, react with volatile organic compounds in the atmosphere to generate ozone, which is the key component in the suffocating blankets of smog that cover such cities as Los Angeles and Denver. Coughing, chest pain, and shortness of breath are the typical human response to smog.

Mechanical Ramifications

Recent research also indicates that the "health" of U.S. engines and valves will not be threatened by the 0.1 gplg lead standard. Opponents of the new standard—especially owners of pre-1970 automobiles and heavy-duty vehicles—have argued that lowering the lead content of gasoline would increase problems with engine knock and valve recession, thereby impairing engine performance and hastening engine wear-out.

Various government and industry studies indicate, however, that unleaded gasoline poses little or no threat to automobile engines that are properly maintained and subjected to normal use. One experiment, conducted by the Ethyl Corporation in the middle and late 1960s, compared the performance of 64 matched pairs of vehicles. One vehicle in each pair used leaded gasoline, and the other used unleaded. The cars traveled an average of 15,000 miles per year at a time when speed limits of 65 or 70 miles per hour were not uncommon.

Despite these factors, only four unleaded vehicles (six percent) required cylinder-head replacements owing to valve-seat recession (one vehicle required two replacements). One vehicle in the leaded group also required a new cylinder head during the same period.

On the other hand, the absence of lead showed a beneficial effect in reducing the amount of valve-related maintenance. Only six vehicles in the unleaded group required valve jobs, compared with sixteen vehicles in the leaded group.

Savings for Drivers

Other studies have confirmed that lead in gasoline and the scavengers added to prevent excessive lead accumulation in engines foul spark plugs, corrode exhaust systems, and necessitate more frequent oil changes. Thus, reducing the lead content of gasoline will result in significant maintenance savings to vehicle owners. EPA estimates that the new lead phasedown proposal will reduce maintenance costs by approximately $900 million a year.

Reducing lead in gasoline will also improve fuel economy. More elaborate refining techniques that will be used to boost octane despite lowered lead content will raise the energy potential of gasoline. Moreover, the diminished lead content of leaded fuel will mean that it takes longer for misfuelers to damage or disable their catalytic converters and to foul the oxygen sensors that optimize the air-fuel mix in newer engines. EPA estimates that this increase in fuel efficiency resulting from the lead phasedown could save consumers $200 million a year.

EPA believes that few if any automobiles operated at legal speeds under normal loads will suffer any engine damage as a result of the lead phasedown. However, the agency recognizes that certain types of trucks, farm equipment, boats, motorcycles, and off-road machinery are thought by some to face greater risk because they are more likely than automobiles to operate at high engine speeds. Even so, EPA is confident that the 0.1 gplg standard will provide sufficient lead to give protection to all engines that need it until new additives can be developed as viable alternatives. Several already appear promising, although none has yet been fully proven.

Americans could see a complete ban on leaded gasoline by 1988.

Gas Pricing Trends

The added cost to refiners of meeting the 0.1 gplg lead standard will undoubtedly be passed along to consumers in the form of higher pump prices for leaded gas. But this cost must be weighed against monetized benefits of over $1 billion a year that are expected to result from protection against the adverse health effects of lead and conventional pollutants as well as vehicle maintenance savings. (See story on page 7.)

It is hoped that the narrowing of the price differential between leaded and unleaded gasoline will discourage misfueling, which is now running at the alarming rate of 16 percent. In fact, EPA hopes to see the day when leaded gasoline costs more than unleaded. However, even though it is certain that the new standard will make it more expensive for refiners to manufacture leaded gasoline than unleaded regular, EPA is not sure this will cause prices at the pump to flip, because service stations may continue to treat leaded as "the fighting grade."

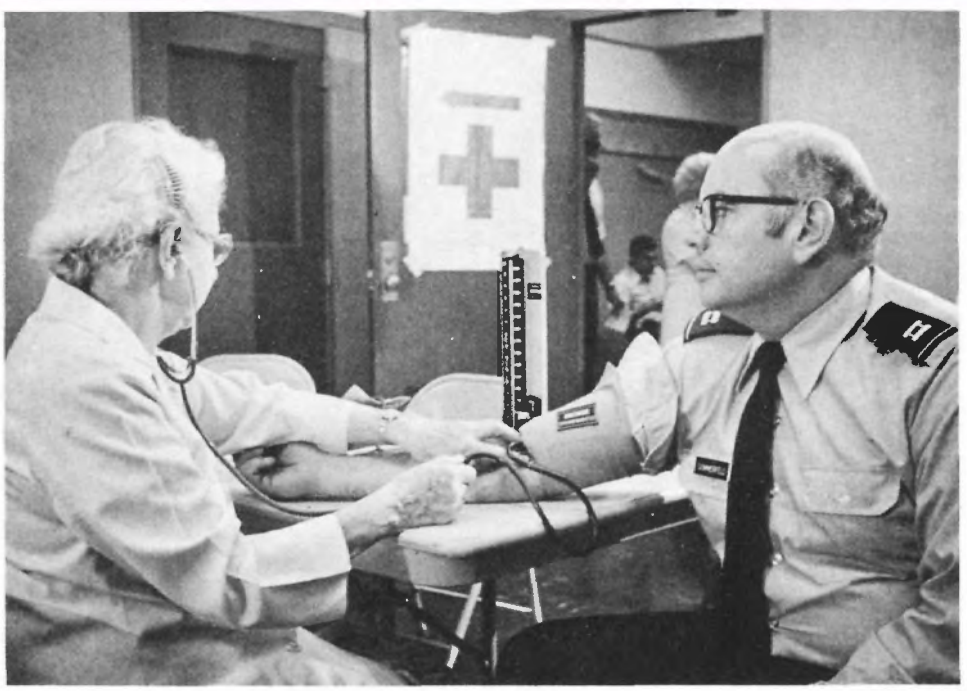
A Ban on Lead?

Possibly the only way of eliminating fuel switching and engine tampering is to impose a complete ban on lead in gasoline. For the time being, however, EPA is hoping that a reduced price differential plus growing public awareness of the delayed maintenance costs caused by misfueling will lead to a gradual reduction in the misfueling problem, especially when reinforced by state enforcement efforts. (See related story on page 6.)

Americans could see a complete ban on leaded gasoline by 1988, seven years earlier than the date projected last August when EPA first proposed the new phasedown rule. In addition to future misfueling patterns, EPA will consider two other factors in determining when a ban should go into effect: the correlation between lead exposure and hypertension and potential problems of valve-seat wear that may result from unleaded fuel.

The timing of the lead phaseout depends in part on the outcome of further investigation into the relationship between lead exposure and blood pressure and cardiovascular disease. Two recently published studies show a strong statistical relationship between blood lead and blood pressure. Based on those studies, EPA has developed preliminary estimates that suggest that the 0.1 gplg standard could result in 1.8 million fewer cases of hypertension in 1986 alone. The reductions in blood pressure could, in turn, prevent more than 5,000 heart attacks, 1,000 strokes, and 5,000 deaths from all causes. And those estimates cover only white males aged 40 to 59, the demographic group for which the best epidemiological data are available.

Because these studies are so new, and the scientific community needs more time to comment on them and to see how they accord with other studies of lead and blood pressure, EPA did not rely on them in setting the phasedown schedule. They could be a key factor, however, in the decision on a final ban, and the agency is actively soliciting scientific comment and review to determine how much weight should be given to these effects. If the suspected relationship between lead and blood pressure holds up under additional scrutiny, it will provide a powerful argument for moving swiftly to a complete ban.



American Red Cross

In Richmond, Va., a man has his blood pressure checked. Preliminary research among white males ages 40 to 59 indicates a strong correlation between lead exposure and hypertension.

Eighty percent of all lead in the atmosphere comes from the exhaust pipes of vehicles burning leaded fuel.

Valve-Seat Wear

Before reaching a final decision on a lead ban, EPA will also further investigate the issue of valve-seat wear. The agency is seeking additional evidence on the extent of the potential problem, including data from engine manufacturers and additional studies of vehicles in actual use (as opposed to track tests run under unusually severe conditions).

Meanwhile, strong evidence already exists to assuage any fears that a lead ban would cause mechanical damage to motor vehicles, even heavy-duty trucks and tractors. Countering the arguments of those who regard lead as crucial to the performance of heavy-duty vehicles are two studies conducted by the U.S. Army and the U.S. Postal Service. These verify for heavy vehicles what earlier studies have already confirmed for automobiles: that no noticeable damage to engine parts or efficiency results from the use of unleaded fuel.

The Army's test involved 7,600 light- and heavy-duty vehicles. Many of these vehicles dated from prior to 1970 when U.S. manufacturers began making hardened valve seats a standard feature of cars and trucks. The Army switched all of these vehicles from leaded to unleaded fuel and subjected them to normal use for a period of three years.

No untoward maintenance problems could be traced to the use of unleaded fuel in these Army vehicles, not even in trucks, tractors, road-graders, cranes, rollers, and compressors. The overall engine failure rate was only 0.5 percent, which was comparable to the Army's experience with the same fleet when it ran on leaded fuel. Only three cases of valve-seat recession were reported, all in light-duty vehicles.

After this test, all the armed services converted completely to unleaded gasoline wherever it was available. Pentagon sources report no special problems, whether of engine performance or maintenance, as a result of this conversion.

The Postal Service study produced similar findings. In 1980, the Postal Service began using unleaded fuel in 1,572 1975 model-year Ford heavy-duty trucks. Most of these trucks were on their second or third engine rebuild or replacement at the time of the switch to unleaded fuel. It is believed that all of the new and rebuilt engines in the fleet had hardened valve inserts.

Three and a half years later, the Postal Service had recorded 69 instances of valve problems (a valve failure rate of 4.4 percent) and 18 cases of valve seat problems (a failure rate of 2.2 percent). The Ford warranty data for the same types of engines showed comparable valve and cylinder-head failure rates when they were run on leaded fuel. The Postal Service, having experienced no significant mechanical or operating problems from the use of unleaded fuel, is now committed to using it in its everyday operations nationwide.

EPA plans to work with user groups for various types of engines and vehicles to ascertain whether particular engines would be at risk if lead is phased out altogether. Moreover, the agency will be working with manufacturers of gasoline additives to determine the availability of alternative additives capable of providing valve lubrication for any engines at risk. Only after this consultative process will the decision be made as to when lead usage in gasoline should be banned altogether.

The next few years are certain to be busy ones not only for EPA but also for oil refiners and marketers. But the long-term benefits of EPA's lead phasedown will more than compensate for any costs or inconvenience encountered along the way. After all, it is more than the health of America's engines and machines that is at stake here. It is the health of every man, woman, and child in the United States. □

Banking and Trading

As part of the new lead phasedown rules, EPA is allowing refiners who reduce lead ahead of schedule to "bank" those reductions for later use in meeting the 0.1 grams per leaded gallon (gplg) standard. This approach gives extra flexibility to individual refineries and is expected to save more than $200 million in potential refinery costs over the next three years.

Banking is an extension of the lead rights trading policy that has been in place since 1982. This policy allows refineries to produce gasoline with more than 1.1 gplg if they induce other refineries to do better than the standard. For example, a refinery can produce one million gallons at 1.3 gplg if it purchases rights from another refinery that produces gas with only 0.9 gplg.

The lead trading policy uses economic incentives to achieve environmental goals at lower cost. In a typical quarter, about three-fourths of all refineries either buy or sell lead rights, and over ten percent of the allowable lead is traded.

Banking extends this lead trading program by allowing refineries that go under the current lead limit to save the extra reductions. The banked rights can be used to help meet the tighter standards that will apply in 1986 or 1987, or they can be sold to other refiners with higher compliance costs or facing unexpected problems (due, for example, to equipment breakdowns). Banking, like trading, saves money without increasing the total amount of lead allowed in gasoline.

The Problems with Misfuelers

by Margherita Pryor

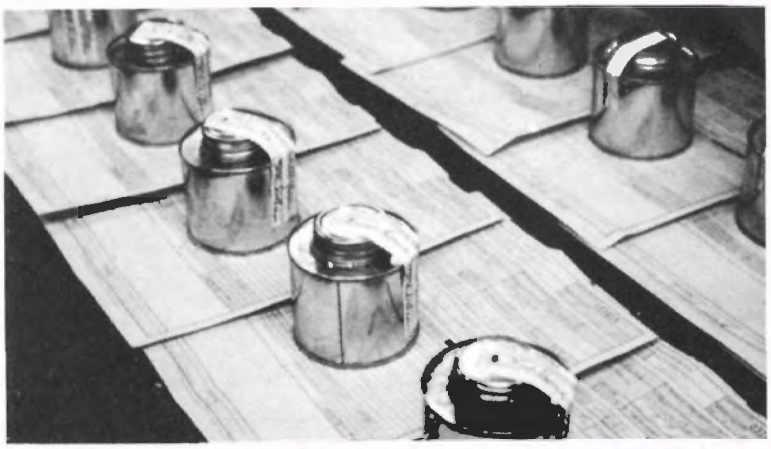
The next time you pull into a gas station, check out the cars filling up with leaded gas. It's very possible that at least one of them has a warning stamped under the fuel cap that reads "Use Unleaded Fuel Only." Or check out the piles of "used" equipment behind some service stations or repair shops. Twenty-eight percent of cars have had major emissions controls removed or disconnected.

These drivers are probably trying to save themselves money. However, recent studies show misfueled cars actually cost owners about 19 cents per gallon more than they should because of reduced engine performance and increased maintenance expenses. And in a lot of states, fuel switchers and engine tamperers are breaking the law, too.

People switch fuels for a number of reasons. The chief of these is economic. Leaded gas is cheaper than unleaded fuel, by seven cents a gallon between regular leaded and unleaded, often by as much as 25 cents a gallon between leaded regular and unleaded premium. In addition, many drivers are convinced lead is necessary for good engine performance, even in later-model cars. And finally, many people are still unaware that lead has serious adverse effects, particularly on the health of children, and that leaded gasoline contributes about 80 percent of all lead in the air.

EPA's current standard allows 1.1 grams of lead per leaded gallon of gasoline. It was set in 1982, on the assumption that the demand for leaded fuel would decline as older, pre-1975 cars disappeared from the roads. Fuel switching has upset these calculations. Today, over 40 percent of all gas sales are for leaded fuel. EPA estimates that 16 percent of drivers who should be using unleaded gasoline use leaded fuel instead. This not only puts more lead into the air, it also destroys catalytic converters—the major emission controls for modern cars. These devices are designed to remove carbon monoxide, hydrocarbons, and nitrogen oxides. But cars with malfunctioning controls have emissions 400 percent to 800 percent higher than those with working converters.

(Pryor is Contributing Editor of EPA Journal.)



A lineup of gasoline samples that EPA has tested for lead content. Inspectors usually collect samples from service stations suspected of illegally dispensing leaded gasoline from small-gauge nozzles that bypass a car's fuel inlet restrictor.

While many catalysts are ruined incidentally through the use of leaded gas, many others have been put out of operation deliberately. EPA surveys indicate that at least 28 percent of all vehicles have had major tampering with emission controls, despite the fact that the Clean Air Act expressly forbids such actions by commercial repair facilities, new car dealers, or fleet operators.

In March of this year, EPA announced actions that not only will drastically reduce the threat of lead to human health, but will effectively eliminate the incentives to misfuel.

First, lead will no longer be available in large quantities as a cheap octane booster. On July 1, 1985, the current limit of 1.1 grams per gallon will be reduced to 0.5 grams. Beginning January 1, 1986, the standard will drop again to 0.1 grams per leaded gallon—a 90 percent reduction from the current limit. Reducing the lead content of leaded gas will increase production costs, a factor that EPA expects will wipe out the price differential that induces people to switch fuels.

Secondly, EPA is continuing to investigate lead substitutes for older cars that need it as a valve lubricant or sealer. Studies so far indicate that the minimum lead content needed for protection is between 0.04 and 0.07 grams per gallon. The new limit of 0.1 grams will not only meet that need with a margin of safety, but will also give car owners significant maintenance savings. Leaded gas fouls spark plugs, corrodes exhaust systems, and leads to more frequent oil changes. EPA estimates that the new rules will save owners about $200 million annually.

Even the new standard, however, retains enough lead to cause catalytic damage if misfueling occurs. Therefore, a major agency goal is to continue active federal enforcement efforts and to encourage vigorous state programs to require the repair of damaged vehicles and deter tampering and misfueling.

Jurisdictions within 40 states already hold individuals liable for these actions. Out of 46 million vehicles subject to inspection and maintenance (I/M) requirements, about 11 million are also subject to anti-tampering laws. Sixteen states have programs that look specifically for evidence of tampering.

No two of these programs are alike. Some enforce through their I/M programs, others observe retail outlets for misfueling, still others conduct periodic road checks. Maryland's program, for example, relies on three kinds of tampering checks—routine I/M, mandatory inspection for evidence of tampering at any change of ownership, and police observations—any of which can result in citations against the owners. Cited owners not only must pay a fine; they also are required to replace the damaged controls. In the case of catalytic converters, this can cost as much as $300.

Despite the difficulties of enforcing prohibitions against actions by individuals, the number of states with such programs is increasing. Many are recognizing that misfueled and damaged vehicles contribute substantially to their air pollution burdens, and that individual owners must be held responsible for proper operation and maintenance of their cars.

Taken together, EPA expects that these actions—reducing lead content in gasoline and enforcing fuel switching/engine tampering laws—will significantly reduce the public's exposure to lead, with resulting benefits of over a billion dollars a year beginning in 1986. These benefits include not only maintenance savings to vehicle owners, but also the savings from reduced levels of other automotive pollutants and from lowered medical costs stemming from excess exposure to lead. □

The Lead Phasedown: How Society Gains

by Albert L. Nichols

A motorist checks the oil in his car. Determining the average cost of an oil change was one of the steps in calculating maintenance benefits of the lead phasedown.

Ethyl Corp. & American Petroleum Institute

Benefit-cost analysis has played an integral role in EPA's recent rulemaking on lead in gasoline. The initial analysis, released by EPA's Office of Policy, Planning and Evaluation in March 1984, showed that, despite substantial reductions achieved through earlier rulemakings, further tightening of the lead limit would yield large health gains, with benefits far in excess of the costs. That report helped spur intensive development of a proposed rule, issued in August 1984, less than two years after the previous rulemaking on lead in gasoline had been concluded.

Additional analysis demonstrated the feasibility and desirability of setting a very tight phasedown schedule. The final rule, issued in March 1985, is even more stringent than the original proposal; it requires that lead in gasoline be reduced from 1.1 grams per leaded gallon (gplg) to 0.5 gplg by July 1985 and to 0.1 gplg by January 1986. The agency is now considering additional steps to reduce the health threat posed by lead in gasoline, including a possible ban as early as 1988.

Costs of Reducing Lead

Since the 1920s, refineries have added lead to gasoline as an inexpensive way of boosting octane. To meet octane requirements with little or no lead, refineries must engage in additional processing, which raises costs, or use other additives that are more expensive than lead.

To estimate the cost of the rule, EPA used a computer model of the refining industry. This model, developed for the U. S. Department of Energy, is similar to others developed by refiners themselves to help increase the efficiency of their operations. It uses a series of mathematical equations to represent processes used in refineries. These equations show how various inputs can be turned into different products at varying costs, and the constraints on industry capacity. For any given set of final products, the model finds the least expensive method of production.

We first ran the model specifying the current lead limit of 1.1 grams per leaded gallon (gplg) and computed the cost of meeting demand for refined petroleum products. We then re-ran the model specifying a tighter lead limit, and recomputed the overall cost. The difference between the costs at the two lead limits is the estimated cost of the tighter standard. Many constraints were added to the model to ensure that the cost estimates were not unrealistically low.

Based on this analysis, we estimate that the rule will cost less than $100 million in the second half of 1985 (when the standard will be 0.5 gplg) and just over $600 million in 1986 (the first year that the 0.1 gplg standard will take effect). The model also showed that demand for gasoline and other petroleum products can be met with existing refining equipment and without any increase in imports.

We also tested the effect of more pessimistic assumptions, such as unexpectedly high demand for high-octane unleaded gasoline, increased downtime for refining equipment, and reduced availability of non-lead additives. These analyses showed that the 0.1 gplg rule could be met under virtually any conditions. Potential problems appeared only when we imposed many adverse conditions simultaneously, an extremely unlikely possibility.

Benefits of the Rule

We estimated benefits in several major categories: children's health and educational effects associated with lead exposure; damages caused by excess emissions of pollutants from misfueled vehicles; and impacts on vehicle maintenance and fuel economy. In addition, we also used the recently published studies on the relationship between blood lead and blood pressure to make preliminary estimates of some of the health benefits that adults might reap from the rule.

We first estimated the impact of

(Nichols is Director of the Economic Analysis Division in EPA's Office of Policy, Planning, and Evaluation.)

reduced lead in physical terms. In the case of children's health effects, we used statistical studies relating gasoline lead to blood lead to project how the numbers of children with elevated blood levels would change if lead in gasoline were reduced. To estimate the impact of reduced misfueling on emissions of conventional pollutants (hydrocarbons, nitrogen oxides, and carbon monoxide), we used data on the current extent of misfueling and increased emission rates in misfueled vehicles, and then combined those with projections of miles driven by vehicles of different types.

Based on several studies comparing matched vehicles on leaded and unleaded gasoline, we estimated the impact of the rule on the frequency of exhaust system replacements, oil changes, and spark plug changes. To estimate reductions in cases of hypertension, heart attacks, strokes, and deaths from all causes related to blood pressure, we used a recently published study on the relationship between lead and blood pressure and earlier studies linking blood pressure to cardiovascular disease. (Because the best data were available for white males aged 40 to 59, we cautiously restricted our estimates to that group.)

Table 1 summarizes several important non-monetary measures of the benefits of the phasedown for the years 1985 to 1987. Note that the estimates for 1985 are for the 0.5 gplg standard, and only cover the second half of the year. The estimates for 1986 and 1987 are for the 0.1 gplg standard, and cover the full years. The estimates for adult blood pressure-related effects should be interpreted cautiously, as they are preliminary and EPA has not relied on them in reaching decisions on the rule just promulgated, pending additional scientific review.

These estimates indicate substantial benefits. They do not include the maintenance benefits, however, and it is difficult to compare them to the costs, measured in dollars. Thus, the next step was to value the benefits in dollar terms. For the maintenance benefits, this step was relatively easy; it involved, for example, determining the average cost of an oil change.

For the other benefit categories, however, valuation is much more difficult and controversial. How much is it worth to prevent a child from having a dangerously high level of blood lead, or an adult from suffering a stroke? For the most part, we did not attempt to assign value to intangibles, such as pain and suffering. Instead, we focused on more easily quantified benefits, such as reduced costs for medical care, compensatory education, crops damaged by pollution, and lost work days. We did, however, tackle the difficult and controversial task of placing a dollar value on reductions in the risk of death. EPA's Regulatory Impact Assessment guidelines suggest a range of $400,000 to $7 million per statistical life saved. We used a value from the lower end of that range, $1 million per case.

Table 1. Non-monetary Measures of the Benefits of Lead Phasedown

	1985	1986	1987
Reduction in number of children above 25 micrograms per deciliter (ug/dl)	64,000	172,000	156,000
Reduction in tons of emissions of conventional pollutants			
Hydrocarbons	0	244,000	242,000
Nitrogen oxides	0	75,000	95,000
Carbon monoxide	0	1,692,000	1,691,000
Reductions in blood pressure-related effects in males aged 40-59			
Hypertension	547,000	1,796,000	1,718,000
Myocardial infarctions	1,550	5,323	5,126
Strokes	324	1,109	1,068
Deaths	1,497	5,134	4,942

Table 2. Costs and Benefits of Lead Phasedown (millions of dollars)

	1985	1986	1987
Benefits			
Children's health effects	$223	$600	$547
Conventional pollutants	0	222	222
Maintenance	102	914	859
Fuel economy	35	187	170
Total Benefits Excluding Blood Pressure	360	1,924	1,799
Total Refining Costs	96	608	558
Net Benefits Excluding Blood Pressure	264	1,316	1,241
Adult blood pressure benefits	1,724	5,897	5,675
Net Benefits Including Blood Pressure	$1,988	$7,213	$6,916

Comparing Costs and Benefits

Despite the incomplete nature of the benefit estimates, they outweigh the costs of the rule by more than three to one, as shown in table 2. If the preliminary estimates related to blood pressure are included, the ratio of benefits to costs jumps to better than ten to one.

As part of our analysis, we also examined a wide range of alternative standards, and found that tightening the lead limit raised benefits substantially more than it increased costs. Although many other factors were important in the agency's decisions, it is clear that the very large health gains estimated as part of the benefit-cost study helped speed up the regulatory process and contributed to the rapid phasedown schedule that was promulgated. □

Health and the Lead Phasedown

An Interview with Bernard Goldstein

Increased evidence on the health effects of lead was one of the main reasons for the recent EPA action phasing down lead in gasoline. EPA Journal interviewed a key agency spokesman on the subject. He is Bernard Goldstein, Assistant Administrator for Research and Development. The interview follows:

James Thompson, D. C. Dept. of Human Services

In Washington, D.C., a technician takes a finger prick blood sample from a child for initial screening for lead poisoning. The D.C. government has had a lead poisoning prevention program for young children since 1973.

Q **Could you tell us what the most serious adverse health effects of lead are?**

A The most seriously affected are children. The effect of lead on their brains is what concerns us most. Children become vegetables at a high enough dose. And higher than that, they can die.

Q **Why are children more susceptible than adults?**

A A child's brain seems to be more susceptible because it's growing. Also, children tend to take in much more lead than adults do. They take in lead from more sources. They put their hands into their mouths all the time. They eat little paint chips that come off the wall that have lead. There's also lead in dirt that comes from automobile exhaust.

Q **I guess they're outdoors more, too.**

A They are outdoors more. They also breathe more than adults. We're sitting around here just talking, but if you had a couple of kids in the room with us, the odds are they'd be running around the room. You breathe more if you run. Even at rest, children tend to breathe a little bit more than adults do, so the dose of anything that is in the air will be greater in children.

Q **Could you explain the scientific basis for the recent decision of the Centers for Disease Control (CDC) to lower the maximum tolerance level for lead in children?**

A Really, it's a medical basis, provided by experts CDC brought together. There is sufficient evidence that lead at relatively low levels—lower levels than were thought before—may have an adverse effect. What CDC has developed is a guideline for practicing physicians and local health departments. The guideline says at what level of blood lead you should thoroughly investigate a child, or bring the child to the hospital, or consider at the very least repeating the tests and beginning therapy.

In the past, if the blood lead level was below 30 micrograms per deciliter (ug/dl), there was little reason for you to do anything or be too concerned about it. Now, you'd better start being concerned at a blood lead level of 25 ug/dl. That's an enormous difference; there is a very large number of kids who have blood lead levels between 25 and 30 ug/dl, far more than there are between 30 and 35.

So now, as a result of the CDC decision, all children with blood lead levels between 25 and 30 at the very least have to have further medical evaluation. And, of course, it's expensive, even assuming that there's no harm done at that lead level in the child.

A lot of recent information suggests there are effects of lead at lower levels than we suspected before. They range from biochemical effects, where if you take blood tests and look at enzyme levels, you'll find changes in those levels or changes in the levels of intermediate substances piled up behind a lead-poisoned enzyme. For example, consider an enzyme active in vitamin D metabolism—and vitamin D is obviously important to a growing child since it has to do with bones. There are visible effects at very low levels of blood lead.

Some of the more important new evidence further suggests, though there's no proof, that lower levels of lead affect children's I.Q., that the child does not develop with the same I.Q. as if there had not been lead exposure.

Q **How did EPA take this evidence into account?**

A EPA has been very conservative in that we have not assumed low-level lead effects in our cost-benefit analysis. That's an important point because the lead industry and others have accused us of taking one side in the controversy over whether blood lead levels below, say, 30 ug/dl produce any adverse effect on children's brains. What EPA has said is that we do not know for sure, although my belief is that lead probably does affect I.Q. However, we have not attached any dollar costs to low-level lead effects on brain function. What that means is that since the cost-benefit dollar calculation is so overwhelmingly in favor of there being more cost than

benefit from lead, if we had attributed any cost to low-level lead effects, the benefits would have been even greater.

If anything, we have underestimated the benefits of removing lead from gasoline by not ascribing any I.Q. effects to the blood lead levels below 30 ug/dl. That is very important, because some people may be confused by the controversy into believing that we have somehow or other ascribed costs to blood lead levels below 30 ug/dl in terms of central nervous system effects. We have not done so because we don't believe those effects are proven, although we do feel that they are likely.

Q Do any scientific studies show a correlation between blood lead levels and lowered I.Q. in adults?

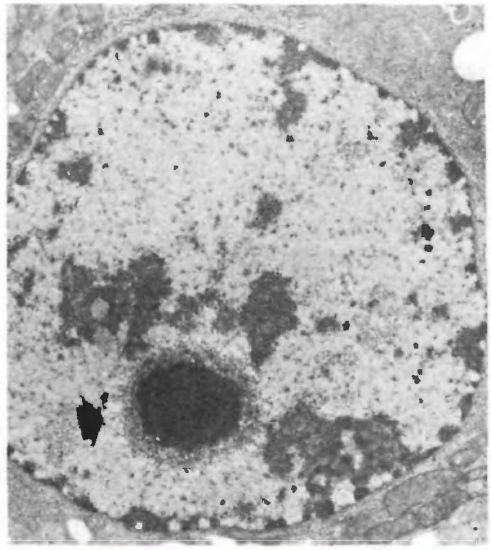
A No. If you, as I have, take care of people who have lead poisoning as adults, some of the symptoms are decreased mentation, but they clear up.

Q What is mentation?

A Well, for instance, I saw a young man just before I came to EPA, at a health clinic in New Jersey. His hobby was restoring old homes. He spent a lot of time using a high-powered sander to get rid of old paint. What he did was make tiny breathable particles of lead paint. After a few months his blood lead level was over 90 ug/dl. He was an accountant, and he noticed that while he used to be able to keep a string of numbers in his head, and add them all together, he couldn't do it anymore. He had to use a calculator. After he was treated for lead poisoning, he could again count and add six or seven numbers in his head. He didn't think that there was any difference from before the lead exposure.

Q So it's reversible.

A It seems to be, but that's not an important test of I.Q. If, in fact, we know that his I.Q. beforehand was 106, and you ask me now if his I.Q. was 104 after the exposure and treatment, I couldn't tell you. With children, however, by using I.Q. tests, we seem to see a difference between those kids who had elevated blood levels and those who did not. Now, we couldn't do a study where you do I.Q. tests before you poison kids with lead, test them afterwards, and then again after treatment. Further, you can't do a study of animals because you can't measure I.Q. in a rat. We only test very gross behavioral effects in animals. And you certainly do get gross behavioral effects in animals due to lead.



Dr. Robert Goyer, NIEHS

In this magnification of a cell nucleus, the dark area (arrow) is composed of a lead protein complex. This is found in cells with excess lead exposure.

Q EPA has announced that it may institute a total ban on lead in gasoline in 1988 rather than 1995 if recent studies confirming the strong correlation between lead intoxication and high blood pressure are confirmed. Could you tell us more about these studies?

A My understanding of what was said is that the ban did not depend just on those blood pressure studies. Of the many considerations involved, the blood pressure studies are simply the most dramatic and obvious ones. There are two studies, both from the same data. There is one data set that is an extensive evaluation of the nutritional and health status of Americans, done by the Department of Health and Human Services. In that study, if you look at a certain subgroup, you find a correlation between their blood lead levels and their blood pressure. These blood lead levels vary from three to 60 ug/dl, but most of them are between five and 30 ug/dl. But just a little bit more blood lead is associated with a little more blood pressure. Now a little bit more blood pressure to an individual isn't that important, but to all the Americans in that age range, it translates into lots more strokes and heart attacks.

The finding is not in both sexes, and only some of those who have worked with lead-poisoned individuals have observed it. We must remember that there are lead industries in which thousands of people have been followed, and mortality studies have been done in which an increase in heart attacks and strokes has not been a general occurrence, despite the fact that the blood lead levels in these people are often 40, 50, 60 ug/dl, and at times even higher. High blood pressure is not a recognized part of the problem that you see with lead intoxication. There are, however, types of toxic responses in which slight elevations in a substance may cause an effect while higher doses do not produce any more of an effect. That is possible, but it's not usual.

The bottom line, as far as I'm concerned, is that a causal role for blood lead in hypertension is still an unproven contention, although certainly worthy of further study.

Q Will the Office of Research and Development (ORD) be funding more research to confirm or test these concepts?

A There will be a fair amount of ORD research in this area. You can be sure that the federal government will be involved. We're continuing with certain of our studies. We're following up on some children with elevated blood lead levels in whom we have found brain-wave abnormalities. We've been following them for a number of years, and we're still finding brain-wave abnormalities. We don't know what brain-wave abnormalities really mean, but these kids have not lost the brain-wave abnormalities that they had when first found to be lead-poisoned, even though their blood lead levels have returned toward normal.

Q The agency is talking about moving the deadline for a total lead ban to 1988. How soon would you have results on the blood pressure question?

A The blood pressure question can be looked at by people re-evaluating data that already exist. There are a lot of studies that will be evaluated. The National Heart, Lung and Blood Institute supports enormous studies of blood pressure in all of its aspects. It's a question now of adding blood lead as another one of the items the Institute measures in its large studies that monitor salt intake, serum cholesterol levels, etc.

Q When he was at EPA recently, Dr. Joshua Lederberg showed a slide of a column he published in 1969 stating flatly that lead exposure was harmful to health. Why has EPA taken so long to act on it?

A Well, EPA has been acting on lead for quite some time. Levels of lead in gasoline are now much lower, and this is

due to EPA action. What happens, of course, is that as more information is developed, we take further action. The insinuation that nothing happened between 1969 and 1985 is simply wrong. There has been a marked decrease in the blood lead levels in the U.S. population during that time.

Q What recent scientific findings have caused EPA to accelerate the lead phasedown?

A The additional evidence of biochemical effects at very, very low levels of blood lead. Additional evidence of brain effects, central nervous system effects, which includes, as I mentioned, the EPA study showing brain-wave changes in children at these low levels. A whole series of studies which have indicated much more subtle levels of damage. The thread running through it all is that our science has improved. We can now detect effects at levels that we really couldn't detect before.

Q How about the health effects of lead in paint and in emissions from lead smelters? How much lead poisoning is attributable to those sources as opposed to gasoline fumes?

A If you look at a lead-poisoned child, with blood lead levels of about 80 ug/dl of blood, you're looking at a child who has most of his body lead from a source other than gasoline, other than what comes out of a tailpipe. They are usually being poisoned by lead paint in old buildings.

By the same token, however, body lead burden is in a dose-responsive fashion responsible for the toxicity. So the higher the dose, the more toxic the child is.

In other words, if the child complains of a stomach ache and might be just a little lethargic, more lead might actually induce a coma. There's no question that the child's elevated body lead burden is added to by the gasoline. Now if you get down to lower blood lead levels, like 25 ug/dl, you're talking about a situation where it's quite conceivable that a significant contribution to that situation was the gasoline lead as compared to other sources of lead. We must not forget that gasoline lead comes out as particles in the exhaust. The particles settle on the ground. Kids who put dirt in their mouths will ingest lead particles.

EPA has the mandate to do something about airborne lead. We have a responsibility to the public to do so, and we are. However, the responsibility to remove lead from the walls of homes belongs to another part of the federal government. They, by the same token, cannot address the airborne lead issue as we can.

Q In 1980, the National Academy of Sciences criticized lack of coordination and integration in the way various federal agencies regulate lead. Has anything been done since 1980 to improve coordination?

A I don't know about the coordination problem. We have our mandate and other agencies have theirs. However, with certain types of compounds, it's difficult to determine who's in charge of what aspect of the problem. Then things get caught in the cracks. That's not true at EPA. It is quite clear that when it comes to lead in gasoline, EPA—and only EPA—has that mandate. Our approach to the lead in gasoline issue is simple and straightforward. But when you talk about lead from a smelter, we have the mandate once it gets outside the smelter, and the Occupational Safety and Health Administration (OSHA) has the mandate within the smelter.

Q How would you rank this lead phasedown action in importance?

A It's one of the most important. It's going to have a major positive impact on the health of the public for a long time to come.

Q Would you say this is an example of the usefulness of environmental research?

A Absolutely. Without the science, we simply could not have gone in the direction we're going. It's the science that backs it up, that gives us the analysis we need to support regulating lead.

Q Lawrence Blanchard of the Ethyl Corporation has said, "In over 60 years, no one has ever found a single person to suffer any identifiable health effects from lead in the general atmosphere." Would you care to comment?

A It's a statement which ducks the issue. As I say, if you do have an identifiable lead-poisoned individual, the lead source is going to be not just in the atmosphere, but from other sources as well. In our bodies right now we have lead that comes from the air we breathe. It also comes from the lead in the water that we drink because there's some lead soldering in the pipes. There's going to be a little lead in some of the food that we eat. So you cannot point to a lead-poisoned kid and say that poisoning is solely due to leaded gasoline.

However, you can point to that kid and say that if there had not been lead in the air, the kid would not have been as sick; the body lead burden would not have been as high. We can certainly point to literally hundreds of thousands of children in whom the body lead burden is so high that the contribution of gasoline led the CDC to tell physicians that they must re-examine the child. Do something about it. Get their body lead burden reduced, because of the added amount that's contributed by gasoline lead. No question about that. Death is not the issue. Poisoning and its harmful effects—that's the issue.

Q How much of the problem would you estimate we're going to take care of with the phasedown?

A Well, close to half the children with blood lead levels over 25 ug/dl will now be below that level. That's the magic dividing line the CDC has given us.

That doesn't mean that you have gotten rid of all the problems. We still have children who will be poisoned by lead. And we still will have lead burdens that are intolerable in that they are responsible for adverse effects. The control of gasoline as a major source of lead is a very major step along the way.

Q Is there any particular lesson that you would draw from the whole experience with the phasedown, the research, the interaction and the follow-through, and so on?

A We always have to recognize that there are going to be people who have different points of view on these issues. Industry has an honest belief in its differences with us on these problems. The history of the agency has been that we have been unsuccessful in approaching issues in which we do not have a credible, scientific base. Where we do have a credible, scientific base, we have been more successful. And I think lead is an example of that. We can move on lead, not because we are waving a banner saying lead is a pollutant and it must be bad for us, but because we have sound, scientific information which allows us to put into a very objective mode the benefits and costs that we will get from lead, and to allow us to convince the public that, in fact, we are doing the right thing. I hope in the long run that this will also convince the courts.

Q When you have that scientific background, you can deal with controversy and differences of opinion?

A Yes, and we can deal with it from a position of strength. We have approached the lead phasedown in a very careful, cautious way. We have evaluated every aspect of the matter. We've not just chosen those facts that make our case and ignored those facts which will make someone else's case.

We have reviewed everything we possibly can in this area. We've brought in the scientific community to peer review everything we've done. We've given every opportunity for the public to comment. We've taken everything into consideration, and based upon all that, we've come to this judgment. Without that process, I don't think we could be successful.

Q **Do you have any further comment?**

A One of the issues that the lead industry raises is that the American public will demand octane. A way to get octane is by adding aromatic compounds. One of the aromatic compounds which may get added to replace lead is benzene. Benzene causes cancer. Therefore, it is said that removal of lead is a foolish approach by EPA because this will end up causing more cancer since there will be more benzene in the air. One Nobel Prize winner came to me and said, "Isn't this an example of how stupid you people are? Getting lead out will result in more cancer-causing problems."

EPA's answer is obvious: anytime you burn anything, you make mutagenic agents. Many of these compounds are carcinogenic, or cancer-causing. We have, in fact, as part of the air toxic program, arrived at a rough estimate of about how many people die each year from lung cancer due to products of incomplete combustion coming out of automobile exhaust. If you put a catalytic converter on an automobile, you convert cancer-causing polycyclic compounds into non-cancer-causing agents. Most of the mutation capability of particles in urban air is ascribable to cars that do not have functioning catalytic converters. To the extent that you have a working catalytic converter you get rid of these compounds. To the extent that lead poisons the catalytic converter, it is obviously making more of those compounds available. Any estimate of the number of additional cancer deaths due to increased benzene that might be put into low-lead gasoline is completely swamped by the much larger number that would be due to the amount of incompletely burned carcinogens that come out of a tailpipe from lead-poisoned catalysts. □

The Link Between Lead in People and Lead in Gas

by Joel Schwartz

Since the mid-1970s, when EPA began regulating lead in gasoline, a crucial question has been, "How much of the lead in people comes from gasoline?"

A preliminary answer came in 1979, when Dr. Irwin Billick of the U.S. Department of Housing and Urban Development published data demonstrating a strong correlation between gasoline lead use in the New York metropolitan area and the average blood lead levels of children screened for lead poisoning in New York. This correlation was particularly striking because those children were chosen as most likely to have high exposure to lead from paint, which would be expected to obscure any relationship with gasoline lead.

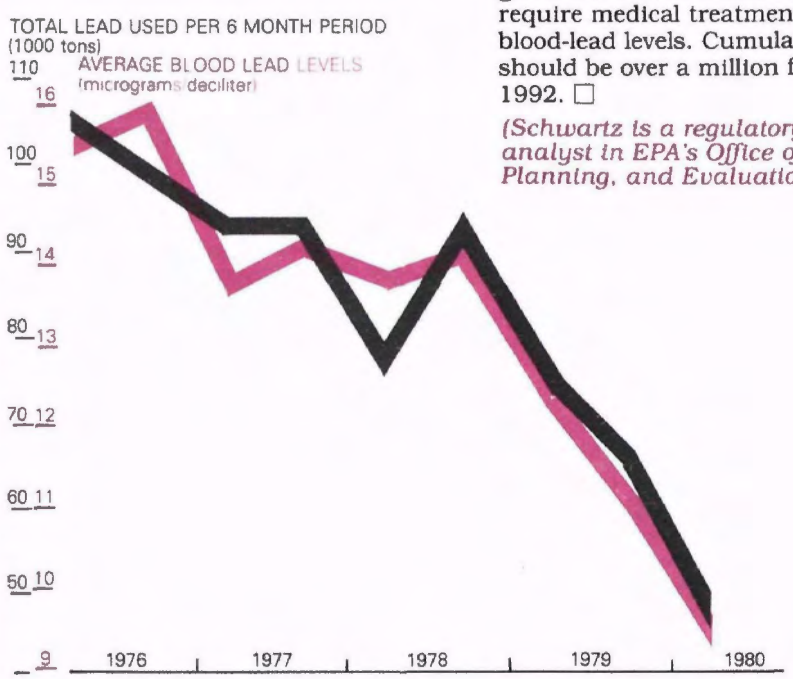
When EPA began to consider new regulations limiting lead in gasoline, the agency was especially concerned about the impact those rules would have on the distribution of blood lead levels throughout the U.S. population. To assess that relationship, we examined data from the second National Health and Nutrition Examination Survey. This survey—containing medical, demographic, and nutritional information on a representative sample of the U.S. population—enabled the agency to assess the relationship between gasoline lead and blood lead using data on 10,000 individuals.

The figure, below, which plots lead in gasoline and lead in blood over time, shows the striking relationship. Note how closely changes in blood lead follow changes in gasoline lead, tracking short-term seasonal fluctuations as well as the long-term downward trend caused by earlier EPA rules. When we control for other factors that affect blood lead levels (including age, race, sex, income, degree of urbanization, and lead solder in food cans), the relationship remains strong. We estimate, for example, that the reductions in gasoline lead from 1976 to 1980 caused a 40 percent drop in blood lead levels.

EPA also examined several other sets of data on children in New York, Chicago, and the national Centers for Disease Control screening program as well as data on pregnant women in Boston. All data showed the same strong relationship between gasoline lead levels and lead in people's blood. In addition, an Italian study, which altered the isotope of lead used in gasoline in Turin, Italy, found that the isotope of lead in people's blood was likewise altered. Similar studies in the United States found the same strong relationship.

Using this relationship, EPA predicted that, in 1986 alone, as a result of the recently announced reduction of lead in gasoline, 172,000 fewer children would require medical treatment for excessive blood-lead levels. Cumulatively, there should be over a million fewer cases by 1992. □

(Schwartz is a regulatory impact analyst in EPA's Office of Policy, Planning, and Evaluation.)



Kathleen Kerley

Other Nations Phasing Down Lead in Gas

by Michael P. Walsh

A self-service gas station near Rudesheim in West Germany, a country which preceded many of its European neighbors both in restricting the lead content of fuel and in introducing unleaded gasoline.

After several decades of increasing use of lead in gasoline, many nations appear to be coming full circle and, like the United States, are reducing the amounts of lead in the fuel used in automobiles. In fact, one country, Brazil, is phasing out gasoline entirely, in favor of ethanol, and in Japan over 90 percent of all gasoline is unleaded.

One of the major uses of lead in the modern world is in gasoline. This followed the discovery in 1921 that adding lead to gasoline raised octane levels. Because of this and other growing uses of lead, human lead exposures have been increasing for many generations. It is now estimated that lead exposures of modern man all over the world are 100 times greater than background or "natural" levels. Studies of annual arctic ice layers in Greenland show that lead levels have risen over the whole of the earth's surface.

Evidence has been accumulating that children in cities suffer serious adverse health consequences when the lead added to gasoline is emitted from vehicles, and very recent data link such emissions to high blood pressure in adult males. Further, the use of lead disables catalytic converters that have been demonstrated to reduce emissions of hydrocarbons and other noxious gases in vehicle exhaust fumes.

Because of these problems, the United States has dramatically reduced the lead content of gasoline over the past decade. EPA's latest rules will reduce the total lead content even further to 0.1 grams per gallon (0.03 grams per liter) by January 1986; ultimately, it is hoped the permissible level will be reduced to zero.

If this happens, the U.S. will be the first country to eliminate lead in gasoline completely, but many other countries are moving in the same direction by lowering the permissible amounts of lead added to gasoline or

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requiring the introduction of at least one grade of unleaded fuel. And it is anticipated that a number of nations will move swiftly to follow the new U.S. standards.

The reasons for these reductions vary. In some countries, the major concern is with the health problems created by lead exposure. In others, the primary motivation is to allow the use of catalytic converters to reduce other pollutants from cars. Foreign automobile manufacturers have for years been exporting to the United States only cars designed for unleaded gasoline.

Prior to the mid-1970s, the lead content of gasoline throughout Europe averaged about 0.8 grams per liter (gpl), or about three times the amount permitted in the United States prior to the most recent EPA actions. West Germany unilaterally adopted a maximum level of 0.15 gpl in 1976 for regular grade fuel with the intention of increasing control opportunities for other motor vehicle pollutants.

After intense discussion, the ten members of the European Economic Community (the Common Market nations) agreed that all member countries should set standards between 0.15 and 0.4 gpl. This was a major step towards reduction of lead in the atmosphere.

Major opposition to lead restrictions during the late 1970s came from the United Kingdom. The British believed lead additives were important for energy conservation. By 1983, however, the United Kingdom reversed its position after a comprehensive review of the latest lead and health information by the Royal Commission on Environmental Pollution concluded, "the safety margin between the blood lead concentrations in the general population and those at which adverse effects have been proven is too small....It would be prudent to take steps to increase the safety margin of the population as a whole." The report continued, "measures should be taken to reduce...dispersal of lead wherever possible."

Almost immediately after the report was issued, the United Kingdom petitioned the Common Market to further reduce lead in gasoline and to introduce lead-free fuel by 1990 at the latest. Several other countries, including West Germany, endorsed the proposal and, in 1984, the Common Market proposed a new directive allowing member countries to mandate the availability of unleaded fuel by as early as 1986, to require at least one grade of unleaded fuel in each country by 1989, and to restrict the lead content of the remaining leaded fuel to a maximum of 0.15 gpl that same year. On March 20 of this year, the Common Market formally approved this proposal. Unleaded gasoline has, in fact, already been introduced in Germany.

European non-members of the Common Market such as Austria, Sweden, and Switzerland are also on the cutting edge of lead reductions and are generally moving as fast or faster than most neighbors.

In Japan, lead reduction has been the greatest in the world so far. Prior to 1975, all gasoline sold in Japan contained lead, whereas today over 90 percent is unleaded. In 1983, the maximum lead content was pegged at 0.13 gpl, far below the about-to-be-changed U.S. standard.

Hong Kong has reduced the lead content of gasoline twice within the past two years to the current maximum of 0.3 gpl. Singapore has moved to a lead level of 0.4 gpl. Malaysia has just decided to go to a similar level on July 1 and has indicated its intention to go to 0.15 gpl by 1990.

Australia, motivated primarily by a desire to reduce carbon monoxide and hydrocarbon emissions through use of catalytic converters, will widely distribute unleaded gasoline by July 1 of this year. Further, all new gasoline-fueled vehicles manufactured after the end of this year must operate satisfactorily on unleaded fuel of 91 to 93 octane.

The USSR, to conserve available lead for military applications, has prohibited leaded gasoline in the Soviet Union's largest cities since 1959.

Canada is following the U.S. in phasing down leaded gasoline, but has not yet adopted the EPA's new, more stringent standards. In Brazil, normal gasoline is being eliminated. All new cars built in the last three years run on 100 percent ethanol. Older cars use gasoline with a 20 percent ethanol content.

Interestingly, some of the Arab nations, where automobile traffic has hitherto not created much of a pollution problem, are beginning to look at the issue. Other countries with large urban populations, such as Mexico and Israel, are faced with such severe economic constraints that conversion to unleaded gasoline has been deferred.

The foregoing represents considerable progress and a major thrust towards eventual worldwide reduction or elimination of lead in gasoline, especially in crowded urban areas. Although lead residues will remain with us for many years, at least the health problems created by peak urban exposures will be reduced for many million people. It's a real reversal of the upward global lead pollution trends of the last seven decades. □

National Gallery of Art / Rosenwald Collection

During the Middle Ages, lead was a key component in alchemical procedures attempting to make gold from baser metals. This composition by Pieter Breughel the Elder depicts an emaciated alchemist, far left, and his long-suffering family surrounded by a disarray of chemical beakers, flasks, and smoking vessels.

Lead Poisoning: A Historical Perspective

by Jack Lewis

Hence gout and stone afflict the human race;
Hence lazy jaundice with her saffron face;
Palsy, with shaking head and tott'ring knees.
And bloated dropsy, the staunch sot's disease;
Consumption, pale, with keen but hollow eye,
And sharpened feature, shew'd that death was nigh.
The feeble offspring curse their crazy sires,
And, tainted from his birth, the youth expires.

Description of lead poisoning by an anonymous Roman hermit
(Translated by Humelbergius Secundus, 1829)

The decades-old controversy over the use of lead as a fuel additive is a mere footnote to centuries of controversy over this remarkably useful but also insidiously deadly metal.

The ancients regarded lead as the father of all metals, but the deity they associated with the substance was Saturn, the ghoulish titan who devoured his own young. The very word "saturnine," in its most specific meaning, applies to an individual whose temperament has become uniformly gloomy, cynical, and taciturn as the result of lead intoxication.

In the rigidly hierarchical world of the ancients, lead was the plebeian metal deemed suitable for a vast variety of everyday uses. Lead products were, to a certain degree, accessible even to the poorest proletarian. But only the chosen few at the top of the social totem pole were able to regularly indulge their insatiable craving for lead-containing products.

Lead was a key component in face powders, rouges, and mascaras; the pigment in many paints ("crazy as a painter" was an ancient catch phrase rooted in the demented behavior of lead-poisoned painters); a nifty spermicide for informal birth control; the ideal "cold" metal for use in the manufacture of chastity belts; a sweet and sour condiment popular for seasoning and adulterating food; a wine preservative perfect for stopping fermentation or disguising inferior vintages; the malleable and inexpensive ingredient in pewter cups, plates, pitchers, pots and pans, and other household artifacts; the basic component of lead coins; and a partial ingredient in debased bronze or brass coins as well as counterfeit silver and gold coins.

Most important of all was lead's suitability as inexpensive and reliable piping for the vast network of plumbing that kept Rome and the provincial cities of the Roman Empire supplied with water. Indeed, the very word "plumbing" comes from the Latin word for lead, *plumbum*. The lead pipes that were the vital arteries of ancient Rome were forged by smithies whose patron saint, Vulcan, exhibited several of the symptoms of advanced lead poisoning: lameness, pallor, and wizened expression.

Addicted to Lead

The Romans were aware that lead could cause serious health problems, even madness and death. However, they were so fond of its diverse uses that they minimized the hazards it posed. Romans of yesteryear, like Americans of today, equated limited exposure to lead with limited risk. What they did not realize was that their everyday low-level exposure to the metal rendered them vulnerable to chronic lead poisoning, even while it spared them the full horrors of acute lead poisoning.

The symptoms of acute lead intoxication appeared most vividly among miners who were thrown into unhealthy intimacy with the metal on a daily basis. Romans reserved such debilitating and backbreaking labor for slaves. Some of these unfortunates were forced to spend all of their brief and blighted lives underground, out of sight and out of mind. The unpleasantness of lead mining was further neutralized late in the Empire when the practice was prohibited in Italy and consigned completely to the provinces.

Lead smelting, which had once been commonplace in every Roman city and town, eventually followed mining operations to the provinces. Italy, the heart of imperial Rome, grew tired of the noxious fumes emanating from lead smelting forges. The obvious damage to the health of smithies and their families was a matter of little or no concern.

Roman aristocrats, who regarded labor of any sort as beneath their dignity, lived oblivious to the human wreckage on which their ruinous diet of lead depended. They would never dream of drinking wine except from a golden cup, but they thought nothing of washing down platters of lead-seasoned food with gallons of lead-adulterated wine.

The result, according to many modern scholars, was the death by slow poisoning of the greatest empire the world has ever known. Symptoms of "plumbism" or lead poisoning were already apparent as early as the first century B.C. Julius Caesar for all his sexual ramblings was unable to beget more than one known offspring. Caesar Augustus, his successor, displayed not only total sterility but also a cold indifference to sex.

The first century A.D. was a time of unbridled gluttony and drunkenness among the ruling oligarchs of Rome. The lead concealed in the food and wine they devoured undoubtedly had a great deal to do with the outbreak of unprecedented epidemics of saturnine gout and sterility among aristocratic males and the alarming rate of infertility and stillbirths among aristocratic women.

Still more alarming was the conspicuous pattern of mental incompetence that came to be synonymous with the Roman elite. This creeping cretinism manifested itself most frighteningly in such clearly degenerate emperors as Caligula, Nero, and Commodus. It is said that Nero wore a breastplate of lead, ostensibly to strengthen his voice, as he fiddled and sang while Rome burned. Domitian, the last of the Flavian emperors, actually had a fountain installed in his palace from which he could drink a never-ending stream of leaded wine.

Medieval and Renaissance Lead

During the Middle Ages, lead was widely used by alchemists as a key component in procedures thought to be capable of generating gold from baser metals. Lead served an even more lofty function when leaded type launched Gutenberg's galaxy late in the fifteenth century. Mass printing was crucial to the eradication of ignorance that led to the upheavals of the Reformation and the Enlightenment.

Kinkier and more destructive uses of lead never lagged far behind. The advantages of the metal as an invisible and slow-acting poison were not lost on the Lucrezia Borgias and Catherine de Medicis of Renaissance Europe. Lead was known to be extremely convenient for eliminating inconvenient relatives. In fact, the world-weary French jokingly referred to the metal as *poudre de la succession*—or succession powder. Another sinister latter-day use of lead was, of course, in the mass production of pistols, rifles, and cannons and the ammunition designed to blaze a bloody trail from their barrels.

Lead mining and smelting began in the New World almost as soon as the first colonists were settled. By 1621 the metal was being mined and forged in Virginia. The low melting temperature of lead made it highly malleable, even at the most primitive forges. Furthermore, lead's resistance to corrosion greatly enhanced its strength and durability. Technological progress in the American colonies and the American republic was to owe a great deal to this useful and abundant metal.

By the twentieth century, the U.S. had emerged as the world's leading producer and consumer of refined lead. According to the National Academy of Science's report on *Lead in the Human Environment*, the United States was by 1980 consuming about 1.3 million tons of lead per year. This quantity, which represents roughly 40 percent of the world's supply, translates into a usage rate of 5,221 grams of lead per American per annum: a rate of dependence on lead and lead-containing products nearly ten times greater than that of the ancient Romans! According to Jerome O. Nriagu, the world's leading authority on lead poisoning in antiquity, the comparable Roman rate of lead usage was approximately 550 grams per person per year.

Not the least significant of those U.S. lead uses, although the one subject to the sharpest decline in the past decade, has been in the automotive industry. Since 1923—with a brief interruption in 1925—the U.S. has made extensive use of tetraethyl lead as an anti-knock, octane-boosting gasoline additive.

In 1923, motorists gas up at pumps in Dayton, Ohio. This service station was the first to sell leaded gasoline to the public.

Running on Lead

Considerable ballyhoo surrounded the introduction of tetraethyl lead in the early 1920s. Iodine, aniline, selenium, and other substances had all fallen by the wayside in the frantic search for a fuel additive that would improve engine performance and reduce engine knock.

Then in December 1921, three General Motors engineers—Charles Kettering, Thomas Midgeley, and Thomas Boyd—reported tremendous success with their first test of tetraethyl lead. Through the Ethyl Corporation, then a GM subsidiary, GM quickly began touting this lead compound as the virtual savior of the American automobile industry.

The discovery was indeed extremely important. It paved the way for the development of the high-power, high-compression internal combustion engines that were to win World War II and dominate the U.S. automotive industry until the early 1970s.

Unfortunately, the use of tetraethyl lead created almost as many problems as it solved. The first danger sign was the mysterious illness that forced Thomas Midgeley to spend weeks convalescing in the winter of 1923. Midgeley had been experimenting rather recklessly with various methods of manufacturing tetraethyl lead, and he did not at first realize just how dangerous the substance was in its concentrated liquid state.

The deadliness of tetraethyl lead was sadly confirmed in the summer of 1924. Workers engaged in producing the additive fell sick and died at several refineries in New Jersey and Ohio. Banner headlines greeted each new fatality until a total of 15 workers had lost their lives—and their minds.

Terrifying rumors circulated about the madness that had put some of the doomed into straitjackets before it put them six feet under. It was not long before journalists were calling leaded fuel "loony gas." Ironically, the gas in question was routinely dyed "a wine color" that made it reminiscent in more ways than one of something served at a Roman orgy.

In May 1925, the Surgeon General temporarily suspended the production and sale of leaded gasoline. He appointed a panel of experts to investigate the recent fatalities that had "occurred in the manufacture and mixing of the concentrated tetraethyl lead." The panel was also asked to weigh "the possible danger" that might arise "from . . . wide distribution of a lead compound" through its sale as a gasoline additive.

Industry dominated the Surgeon General's investigatory committee, which included only one genuine environmental visionary, Dr. Alice Hamilton of Harvard University. The Coolidge Administration gave the panel just seven months to design, run, and analyze its tests.

The committee's final report, published in June 1926, complained of the time constraints under which it had been forced to operate. Seven months was "not sufficient," argued the panel, "to produce detectable symptoms of lead poisoning" in experimental subjects because of the very slow gestation of that toxicological syndrome.

Nevertheless, the Surgeon General's panel ruled that there were "no good grounds for prohibiting the use of ethyl gasoline . . . as a motor fuel, provided that its distribution and use are controlled by proper regulations." The coming decades of Depression, total war,

American Petroleum Institute

and post-war boom were hardly conducive to the implementation of "proper regulations" for leaded gasoline. Indeed, no compulsory standards were set for the industry until the early 1970s when EPA began its long, hard struggle to phase down lead levels in U.S. gasoline.

One saturnine prophecy marred the otherwise sanguine 1926 report to the Surgeon General. By 1985 these words were to reverberate with particular resonance down the corridors of time:

> "It remains possible that, if the use of leaded gasolines becomes widespread, conditions may arise very different from those studied by us which would render its use more of a hazard than would appear to be the case from this investigation. Longer experience may show that even such slight storage of lead as was observed [among human guinea pigs] in these [1925] studies may lead eventually to recognizable lead poisoning or to chronic degenerative diseases of a less obvious character. In view of such possibilities the committee feels that the investigation begun under their direction must not be allowed to lapse . . . . With the experience obtained and the exact methods now available, it should be possible to follow closely the outcome of a more extended use of this fuel and to determine whether or not it may constitute a menace to the health of the general public after prolonged use or under conditions not now foreseen. . . . The vast increase in the number of automobiles throughout the country makes the study of all such questions a matter of real importance from the standpoint of public health."

Needless to say, this advice fell on deaf ears during the gin-soaked, jazz-crazed Roaring Twenties.

Voluntary Standard

In 1927 the Surgeon General set a voluntary standard for the oil industry to follow in mixing tetraethyl lead with gasoline. This standard—3 cubic centimeters per gallon (cc/g)—corresponded to the maximum then in use among refiners, and thus imposed no real restraint. Even without prodding, however, the industry did take giant strides toward instituting safer working conditions in oil refineries, thereby protecting individual laborers in the microcosm of the workplace.

Three decades later, the Surgeon General actually raised the lead standard to 4 cc/g (the equivalent of 4.23 grams per gallon). This voluntary standard once again represented the outside range of industry practice. Nevertheless, the Surgeon General concluded in 1958 that a loosening of the voluntary standard posed no threat to the health of the average American: "During the past 11 years, during which the greatest expansion of tetraethyl lead has occurred, there has been no sign that the average individual in the U.S. has sustained any measurable increase in the concentration of lead in his blood or in the daily output of lead in his urine."

The actual industry average during the 1950s and the 1960s hovered in the vicinity of 2.4 grams per total gallon. The Department of Health, Education and Welfare (HEW), which was home to the Surgeon General starting with the Kennedy Administration, had authority over lead emissions under the Clean Air Act of 1963. The criteria mandated by this statute were still in the draft stage when the Act was reauthorized in 1970 and a new agency called EPA came into existence.

By then, the adverse effects of America's decades-old addiction to fossil fuel in general and leaded fuel in particular were becoming obvious to all. In January 1971, EPA's first Administrator, William D. Ruckelshaus, declared that "an extensive body of information exists which indicates that the addition of alkyl lead to gasoline . . . results in lead particles that pose a threat to public health."

It should be emphasized, however, that scientific evidence capable of documenting this conclusion did not exist in previous decades. Only very recently have scientists been able to prove that low-level lead exposure resulting from automobile emissions is harmful to human health in general, but especially to the health of children and pregnant women.

EPA took an emphatic stand on the issue in its final health document on the subject, "EPA's Position on the Health Implications of Airborne Lead," which was released on November 28, 1973. This study confirmed what preliminary studies had already suggested: namely, that lead from automobile exhaust was posing a direct threat to public health. Under the Clean Air Amendments of 1970, that conclusion left EPA with no option but to control the use of lead as a fuel additive known to "endanger the public health or welfare."

The very next month, in December 1973, EPA issued regulations calling for a gradual reduction in the lead content of the total gasoline pool, which includes all grades of gasoline. The restrictions were scheduled to be implemented starting on January 1, 1975, and to extend over a five-year period. The average lead content of the total gasoline pool of each refinery was to be reduced from the level of approximately 2.0 grams per total gallon that prevailed in 1973 to a maximum of 0.5 grams per total gallon after January 1, 1979. Litigation was to postpone implementation of this phasedown for two years.

Dawn of the Catalytic Converter

Starting with the 1975 model year, U.S. automakers responded to EPA's lead phasedown timetable by equipping new cars with pollution-reducing catalytic converters designed to run only on unleaded fuel. Fittingly, a key component of these catalysts that were to be the undoing of lead was that noblest of noble metals, platinum.

Although over 40 percent of all pump sales are still leaded as of today, the market share of leaded vehicles is steadily diminishing. And with it, so is the noxious cloud of lead-polluted air we have grown accustomed to breathing. EPA estimates that ambient lead levels dropped 64 percent between 1975 and 1982.

In 1982, with the introduction of unleaded gasoline well underway, EPA developed a new standard intended to apply strictly to leaded gasoline. In October of that year the agency promulgated a standard of 1.1 grams per leaded gallon (gplg). This was roughly equivalent to the standard of 0.5 per total gallon that had become effective in 1980. But by focusing on leaded gallons only, EPA's new standard narrowed the range of lead content deviation and set the stage for significant reductions still to come. At this writing, 1.1 gplg is still the EPA standard, but it will expire on July 1 of this year when a lower standard takes effect.

As part of the EPA's latest lead phasedown initiative, the 1.1 gplg standard will drop on July 1 to 0.5 gplg. Then on January 1, 1986, the standard will go down even further to 0.1 gplg. This will represent a 90 percent decrease from the agency's current standard for leaded fuel. Overall, the 1986 standard will represent a drop of more than 98 percent in the lead content of U.S. gasoline from the time of EPA's founding in 1970 to 1986. This already impressive achievement may go one step further if EPA institutes a total ban on lead; the agency is now considering a total lead phaseout, which could begin as soon as 1988.

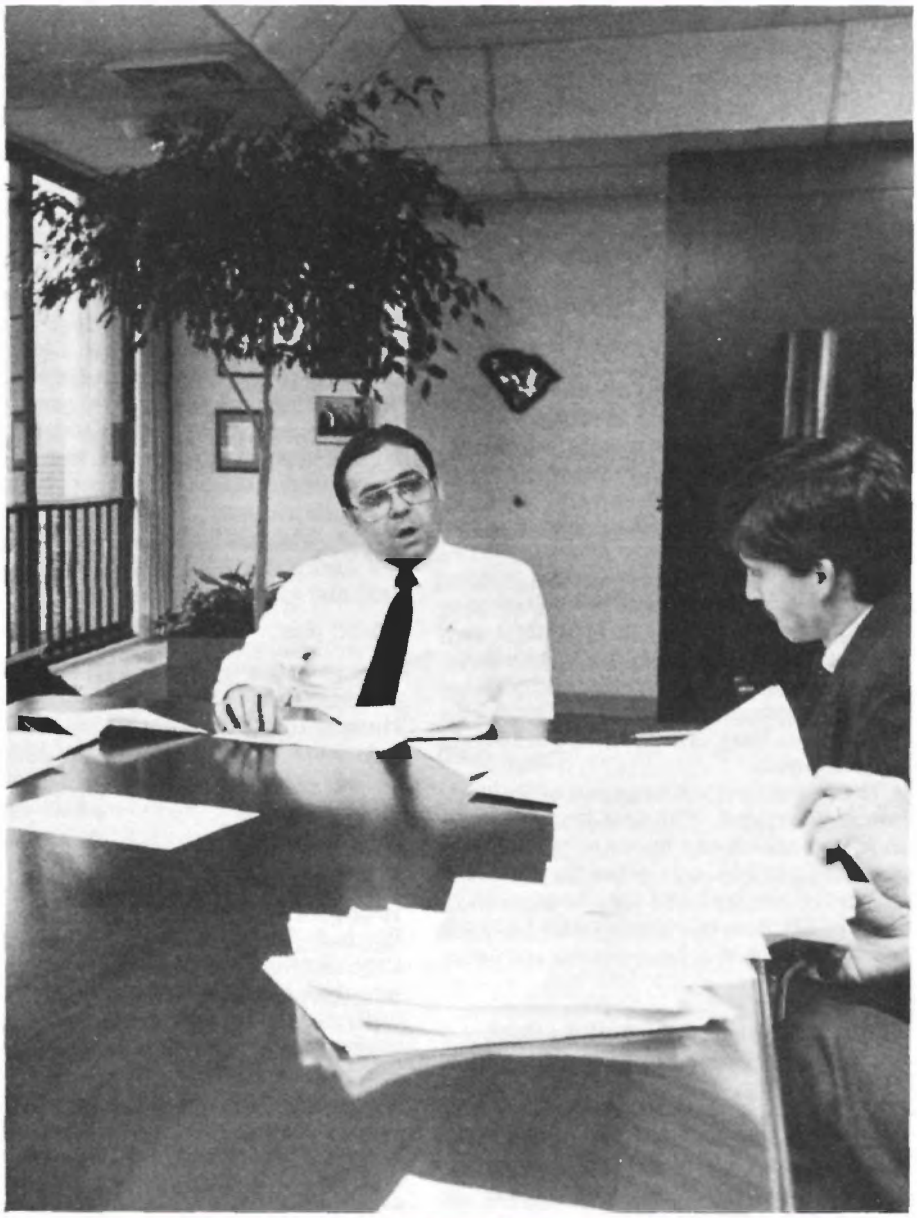
On the basis of all that is known about the history of lead and its adverse effects on human health, it is impossible not to welcome EPA's latest lead phasedown initiative as well as the agency's decision to consider banning lead altogether from U.S. gasoline. □

(Lewis is Assistant Editor of EPA Journal.)

A Day in the Life of the Administrator

by Susan Tejada

(This article is part of a series on how some EPA employees spend their working days.)



Steve Delaney

March 13, 4:30 p.m.: Administrator Lee Thomas presides over a decision meeting on a survey of pesticides in ground water.

Brief a U.S. Senator on a controversial issue.

Decide the fate of a $5 million program.

Answer probing questions in a one-hour press interview, knowing your answers will be syndicated to newspapers all over the country.

For an average government worker, any one of these activities would dominate a day, generating hours of advance preparation and, more than likely, hours of anxiety as well. But for an Administrator of EPA, these activities and more comprise an ordinary day's work.

Last February, Lee Thomas, agency Assistant Administrator for Solid Waste and Emergency Response, became EPA Administrator, succeeding outgoing Administrator William Ruckelshaus. Thomas had been with EPA since 1983, when President Reagan named him to revitalize solid and hazardous waste programs that had been badly shaken by scandals and resignations.

This article describes one day in the life of Administrator Thomas: March 13, 1985.

5:30 a.m.

Lee Thomas woke up at his regular time and put on a gray suit, white shirt, and red tie. Moving quietly so as not to awaken his wife and two young sons, he fixed himself some coffee and looked over the morning paper. As usual, coffee would be his only nourishment until lunch.

6:30 a.m.

With the rest of the family still asleep, Thomas left his home in suburban Virginia for the one hour drive to the office. Agency cars and drivers are available to the Administrator and Assistant Administrators, after they arrive at work, for official business. Thomas always drives his own car back and forth to work. He tuned in to the traffic reports on the car radio to figure out which route was offering the fewest headaches today.

7:30 a.m.

Thomas took the two separate elevator trips necessary to reach his top-floor office. Fortified by a second cup of coffee, he began the workday by meeting with Jack McGraw, his replacement in the Office of Solid Waste and Emergency Response (OSWER).

"I like to try to meet with each of the Assistant Administrators once every week or so, on a one-to-one basis," says Thomas. But, for the time being at least,

the meetings with McGraw are more frequent: "a couple of times a week," Thomas explains, "as I phase out the involvement I had down there."

Some half dozen subjects were on their agenda, including an update on the production of methyl isocyanate at the Union Carbide plant in Institute, W. Va.; the difficulties of obtaining liability insurance at Superfund and RCRA sites; and the status of the RCRA codification rule, a package updating existing regulations. Despite a somewhat baffling array of subjects, the two men worked quickly because, according to McGraw, Thomas "already knows the issues and has amazingly quick recall. He doesn't need background information. He already has that. What he needs is the bottom line."

Their discussions were not strictly business-related. The first thing Thomas inquired about—as he usually does, according to McGraw—was the health of Kathy Greenwood, his former secretary in OSWER who is courageously battling a serious illness.

8:00 a.m.

Thomas held his daily staff meeting, with Jim Barnes, Acting Deputy Administrator; Josephine Cooper, Assistant Administrator for External Affairs; Executive Assistant Linda Fisher; and Special Assistant Russ Dawson.

Today's meeting was shorter than usual. Discussion centered on the status of EPA's Bhopal Task Force, and the possible need to reschedule Superfund hearings.

These early morning sessions are "not major policy or strategy meetings," according to Fisher, but more "an opportunity to get everybody going. Lee runs down his schedule for the day, we review any breaking news stories, and we go over the latest scoop from the Hill. Today, for example, I was able to brief Lee on my conversation with a congressman from Louisiana before his meeting with the state environmental director from Louisiana. That's the important thing about these meetings: we know we will see Lee every morning, so if we can't catch him during the day, we know we'll have a chance to update him the next morning."

8:30 a.m.

At Thomas' request, representatives of Clean Sites, Inc., came in to provide a status report on their work. Clean Sites is a non-profit corporation formed last year to clean up hazardous waste sites. Of the members of the corporation's Board of Directors present in Thomas' twelfth floor office, two were former EPA Administrators: Russ Train and Doug Costle. Thomas urged Clean Sites to become very interactive with EPA regional offices.

10:00 a.m.

Accompanied by Jo Cooper, Region 2 Administrator Chris Daggett, and Allan Hirsch, Director of the Office of Federal Activities, Thomas headed for Room 567 of the Dirksen Senate Office Building and a meeting with Senator John Chafee of Rhode Island.

Chafee wanted to discuss his dissatisfaction with an EPA decision not to oppose a dredge and fill permit for the Westway highway project in New York City. Section 404(c) of the Clean Water Act gives the EPA Administrator authority to veto such permits if he determines they "will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas...wildlife or recreational areas." Chafee felt the dredge and fill activity for Westway would have an adverse impact on striped bass in the Hudson River. But Thomas had decided not to refer the Westway environmental impact statement to the Council on Environmental Quality for review. Instead, he proposed to add to the permit stipulations calling for further study to be carried out concurrently with the dredge and fill activity.

"Senator Chafee was very upset about our decision," explains Thomas. "He felt it was an example of how we were not carrying through with the 404 program the way he would like to see it carried through. And I told him that I was not very well satisfied with the program either, and I was going to do two things about it. One, I was going to work on the 404 procedural issues with the Corps of Engineers. And two, I was going to take a broader look at how the overall wetlands protection effort was being addressed by the agency."

"I don't think Senator Chafee was totally satisfied with that. He felt that we should be more aggressive in using the 404(c) provision of the law, and he's going to hold oversight hearings."

This kind of give-and-take with Members of Congress is a standard feature of Thomas' job. "I would say," he estimates, "that I go up on the Hill three or four times a week to meet with an individual Congressman or Senator about concerns over a program. And I think that's an important thing for me to do, an important role for me to play, expressing our opinions about how we think legislation should be amended or initiated."

11:30 a.m.

Back in the office, Thomas switched gears and turned his attention to more mundane matters. He interviewed a job applicant.

"I interview people for the major jobs, like Assistant Administrator positions," he says, "but generally only after Jim Barnes has interviewed them. Right now, we've got three or four major jobs open, so I'm interviewing a couple of times a week. That'll certainly taper off as the positions are filled."

Noon

In the dining room that adjoins his office, Thomas finally had his first meal of the day, lunch with a friend. A former attorney with the Environmental Defense Fund, this man had actually fulfilled an escapist fantasy many overscheduled bureaucrats entertain. He had taken a year off and traveled the world, to New Zealand, Australia, Indonesia, India, Thailand, and China.

"I was real interested in his trip," says Thomas, with a hint of longing in his voice.

The lunchtime conversation was more interesting than the food. "There was no time to go out. Somebody went to the restaurant downstairs, and brought lunch up in little boxes. Actually," says Thomas, pointing to the large conference table in his office overlooking the Potomac River, "I usually have a sandwich right there. There's never any time to go out. Generally we work during lunch, while we eat. I've done that ever since I came to EPA." He pauses for a moment before recalling, "I guess I did it even before I came to EPA."

1:00 p.m.

Thomas got together with Jack Ravan, Assistant Administrator for Water at the time, to prepare for a 2:00 meeting at the White House. The Cabinet Council on Natural Resources and the Environment was meeting to go over the Administration's position on reauthorization of the Clean Water Act.

"Jack Ravan and I went over the Clean Water Act positions," Thomas notes, "and where we were with resolving those positions, and talked through each of the issues. Then we jumped in the car and dashed to the White House. We spent an hour with the Cabinet Council, and got their consensus on 90 percent of what we had come to discuss. The rest we carried over to the next week."

3:30 p.m.

Running a half hour late and beginning to feel the effects of both his crowded schedule and the flu he had caught from his children, Thomas arrived back at EPA for an interview with reporter Kay Kahler.

"She covers this agency for Newhouse News," Thomas remarks. "She knows the issues very well, so she asked some good questions."

According to Thomas aide Russ Dawson, who sat in on the interview, Kahler's tough questions covered a wide range of issues: President Reagan's support for the environment, EPA's relationship with the Office of Management and Budget (OMB), the Administration's position on acid rain, the aftermath of Bhopal. "Lee is comfortable with reporters," says Dawson, "and comfortable with his own opinions. But today he was not feeling well. It was a mistake to schedule the interview late in the day. He was exhausted."

Thomas submits to these one-on-one press interviews as often as he can—sometimes two or three times a week. "There are more than 20 reporters that cover the agency regularly," he explains. "They like an opportunity periodically to have a half an hour or so to talk with the Administrator." Thomas also usually has a brown bag lunch with a group of reporters every few weeks.

The press is not the only group requesting time on Thomas' calendar. According to Dawson, he and other aides "sit down two or three times a week and go through a stack of requests for speeches and meetings and courtesy visits and everything under the sun. In the course of a week, that stack is pretty big."

4:30 p.m.

Thomas presided over a large meeting called to decide the fate of a proposed $5 million survey of pesticides in ground water and drinking water.

For nearly a year, staff of the Office of Drinking Water and the Office of Pesticide Programs had been cooperating in planning the survey. Now, as they gathered outside the Administrator's office waiting to argue their case, they appeared nervous. They did some last minute strategizing.

Finally, with the late afternoon sun shining through the windows as a backdrop, they took their seats around the Administrator's conference table and began their presentation.

Thomas had read briefing materials on the survey the night before, and had formulated some pointed questions to identify potential trouble spots: What will EPA do if the survey *does* document contamination? Has OMB approved the paperwork involved? What does the agricultural chemical industry think of the survey? Where will the $5 million come from? Is the Department of Agriculture involved?

The one hour discussion ended with Thomas' decision: "Let's go ahead." He enjoined the group to develop a communications strategy, coordinate with the Department of Agriculture, and work with Jim Barnes on funding possibilities. "I think the substance of your proposal is excellent," he told the group, "and we ought to proceed with it."

"Almost all the meetings I have are decision meetings," Thomas notes. In fact, he adds, this is the big difference between being an Assistant Administrator and being the Administrator. "In this job, you can't say, 'Well, the Administrator has to decide that, or the Deputy Administrator has to decide that.' You don't have anybody you can say is going to decide that. *You've* got to decide that. You're the court of last resort."

6:00 p.m.

Thomas and Jim Barnes got together, as they do at the end of every workday, to go over leftover business and plan for the next day.

7:30 p.m.

One more hour on the freeway, and Thomas arrived back home. "I like to get home, if I can, by 7:30," he says, "because that's when the boys are finishing their supper. I help get them ready for bed, and give them a bath. We play for awhile. And then I put one of them to sleep, and my wife puts the other one to sleep." At ages one and two-and-one-half, "they're both still rockable, so they both get rocked."

9:00 p.m.

With the kids asleep, and with the White House Cabinet Council, Congress, and the press taken care of for the day, Thomas cleaned up the kitchen and got something to eat. Then he spent an hour and a half reading briefing materials for the next day.

Because of the workload, the additional time he puts in as Administrator is, Thomas concedes, "more demanding on the family, particularly my little children. So basically, I spend all my time either working, or with them. There isn't time for anything else. On weekends, I work three or four hours a day, at home, when the boys take their naps, or at night. Every Saturday, I do the grocery shopping with my older boy. That way, I get to spend time just with him, and my wife gets to spend time together with the little one. You really learn to structure your time."

Still, despite the additional work and pressure, Thomas concludes, "I really like this job." □

(Tejada is Associate Editor of EPA Journal.*)*

Reflections on the Nation's Air Cleanup

by Joseph Padgett

In this article, Joseph Padgett reviews the progress to date of the nation's air cleanup effort and discusses its future. Padgett currently is President of the Air Pollution Control Association, the first EPA official to be elected to this office. During his one-year term as APCA president, he is on assignment to the North Carolina Division of Environmental Control under the Intergovernmental Personnel Act exchange program. At EPA, Padgett was Director of the Strategies and Air Standards Division in the Air Program Office. The views expressed here are not necessarily those of EPA.

Three decades ago the first federal Air Pollution Control Act was signed into law by President Dwight Eisenhower. In that time, and particularly since 1970, we have made remarkable progress in cleaning up the air. But new problems, such as air toxics, atmospheric deposition, and indoor air pollution, have arisen. Unfortunately, these "new" problems are equally threatening to our environment and perhaps more complex to solve. Our challenge in the 1980s and beyond is to deal successfully with these new issues without losing any of the gains we already have made.

First, let's take a brief look at the progress achieved over the years in controlling air pollution. This background provides a context within which we can discuss emerging air issues and possible changes in our regulatory and legislative approach to help to deal with them. It also helps us to assess our current status.

Historical Perspective

We have long recognized dirty and polluted air as a serious problem. However, until the 1940s, air pollution was viewed largely as one involving smoke from furnaces, industrial processes, and locomotives. Little attention was paid initially to health-related aspects of dirty air.

Compared with states, counties, and municipalities, the federal government is very much a newcomer to air pollution control in the United States. Municipal and county regulations against smoke emissions go back to Chicago and Cincinnati in 1881, and Albany County, N.Y., around 1913. Probably the earliest state law was passed by Ohio before 1897 to limit smoke emissions from steam boilers. It was not until 1952 that a state, Oregon, first passed comprehensive legislation and provided statewide authority to a state air pollution control agency. In 1907, the International Association for the Prevention of Smoke, which later became the Air Pollution Control Association (APCA), was organized to foster smoke prevention regulations and controls.

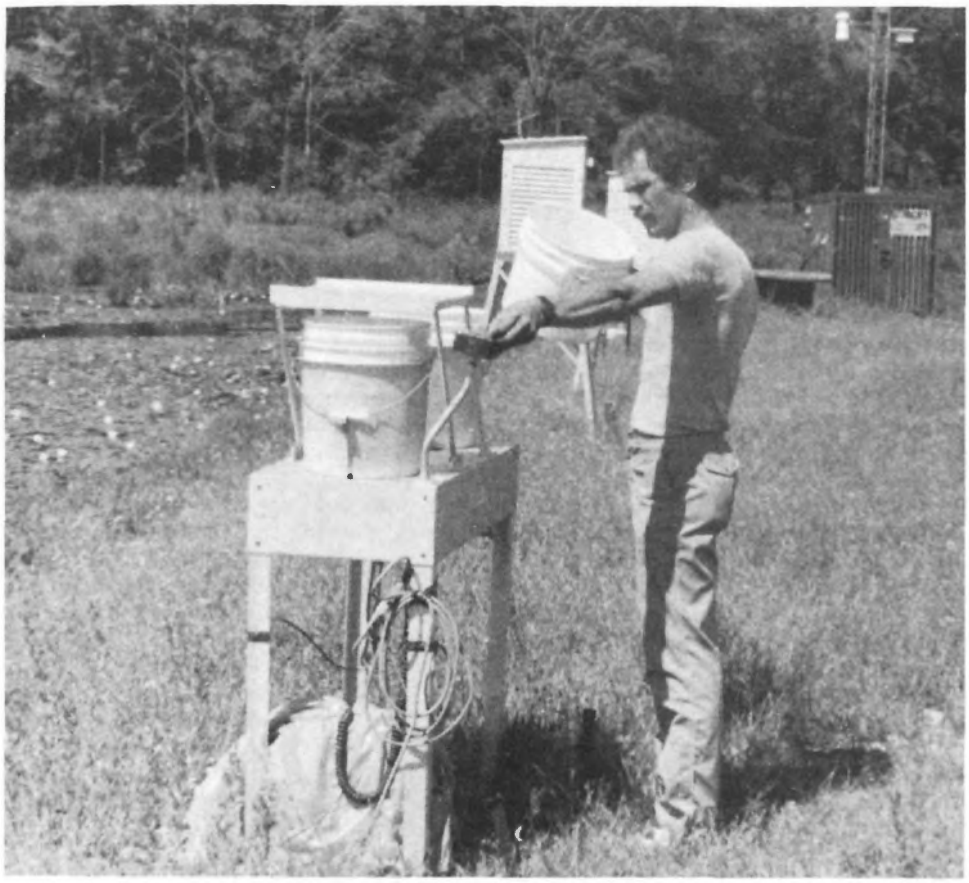
By the end of the 1940s, improved boiler design, developed partly to reduce black smoke and partly to increase efficiency, had greatly reduced emissions. While comprehensive smoke abatement ordinances and laws were being implemented to ensure continued progress, attention was turning to control of other pollutants and sources other than boilers.

California's smog problems, the killer fog at Donora, Pa., in 1948, and another killer fog, this time in London in 1952, focused national attention on the complexities and potential health hazards of air pollution. The State of California, Los Angeles County, and local industries began spending millions of dollars to study the causes and effects of smog. Legislators began pushing for the federal government to take the lead (and supply the money) for air pollution research.

A series of federal air pollution laws has been enacted since 1955. The initial Clean Air Act was passed in 1963. In 1970, it was amended, but the amendments were so sweeping and total that they could be considered an entirely new Act. Further amendments in 1977 continue to shape today's federal air pollution control program. (The references in the remainder of this article to the Clean Air Act, or CAA, mean the 1970 and 1977 amendments.) The scope of federal activities in the federal-state partnership has grown with each new law.

The explicit performance-oriented nature of the 1970 CAA seemed to reflect the nation's frustration with lack of progress resulting from earlier federal and individual state actions. Clearly, direction, coordinated action, and regulatory and enforcement authority at the national level were needed. Equally important, much more money was needed for research and development and for strengthening state and local control agencies charged with most of the implementation responsibilities. Success in achieving this last goal was one of the most important accomplishments of federal legislation and especially of the CAA.

The fundamental purpose of the CAA is protection of the public health and welfare from harmful air pollution. It creates a federal-state partnership which provides for national oversight and a framework of national regulations supplemented by individual state implementation regulations. The CAA requires EPA to establish national standards for ambient air quality and for



Maj. Richard Graham, U.S. Military Academy

As part of the National Atmospheric Deposition Program, a field technician changes collection vessels on a precipitation sampler in West Point, N.Y. Both wet samples (rain and snow) and dry samples (dust and dirt) are collected weekly and analyzed for evidence of acidity in the atmosphere.

emissions from new stationary sources. It also requires EPA to identify and list hazardous air pollutants, to set hazardous pollutant emission standards for sources whose emissions may cause a risk to health, and to set fuel and fuel additive standards. Automobile emission standards were included in the CAA and an automotive testing and certification program was established. Specific deadlines were set for many actions. Timetables were included for states to prepare and submit plans to attain national ambient standards, and for federal approval of the state standards. Federal implementation of regulations is required where state progress is inadequate.

Progress Under the Clean Air Act

The CAA has been a highly successful law under which substantial progress has been made in cleaning up the nation's air. Concentrations of five of the six criteria pollutants for which national ambient air quality standards are set have dropped significantly since state and federal emission controls began to take effect in 1975-77. From 1975 to 1982, levels of lead in the air recorded at 46 urban sites dropped 64 percent; carbon monoxide levels recorded at traffic-saturated center city locations fell 31 percent; and ozone levels decreased 18 percent at almost 200 sites. Sulfur dioxide in urban areas dropped 33 percent; and particulate levels decreased 15 percent. Nitrogen dioxide (NO_2) levels remained the same at the end of the five year period, but concentrations are low. For example, only one area in the nation did not meet the primary standard for NO_2 in 1984.

Until recently, EPA's air program has emphasized control of criteria pollutants. The figures cited above show clearly the success which has been achieved. What's more, EPA, state, and local regulatory programs in place, or being implemented, will reduce emissions further and improve air quality in most areas of the nation. This impressive achievement required the continuing and cooperative efforts of EPA and the entire network of state and local air pollution control agencies. The underlying regulatory framework of this program includes a myriad of regulations and procedures. Taken together, they comprise our nation's air management system for criteria pollutants. It is complex and needs to be simplified, but it works.

Nonetheless, there are still problems associated with criteria pollutants. High ozone and particulate concentrations persist in some urban areas, such as Los Angeles and Houston. It is likely that ozone levels there will continue to exceed the national standard for the foreseeable future despite our best control efforts. Also, the periodic review and revision of ambient air quality standards can result in major program modifications. The particulate standard is currently being revised, and will likely result in major changes to the control program.

The most difficult unresolved issue under the CAA is our inability to identify and implement appropriate controls for toxic air pollutants (defined here as *all* pollutants other than the criteria pollutants), which have, or may have, an adverse effect on human health. The CAA provides for the identification and control of "hazardous" pollutants, defining them as those which "may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness." EPA is required to list these pollutants, identify sources of emissions, then establish emission standards which will provide an "ample margin of safety to protect the public health."

The number of potentially hazardous air pollutants is large, but the health data for most are uncertain and controversial. EPA has listed eight hazardous pollutants and established emission controls for six. Primary concern has been with potential carcinogens, which are considered to have no safe level. To meet the letter of the law, emissions of such pollutants might have to be banned entirely. The resulting dilemma—uncertain health data and often unreasonable control costs to reduce potential risk low enough to approximate "zero"—has made it difficult to reach regulatory decisions. So far EPA has not regulated sources where the risk is judged to be low. EPA has promised decisions on whether to regulate between 20 and 25 pollutants by January 1986. However, it is likely that EPA may decline to list most candidates as hazardous because of uncertain health data. There is not much middle ground in the CAA to support the imposition of modest controls for pollutants when data are uncertain but suggestive.

Substantial indirect control of air toxics has been achieved by controlling particulates and those volatile organics which are precursors to ozone formation. For direct control of air toxics, EPA continues to develop emission standards for hazardous pollutants of national concern while providing support to state and local

initiatives where air toxics concerns may be more localized. State and local regulatory agencies have more flexibility in dealing with toxics. Many have effective programs in place, and others are developing programs.

Emerging Air Issues

A major task of the 1980s and beyond is to translate our success and expertise in controlling criteria pollutants to the resolution of emerging air issues, many of which appear to be at least as complex and resistant to effective control strategies as any associated with criteria pollutants in the past.

Air toxics, atmospheric deposition such as acid rain, and indoor air pollution are three important air issues which will command our attention for the next decade and beyond. Other important air issues include air emissions from hazardous waste sites, ozone depletion in the stratosphere, emissions from wood stoves, visibility, and pollutants associated with new industries such as bioengineered products. The toxic chemical disaster in Bhopal, India, dramatically focused our attention on another air-related issue. It is not yet clear what role the air program will play in the nation's response to avert such a disaster in this country.

Air Toxics: The identification and control of air toxics is the main item of unfinished business from our 1970 CAA agenda. EPA has been unable to make much headway on this under the CAA for reasons discussed earlier. However, extensive resources are being devoted to developing an effective national strategy on air toxics. Revisions to the CAA may be needed to implement a comprehensive air toxics strategy.

Acid Deposition: Often called acid rain, acid deposition is a part of a larger problem—atmospheric deposition, by which pollutants drop from the air onto the soil and vegetation. There is strong popular support for regulatory action on acid rain. The U.S. has committed to an extensive acid rain research program but no legislation has been passed to authorize regulatory action. Atmospheric deposition includes not only acid deposition pollutants, but all gases and particulates which may come in contact with vegetation or soil surfaces. Ozone is of particular concern. A combination of air pollutants is thought to be responsible for killing trees in certain high elevation forests; research about this problem is intensifying. Accepting some additional delay in implementation and then addressing the broader question of atmospheric deposition, rather than focusing only on acid rain, may be the better control strategy.

Indoor Air Pollution: EPA is reluctant to develop a regulatory program for indoor air pollution without legislative guidance from Congress. Lack of attention to this problem is hard to understand when one considers that most individuals spend over 90 percent of their time indoors. Pollutants such as formaldehyde, radon, asbestos, and some of the criteria pollutants are of special concern, especially in colder climates where buildings are more airtight. Research has been underway for years and pressure may be mounting for legislative and regulatory action.

Legislative and Regulatory Approaches

The major air issues on our future regulatory agenda tend to be complex, the science uncertain, and the solutions expensive. Repeated surveys show that the public strongly supports environmental control, but the public also believes that reasonable benefits should be realized from control strategies. Concepts such as risk management and cost/benefit analysis should be considered to provide increased flexibility in setting the standards, regulations, and implementation schedules needed to achieve cost-effective control strategies.

The CAA now limits consideration of risk management and cost/benefit concepts in setting standards and mandates specific pre-set implementation schedules. Many such mandated schedules have proven to be unrealistic. Realistic attainment dates are specific to both pollutant and geographic location. Some areas, such as Los Angeles, may never attain the present ozone standard. Others attained it within the prescribed time schedule. Experience gained since 1970 argues for a more flexible approach which would permit EPA to set attainment dates on a case-by-case basis.

The regulation of hazardous pollutant emissions is one example of the value of risk management and cost/benefit analysis. This issue has been discussed earlier in some detail. Another example is the use of these techniques in setting national ambient air quality standards. The CAA now requires that these standards be set at levels below a threshold concentration at which adverse effects to human health are experienced. However, some pollutants have no clearly defined thresholds, and limited effects on a few individuals might be inferred at near zero levels. Also, available health data often are so sparse or unreliable that a wide range of uncertainty is associated with the choice of a specific standard. In either of these situations, risk and benefit/cost estimates can help to select a standard which adequately protects health without incurring unreasonable costs to attain the standard.

The requirement to meet specific numerical emission or ambient standards, as now specified in the CAA, also should be reassessed. EPA on occasion has discussed using ranges in standard setting. Given the uncertain quality of the effects data often available, this approach, or perhaps the use of goals in some cases, might be superior to the present method.

Future legislative and regulatory strategies may be dealing less with the traditional "smokestack" industries and more with diverse decentralized sources which more directly involve the individual. Indoor air pollution strategies, wood-burning stove controls, gasoline pump controls, automobile inspection and maintenance, and transportation controls are examples of this trend.

Educating the Public

Former Administrator William Ruckelshaus often expressed concern about helping the public to understand risks, benefits, the sometimes poor quality of data available for decision-making, and the myriad of factors EPA must consider in reaching a regulatory decision. The public needs to understand risk management and the fact that responsible public policy cannot protect every individual against all risk. And, above all, EPA needs to build public understanding and trust that it is carrying out its role—protecting the environment—in a balanced, responsible manner, and in the public's best interest. □

Associated Press/Wide World Photos

Gabriella Dorio of Italy races to the finish of the women's 1500 meter race at the 1984 Summer Olympics in Los Angeles. Air pollution, which can impair lung function and endurance, was a factor in scheduling times and locations of events.

Initiatives to Deal with L.A. Smog

by Judith E. Ayres

(Ayres is Administrator of EPA Region 9.)

Last summer Los Angeles hosted the 1984 Summer Olympics. Although many feared smog levels would skyrocket, it turned out that the Olympics actually contributed to cleaner air in Los Angeles, if only for a short period of time.

How did this happen?

As a result of a concerted public-private effort to reduce traffic congestion during the games, daily bus ridership in the Los Angeles area grew by about 250,000. Many commuters started to work one-half hour earlier than normal, stretching out the typical morning traffic peak. The local air regulatory agency estimated that improved distribution of traffic and

increased use of mass transit appeared to be largely responsible for a 12 percent improvement in air quality during the Olympic period. This translated into fewer air pollution alerts rather than more. It showed that an extra effort (in this case, flex-time and ride-sharing) can lead to significant air quality improvement without major life-style changes. An impossible situation became a little less impossible!

Why is this footnote to the success of the Summer Olympics important? Because it shows that Los Angeles can take on an ambitious air quality challenge and succeed.

The Clean Air Act requires areas not meeting ozone and carbon monoxide standards by December 31, 1987, to face sanctions that include restrictions on federal highway funds, sewage treatment plants, air pollution control grants, and prohibitions on construction or growth of certain major industrial sources.

Four areas in California have a high likelihood of not meeting the 1987 deadline: the Los Angeles metropolitan area (or South Coast Air Basin); Fresno for ozone and carbon monoxide; and Ventura and Sacramento for ozone only.

For the Los Angeles area, expected improvements in air quality notwithstanding, attainment of the air quality standards by 1987 is impossible. Because of this, Region 9 has initiated a program—the Reasonable Efforts Program—which we believe will result in emissions reductions and cleaner air without major life-style changes or crippling costs to taxpayers. This program seeks a regulatory solution for areas like Los Angeles that face the threat of sanctions for missing the 1987 deadline, but are willing to move beyond the level of controls already in place and to try harder to give an extra effort, as Los Angeles did during the Olympics.

The Reasonable Efforts Program has two distinct phases. The first presses for adoption of additional technically feasible control measures. Although EPA will have the first cut at evaluating the feasibility of such measures, state and local agencies will help EPA determine the appropriateness of a particular measure for a specific area. Based on an agreed-upon list of additional measures, local and state agencies and EPA will take appropriate actions to control pollution sources further.

The second phase is aimed at maximizing the effectiveness of air plans and programs by auditing or oversight. Auditing will look at enforcement, permitting, emission inventory gathering, and rule effectiveness. Again, EPA will work closely with local and state agencies.

The Reasonable Efforts Program is an ongoing process. New measures will be regularly considered. Existing controls will be re-evaluated periodically.

In large part, Region 9's approach is based upon policy set in 1983 by former Administrator William Ruckelshaus when he committed the agency to : 1) expeditiously carry out the Clean Air Act; 2) move the nation closer to the health goals of the Act; 3) strengthen federal, state and local air pollution programs; 4) treat all parties fairly; 5) provide incentives for states to fulfill their planning and implementation obligation—rather than punish them for failures; and 6) avoid unnecessary economic disruption.

Region 9 has taken this policy to mean that sanctions should be avoided if they do not improve air quality. Sanctions, however, can serve as a useful incentive to obtain positive results. This was evidenced by California's adoption of an inspection and maintenance program following invocation of a construction ban and highway funding restrictions.

However, we do not support invoking sanctions in areas making reasonable efforts to take steps to promote progress toward achievement of federal air standards, even if attainment of those standards by 1987 is impossible. In other words, an area should not be penalized for doing the very best it can.

This approach can result in significant emissions reductions and cleaner air. EPA Headquarters and other EPA regions have expressed interest in the Reasonable Efforts Program and are assessing its broader applicability.

Our region will continue to set priorities to ensure that best efforts are made to achieve clean air goals. The Reasonable Efforts Program is a practical solution for areas with intractable air pollution problems.

It has the possibility of producing more environmentally effective results than sanctions. If so, the environment will benefit, the people will benefit, and our public policy will benefit, and that is about the best we can do. □

Handling a Pollution Emergency

by Christopher J. Daggett

This is the eighth in a series of articles in the EPA Journal *by the agency's regional offices on environmental problems they are addressing. The author is Administrator of Region 2.*

Douglas Love, The Southampton Press

At a public meeting with Sag Harbor residents last January, Bob Cobiella (left), EPA on-scene coordinator, explains plans to extend the public water main to homes with contaminated wells. Local officials present were (left to right) Southampton Town Supervisor Martin Lang, Deputy Supervisor Wayne Allen, and town engineer Elias Kalogeras.

Imagine beginning each day with a drive across town to use a friend's shower, or preparing your meals, washing your hands, and brushing your teeth with bottled water. How would you feel about running down to the local firehouse for a drum of clean water whenever your supply ran out?

For 11 months, this was the routine for 16 families living in Long Island's tiny Sag Harbor community. Their private water wells were contaminated by a 500-foot-wide, half-mile-long plume of ground water polluted with volatile organic chemicals from a nearby industrial site.

Thanks to some of the residents' diligence, however, as well as the concerted work of elected officials and environmental authorities, potable water began flowing again from the taps of their homes in February of this year. The events that led to this fortunate conclusion demonstrate what can be accomplished when the federal, state, and local governments coordinate their efforts in response to the mysterious and complex problem of ground-water contamination.

In the fall of 1983, Charles Soffel and his wife discovered that their well water was making them ill. They contacted Suffolk County's Department of Health Services (SCDHS), which in turn tested the well and found it contaminated with toxic chemicals. As SCDHS made plans to sample other wells in the area, neighbors of the Soffels began coming forward with complaints about their own water and the trouble it was causing them. Residents' fears that their drinking water was seriously contaminated were confirmed when the sampling of the wells showed traces of trichloroethane and trichlorethylene, toxic industrial solvents used by manufacturers for fumigation and metal degreasing. These solvents are potentially carcinogenic and known to cause skin irritation, fatty degeneration of the liver, and even cardiac arrest, when consumed in large enough doses.

Further testing by SCDHS determined the origin of the contamination to be in the ground water under the nearby Sag Harbor Industries facility. Health officials advised the residents not to use their well water for drinking or household purposes.

Experts agreed that the only practicable long-term solution for the home owners would be an extension of the public water main into the affected area. The Southampton Town Board, the local governing authority, noted that estimates of the cost of the extension were running as high as $500,000 and informed the residents that its funds were insufficient to underwrite the project.

Faced with the prospect of funding the construction themselves, residents turned to their elected representatives. Southampton Town Supervisor Martin Lang, U.S. Congressman William Carney, and U.S. Senator Daniel Patrick Moynihan. In turn, the representatives petitioned New York State for immediate funding. In September, SCDHS forwarded an official request for funding to the New York State Department of Environmental Conservation (DEC).

The DEC responded that, because of state budgetary constraints and built-in administrative delays, it would be unable to provide funding quickly enough to alleviate the Sag Harbor situation. DEC was aware, however, that under the Superfund program, EPA had the necessary funds, as well as the authority, to clean up the site before seeking compensation from the parties responsible for the contamination. On November 5, DEC asked the EPA Region 2 office to study the eligibility of the project for Superfund backing.

One week later, the regional office sent a team of investigators to the site. Thanks to the outstanding job done by SCDHS and New York State's DEC, the data the team had to work with were much more extensive than typically encountered. Using these data as a base, the team conducted further tests and determined that actual contamination existed at the tap for about 45 people, and 39 more were threatened with exposure. The contaminant plume was reported to be moving at a rate of one to two feet a day, and all 28 homes within or adjacent to the plume were considered to be at risk.

It was clear that conditions at the Sag Harbor site presented an immediate threat to the health of the residents and, therefore, met the criteria for a removal action under the Superfund statute (in this case, actually an action to install water pipe). When EPA announced its decision on December 7, the reaction of residents and local officials was, as expected, very positive.

As originally outlined, the regional office plan was to provide an interim solution to the problem by installing individual carbon filtration units in those houses with contaminated wells. We planned to install public water mains, taps, meters, and hook-up lines in the spring, when the warmer temperatures would make the necessary excavation work feasible.

It was discovered, however, that the water mains could be installed immediately, provided that temperatures remained seasonable. Accordingly, on January 19 the Suffolk County Water Authority, under a contract with EPA, began laying some 4,000 linear feet of water main. In the weeks that followed, work progressed faster than expected and the original target date for completion was moved up from March 20 to March 7. The accelerated work schedule, coupled with the abandonment of the installation of carbon filters as an interim solution, cut the final contract cost of the project from $440,000 to $310,000.

Now that the bulk of the construction work is done, and residents have access to clean water, EPA and the state are considering several potential options for removing the actual source of the contamination from the Sag Harbor Industries site.

EPA is also moving to collect compensation for the costs it has incurred in the construction project. Under Superfund law, any parties which generated or transported the industrial wastes that contaminated the ground water, or owned the site at which the waste was generated are liable for the costs of removal and construction. EPA is in contact with the current owner of the site, Sag Harbor Industries, as well as a former owner, Nabisco Brands, and we are hopeful that the issue can be settled without a protracted legal dispute.

One factor that has contributed to the success of the Sag Harbor project is a general awareness on Long Island of the critical status of the area's ground-water supply. The island's underground aquifers have the highest per capita usage in the United States and, as such, are the most heavily monitored. In fact, ground water is the sole source of water supply for residents of the island, and also the predominant source of fresh water for the area's wetlands, rivers, and bays. The village of Sag Harbor is situated in the middle of Suffolk County's most critical watershed recharge site, where precipitation flows deep into the Glacial Aquifer.

The ground-water issue is beginning to get the attention it requires, not only on Long Island, but around the country. The consumption of ground water is increasing at twice the rate of surface sources of fresh water and it won't be long before most Americans will rely on ground water for their drinking supply. Many regions and communities simply could not exist without clean and dependable ground water.

Unfortunately, through the early 1970s, ground-water problems were pushed to the bottom of the national agenda as the public and private sectors concentrated on more visible pollution. In time, as the nation met many of the challenges posed by polluted air and surface water, it was able to focus on the more complicated question of ground-water contamination. The increasing ability to measure contamination at much lower levels than before also helped bring the issue to the foreground of public debate.

In 1983, EPA created a ground-water task force to develop a strategy for protection of this vital resource (see *EPA Journal*, July/August 1984). The task force found, among other things, that state, local, and federal officials are hampered in their protection initiatives by a lack of coordination among responsible agencies. After an extensive analysis of EPA statutory authorities, as well as existing state ground-water programs, the task force also concluded that the nature and variability of ground water make its management the primary responsibility of the states. The group's study reiterated EPA's commitment to assisting the states where necessary and to strengthening a federal-state partnership that will ensure the most effective use of our resources for protecting ground-water quality.

The cooperation among state, federal, and local levels witnessed at the Sag Harbor cleanup bears out the conclusions of the task force. We in Region 2 are aware that we must serve as a resource for local government, and provide the expertise of our experienced personnel. Moreover, when the threat to human health is significant and requires the immediate funding that can only be provided under a program like Superfund, we will take the necessary action. □

Update

A review of recent major EPA activities and developments in the pollution control areas.

AIR

Acid Rain Implementation Grants

EPA has announced the first of a series of grants to states for exploring solutions to problems they can expect to face should a national acid rain control program be adopted.

Awards totaling $590,000 have been made to Wisconsin's Department of Natural Resources, the New York State Department of Environmental Conservation, and an organization of northeastern states for projects to identify and explore the implementation problems which might be associated with any potential acid rain control program.

Congress appropriated $3 million for the STAR (State Acid Rain) program, which encourages states to use their perspectives and existing air pollution management expertise to find solutions to the implementation challenges posed to states by any potential national acid rain program.

State, local, and regional agencies from all parts of the U.S. have submitted over 50 proposals to EPA, with funding requests totaling $60 million.

HAZARDOUS WASTE

Incineration Studies

EPA has released two studies that examine the environmental effects of incineration of liquid hazardous wastes at sea and on land. The studies are part of the continuing effort to provide information for EPA decisions on hazardous waste management options.

The studies were carried out during the past year by the EPA Office of Policy, Planning and Evaluation (OPPE) and the agency's Science Advisory Board (SAB) at the request of the Administrator.

The purpose of the OPPE study was to collect in one place all currently available information on incineration, including its advantages and disadvantages, and the issues associated with its use.

The purpose of the SAB study was to identify those scientific aspects of incineration where it was felt that additional research was needed.

Both the OPPE study and the SAB study, undertaken for different reasons, conclude that incineration is a method for disposing of liquid organic hazardous wastes that is environmentally preferable to current land disposal methods.

PESTICIDES

Proposed Penalty for Diamond Shamrock

EPA's Office of Pesticides and Toxic Substances has issued an administrative civil complaint against the Diamond Shamrock Chemicals Company of Irving, Tex., assessing a $1,782,000 proposed penalty for violations of the Toxic Substances Control Act (TSCA).

EPA is citing the company for three counts of failing to notify EPA prior to the manufacture of three new chemicals (TSCA requires all U.S. companies to notify EPA 90 days prior to manufacturing a new chemical so the agency can conduct a health effects review). The complaint also cites the company with one count of using an illegal chemical substance for commercial purposes.

Diamond Shamrock voluntarily disclosed this violation information to EPA. The chemical names cannot be released by EPA because the company has declared them confidential business information under Section 14 of TSCA.

2,4,5-T and Silvex Registrations Terminated

EPA has terminated all registrations for the once commonly used weed and brush killer pesticides, 2,4,5-T and Silvex. At the same time, the agency ended the cancellation proceedings for these two pesticides. The agency's actions culminate more than a decade of government action aimed at regulating these pesticides.

Although the registrations for 2,4,5-T and Silvex have now been canceled, existing stocks of certain canceled 2,4,5-T and Silvex products may be sold and distributed for a limited time for certain uses which were not suspended in 1979. However, the period to use existing stocks already has expired for most affected products, and within approximately one year 2,4,5-T and Silvex will no longer be available in the U.S. marketplace.

TOXICS

Union Carbide Agrees to MIC Production Changes

EPA, through its participation in an intergovernmental task force technical review, has determined that resuming production of methyl isocyanate (MIC) at Union Carbide's Institute, W. Va., plant will not endanger the residents of the Kanawha Valley.

In announcing the decision on April 16, EPA Regional Administrator James M. Seif gave background on the investigation: "In light of the accident at Bhopal, India, we initiated a technical review involving a wide range of government experts to respond to public concerns about the likelihood of a major release of MIC at the Institute plant. We have thoroughly reviewed Union Carbide's MIC unit, as well as contingency planning in the Valley."

Members of the task force, which was formed in January, included EPA, the U.S. Occupational Safety and Health Administration, the West Virginia Department of Natural Resources, and the West Virginia Air Pollution Control Commission. The Federal Emergency Management Agency provided technical assistance. The task force inspected the plant and independently evaluated information, including data from Union Carbide, using basic principles of engineering,

physics, and chemistry as well as standard industrial practices and technical judgment.

Union Carbide has agreed to make the following modifications before MIC production resumes:

- Increasing the neutralization and destruction capacity of control equipment;
- Modifying relief valves;
- Modifying and strengthening operating procedures for MIC storage and handling;
- Installing a leak detection system;
- Installing a computerized system to predict the path and concentration of an air release;
- Installing backup temperature and pressure detection devices in production and storage tanks;
- Modifying the internal emergency response plan;
- Reducing the amount of MIC in storage.

WATER

Clean Water Act Proposal

EPA has outlined the Reagan Administration's proposals for reauthorization of the Clean Water Act. This is the Administration's second proposed bill to reauthorize a major environmental law. The first was the Comprehensive Environmental Response, Compensation and Liability Act (Superfund), which was submitted to Congress on February 22.

Among the Administration's chief proposals are provisions for strengthening the enforcement of the Clean Water Act, refining the permitting system used to regulate dischargers, and phasing out the construction grants program by the end of this decade.

The Reagan Administration's bill recommends changes in the enforcement provisions. These include an option allowing EPA to assess penalties of up to $10,000 per day per violation with a maximum penalty of $125,000. The option of assessing administrative penalties already is available under other environmental statutes, but this would be the first time such penalties would be employed under the Clean Water Act. Also, the daily maximum penalty per day which could be imposed by court action would be increased from $10,000 to $25,000 per violation.

In addition, criminal penalties would be increased. Penalties for knowing violations of substantive provisions of the act have been increased to felony levels. Maximum fines for knowing first offenses have been increased to $50,000 and terms of imprisonment up to three years.

Also, maximum prison sentences for knowingly making false statements, representations, and certifications, or tampering with monitoring equipment have all been increased from six months to two years. Another new provision would be added to the act providing for stronger felony penalties for certain conduct which knowingly threatens "imminent danger of death or serious bodily injury."

12-Mile Site Petitions Denied

EPA has announced its final determination to deny petitions to re-designate the 12-Mile Sewage Sludge Dump Site in the New York Bight Apex. The site has been used since 1924 for ocean dumping of municipal sludge.

The decision means that several current municipal sludge dumpers will no longer be allowed to dispose of municipal sludge within 12 miles of the New Jersey and Long Island, N.Y., shores.

Instead, they must relocate their dumping operations to the designated Deepwater Municipal Sludge Dump Site (formerly known as the 106-Mile Site), which occupies an area of 100 square miles. This site is located approximately 120 nautical miles southeast of Ambrose Light, N.Y., and 115 nautical miles from Atlantic City, N.J., the nearest coastline. The site is in water depths ranging from 7,380 to more than 9,000 feet.

EPA determined that the deepwater site is environmentally preferable since living resources there are more sparse and less valuable. Because of its great depth and the dispersion of dumped material by currents, disposal of municipal sludge there will result in relatively low concentrations of contaminants and reduced environmental impacts. Its greater distance from the coastline will also reduce the potential for any impact on shorelines, beaches, and near-shore recreational activities.

Pretreatment Program Changes Proposed

A special task force has urged EPA to simplify procedures, impose tougher enforcement, and increase resources for its program dealing with pretreatment of industrial wastewater discharged into publicly owned treatment plants.

The recommendations are included in the final report to EPA Administrator Lee M. Thomas from the Pretreatment Implementation Review Task Force. The panel, created in February 1984, included representatives from state and city governments, industry, public interest groups, and EPA regional offices.

Many industrial facilities release their liquid wastes to publicly owned treatment works rather than into a waterway. The Clean Water Act directed EPA to establish national standards for pretreatment of this wastewater since it could either cause the plants to malfunction or pass through and contaminate sewage sludge and waterways.

In 1978, EPA proposed regulations and a national pretreatment strategy. However, dissatisfaction with the rate of progress in achieving its goals last year led former EPA Administrator William D. Ruckelshaus to create the task force for the purpose of advising the agency on how the program could be made more effective.

The panel was headed by Rebecca Hanmer, Director of the EPA Office of Water Enforcement and Permits. EPA has already initiated work on a number of the task force proposals.

AGENCYWIDE

Faculty Exchange Progam

This summer, EPA's Region 5 office in Chicago will inaugurate a faculty exchange program with Clark College, Talladega College, and Savannah State University. The 16-week pilot program is designed to familiarize selected science and engineering faculty at these colleges with EPA's mission, personnel, and operations as well as the agency's current research and development needs.

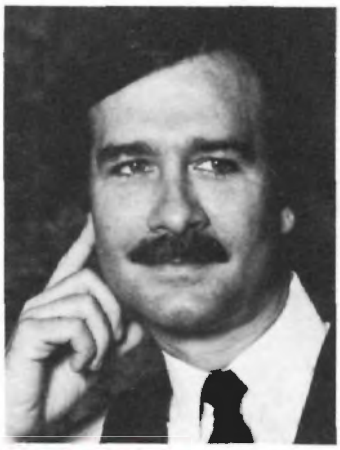
Through closer association with these and other historically black colleges and universities, EPA hopes to generate new perspectives on environmental problems and innovative approaches to their solution. The agency would like these colleges and universities to become new centers for environmental studies and ecological research. Students enrolled in science and engineering courses at these schools could also help to meet EPA employment needs in the years ahead.

The names of the first four participants in the faculty exchange program were to be announced at the end of April. All four will work from June to August in the Environmental Services Division of EPA Region 5 □

Appointments at EPA

Linda J. Fisher

F. Scott Bush



Terrell E. Hunt

Frederick F. Stiehl

Linda J. Fisher has been named Executive Assistant to EPA Administrator Lee M. Thomas. In her new position, Fisher is serving as the Administrator's senior staff advisor on all policy and legislative matters.

Fisher came to EPA in 1983, shortly after Lee Thomas began his tenure as Assistant Administrator for Solid Waste and Emergency Response (OSWER). She served as his Special Assistant in OSWER from July 1983 until the beginning of this year.

In 1983, Fisher worked as a lawyer with the firm of Chester, Hoffman, Willcox in Columbus, Ohio. From 1980 to 1982 she studied for a J.D. at Ohio State University.

Fisher was an associate staff member of the U.S. House of Representatives Appropriations Committee from 1979 to 1980. She was a legislative assistant to Congressman Ralph Regula (R.-Ohio) from 1976 to 1978. She began her career on Capitol Hill in 1974 as a legislative assistant to Congressman Clarence J. Brown (R.-Ohio).

In addition to her 1982 J.D. from Ohio State, Fisher has a 1978 M.B.A. from George Washington University and a B.A. in History from Miami University of Oxford, Ohio.

F. Scott Bush has been appointed Director of the Analysis and Evaluation Division in EPA's Office of Water. In his new position, Bush will be responsible for the analysis of EPA's Water Regulations and Standards as well as administering various grant programs to the states.

Bush comes to EPA from the U.S. Department of Energy (DOE), where he has held a variety of executive positions since 1977. Most recently, he served in DOE's Economic Regulatory Administration, where he managed DOE's petroleum, electricity, and natural gas import programs.

In 1981, Bush served as Acting Director of the Programs Operations Office in DOE's Economic Regulatory Administration. From 1979 to 1981 he was DOE's Assistant Administrator in charge of regulatory policy.

Bush also served in several high-level positions in the Federal Energy Administration (FEA), which became part of DOE in 1977. From 1976 to 1977 he served as FEA's Acting Associate Administrator for Policy and Evaluation.

From 1973 to 1974 Bush worked as a Special Assistant to the Executive Director of the Cost of Living Council. He was Assistant Executive Secretary of the Pay Board from 1971 to 1973. From 1968 to 1971 Bush was program specialist for the Economic Development Administration at the U.S. Department of Commerce. He worked as a lawyer for McDermott, Will & Emery of Chicago from 1967 to 1968.

Bush studied for his law degree at Northwestern University Law School from 1964 to 1967, when he received his J.D. He completed his undergraduate education at Dartmouth College, where he graduated with a degree in Political Science in 1959.

From 1959 to 1961 Bush served in the U.S. Army. He was a Foreign Service Officer with the Department of State from 1961 to 1964. Among other duties, he served for two years in the U.S. Embassy in Tunisia.

Terrell E. Hunt has been appointed Director of the Criminal Enforcement and Special Litigation Division of EPA's Office of Enforcement and Compliance Monitoring (OECM). In his new position, Hunt will supervise three units within OECM: the Office of Criminal Enforcement, which houses the headquarters attorneys assigned to the criminal enforcement program; the Legal Enforcement Policy Division, which establishes generic cross-media enforcement policy; and the Special Litigation Division, which litigates enforcement actions arising from the pesticides and toxic substances programs.

Hunt first joined EPA in July 1972 as a Management Intern, and served rotational assignments in four different offices at EPA headquarters to gain practical experience in a variety of areas. From 1973 to 1983 he served in various staff and supervisory positions in the pesticides and toxic substances enforcement program of the Office of Pesticides and Toxic Substances (OPTS).

Hunt became Chief of the enforcement program's Policy and Strategy Branch in 1979. In 1983 he served as a Special Assistant to former Deputy Administrator Al Alm.

Prior to joining EPA, Hunt was a research assistant in the Executive Office of the President, Office of Emergency Preparedness.

Hunt graduated with high honors in economics from Brigham Young University in 1970. He received his J.D. from the Georgetown University Law Center in 1976 and is a member of the District of Columbia Bar.

Hunt, who has received several cash awards for his work at EPA, won an EPA Bronze Medal in 1975.

Frederick F. Stiehl has been named Associate Enforcement Counsel for Waste in EPA's Office of Enforcement and Compliance Monitoring (OECM). In his new position, which he has held on an acting basis since August 1984, Stiehl is responsible for overseeing EPA's national enforcement litigation program under the Resource Conservation and

Susan H. Sherman

Margaret J. Stasikowski

Dr. Charles E. Findley

Recovery Act and the Comprehensive Environmental Response, Compensation and Liability Act.

Stiehl has been with EPA since 1979 in a variety of executive positions. Until 1981 he was a senior attorney-advisor charged with providing advice and support to regional legal staff. For eight months in 1981 he was Chief of the Office of Hazardous Waste Enforcement Litigations Branch. In December 1981, Stiehl began serving as Deputy Associate Enforcement Counsel in OECM, a position he held until 1984.

From 1972 to 1979, Stiehl served as a trial attorney in the Office of the Corporation Counsel of the District of Columbia government. He was Chairman of the Howard County Mental Health Advisory Board in Columbia, Md., from 1976 to 1982. From 1970 to 1972 Stiehl was an assistant editor at the Bureau of National Affairs, Inc.

Stiehl received his J.D. from the Washington College of Law of American University in 1970. He completed his undergraduate education at Rutgers, where he graduated with a B.A. in Political Science in 1967.

Susan H. Sherman has been named Deputy Director of the Office of Pesticide Programs in OPTS. In this position, which she has held on an acting basis since June 1984, Sherman plays a key role in managing and directing EPA activities in regulating the 45,000 pesticide products now marketed in the United States.

Sherman began her civil service career as a caseworker at the USDA Food and Nutrition Service in 1968. She joined EPA in 1972 as a writer-editor in the Registration Division of the Office of Pesticide Programs. In 1974 Sherman was named Chief of EPA's External Affairs Unit, a position she held for five years.

In 1979 Sherman became Acting Deputy Director of the Hazard Evaluation Division in the Office of Pesticide Programs. She held that position until 1980 when she became Chief of OPTS's Policy and Special Projects Staff.

Sherman received her B.A. in English from the College of William and Mary in 1968. She was the recipient of EPA's Gold Medal in 1978 and the agency's Bronze Medal in 1976 and 1979. In 1983 she received an EPA Special Achievement Award. Also active in civic affairs, Sherman is on the Board of Directors of the Falls Church Village Preservation and Improvement Society.

Margaret J. Stasikowski has been appointed Director of the Chemical Control Division in EPA's OPTS. In this position, which she has held on an acting basis since March 1984, Stasikowski is responsible for management of the Toxic Substances Control Act (TSCA) Premanufacture Notice Review Program and regulation of new and existing chemicals under Sections 5, 6 and 7 of TSCA.

Stasikowski joined EPA in 1974 as a physical science administrator in the Office of Research and Development. Between 1975 and 1977 she worked as a physical scientist in EPA's Industrial Environmental Research Laboratory.

From 1977 to 1980 Stasikowski worked as Chief of the Office of Operations of the Certification Division of the Mobile Source Pollution Control Program in Ann Arbor, Mich. She returned to EPA headquarters in 1980 as a Special Assistant to the Director of the Office of Toxic Substances. In 1981 she became Deputy Director of the division she is now directing.

From 1973 to 1974 Stasikowski was an industrial hygienist with the Oil, Chemical & Atomic Workers Union in Denver.

Stasikowski received her M.S. in industrial hygiene and air pollution control from the University of Cincinnati in 1973. She received her B.S. from Ohio State University in 1970.

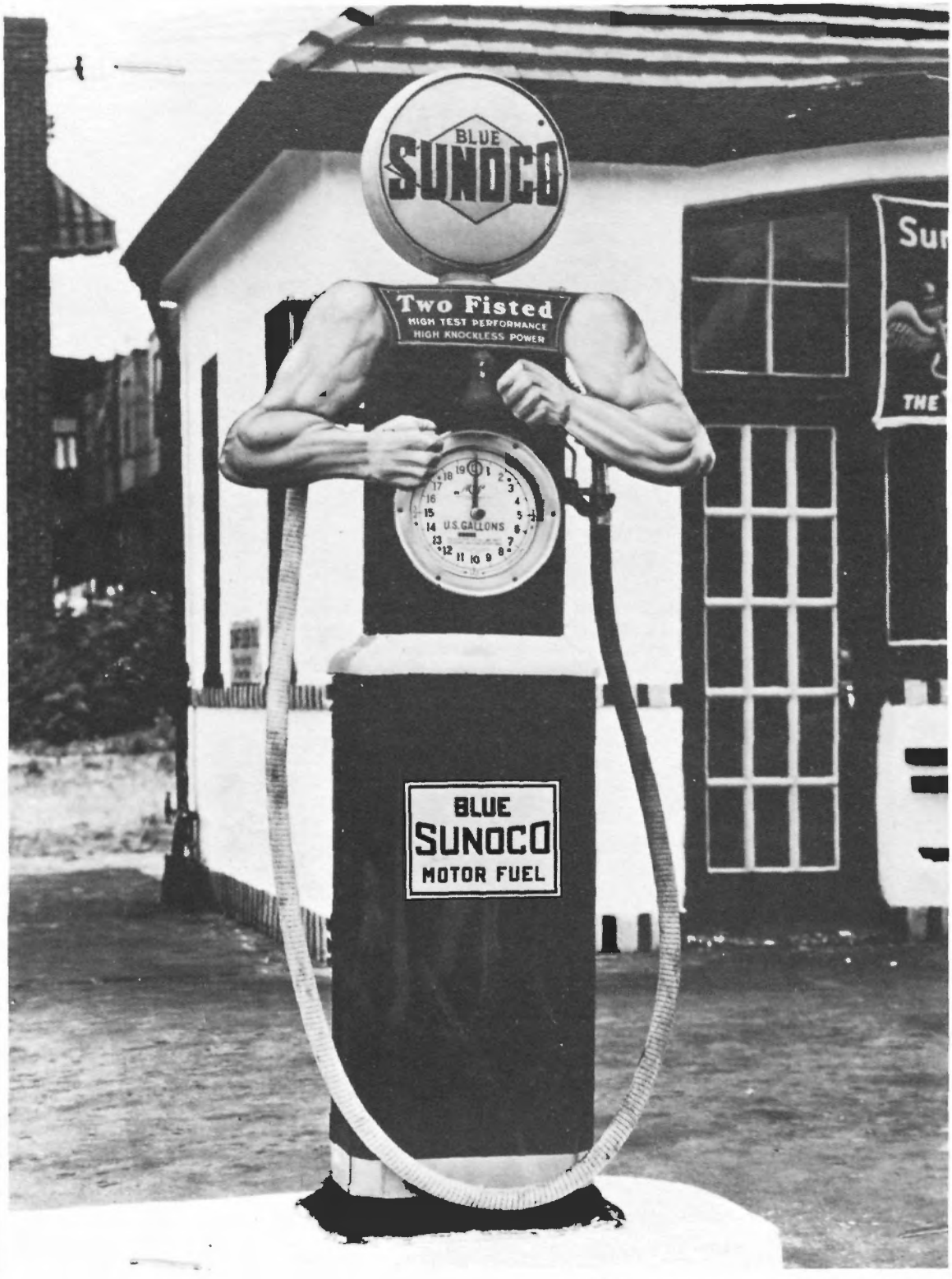
Dr. Charles E. Findley has been named Director of the Hazardous Waste Division at EPA's Region 10 office in Seattle. In this position, he will be responsible for implementing the RCRA and Superfund programs in Region 10.

For the past five years, he has served in Region 10's Air and Waste Management Division, first as its Deputy Director and then as its Acting Director.

Dr. Findley has been with EPA's Region 10 office since the beginning of his civil service career. He began working there in 1971 as a mechanical engineer. In 1974 he became the Chief of Region 10's Air Operations Section. He held that position for three years.

In 1977 Findley became Chief of the National Pollutant Discharge Elimination Standards Permits Section in Region 10. Between 1979 and 1980 he worked on an intergovernmental personnel assignment in the Mayor's Office of Intergovernmental Relations in Seattle.

Dr. Findley received his B.S. in Mechanical Engineering from the University of Washington in 1966. In 1971 he was awarded an M.S. in Engineering from the same university. Simultaneously in 1978, Findley completed his Ph.D. in Engineering at the University of Washington and his M.A. in Public Administration at Harvard. □



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In 1932, a gas pump advertises "two fisted motor fuel" to boost engine performance. Today, more than 40 percent of all U.S. pump sales are still of leaded gasoline.

Back cover: A scenic panorama of Magens Bay on St. Thomas, U.S. Virgin Islands. Photo by Michael Flaherty, EPA.

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