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EPA JOURNAL

Toward a Conserving Society

The Washington Post

April 22, 1970: Thousands of people gather on the grounds of the Washington Monument in Washington, D.C., to demonstrate their support for Earth Day.

Toward a Conserving Society

Earth Day 1970 marked an environmental awakening in America. This issue of the *EPA Journal* explores the impact of that awakening on our society.

Leading off the issue, EPA Administrator Lee M. Thomas examines the results of the dramatic increase in national environmental concern. Another article reviews public attitudes on environmental problems as revealed in opinion polls year by year.

An article describes the revolution that has taken place in the design of the automobile as a consequence of environmental and energy concerns. Another piece reports on the striking changes that one large electric utility has implemented as a result of environmental regulations.

The impact of Earth Day on consumer packaging is reviewed. Developments in industry recycling—another focus of Earth Day—are described. Integrated Pest Management—a goal of early environmentalists—is also discussed.

A final article related to the issue's theme looks beyond the changes to date and asks what needs to be done to ensure environmental progress in the future.

Feature stories in this issue of the magazine include an article describing what was done to ensure a safe restart of production of methyl isocyanate at Union Carbide's plant in Institute, W. Va. Production had been halted after the Bhopal, India, disaster. This is the last of a 10-part series in the *Journal* by EPA regional offices.

Another article reports on activity by the chemical industry aimed at making better preparations to deal with emergencies.

A feature describes an unusual Superfund site—caves under Bowling Green, Ky. Another article describes a clean water success story at Tillamook Bay, Ore. And an article reports on the pollution that has been appearing in the Arctic skies, pristine no longer.

This issue of the *Journal* concludes with two regular features—Update and Appointments. □

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EPA is charged by Congress to protect the nation's land, air, and water systems. Under a mandate of national environmental laws, the agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.

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A New Sense of Environmental Responsibility

by Lee M. Thomas

The American public's environment is by no means yet restored to an acceptable condition. Reversing the damage inflicted by a century of economic growth is not an overnight proposition. However, recent progress in controlling air pollution and protecting water resources demonstrates that we are on the right track.

Indeed, for anyone with a sense of history, the recent shift in attitude toward the natural world dating, let us say, from Earth Day 1970, is extraordinary in its breadth, depth and intensity. A new sense of responsibility for our environment is evident everywhere.

Developments in environmental technology are also encouraging. The internal combustion engine is becoming more efficient and that means not only fewer harmful exhaust emissions but more miles per gallon as well. Industry uses 40 percent less energy to produce a given dollar of gross national product than it did 15 years ago and that lowers extraction-driven damage to ambient air and water. Recycling of materials we used to throw away can be expected to accelerate as business and municipal governments recognize that trash is really "urban ore," a storehouse of cheap raw materials and recoverable energy. Cogeneration of power and steam appeals to more and more managers, and alternative sources of sustainable energy such as geothermal, wind, marithermal, and low-head hydropower are often realistic options as we gain engineering and market experience.

"I think it can safely be said that nothing we do or fail to do in our environment is without consequences, positive or negative, and that everything truly is connected to everything else."—Lee Thomas.

In addition, we are more acutely aware today of the necessity of continuous management of toxic substances and hazardous wastes. Indeed, here stands the greatest challenge to our ability to ensure a clean environment, for toxics are all-pervasive. Fortunately, we at last have the legislative tools in RCRA and Superfund to get a grip on these problems in the months and years ahead.

On the biological front, we can be gratified to see the activity in integrated pest management, the spread of no-till cultivation, and the emerging conviction that soil erosion control is essential not only to limit a major nonpoint source of water pollution, but to ensure agricultural productivity over the long term as well.

I think it can safely be said that nothing we do or fail to do in our environment is without consequences, positive or negative, and that everything truly is connected to everything else. Pollution control, resource management, demographic policy, growth rates, natural systems, geopolitical events, and national security are bound together like the strands of a Gordian knot. We often deny or overlook the interdependence of systems phenomena, but they are real and all too demonstrable. We ignore them at our peril.

Fortunately, such "invincible ignorance" is no longer fashionable. We Americans have recognized our necessary role as environmental stewards; we have set other nations a timely example of leadership over the last decade and a half. I have no doubt that we will consolidate our gains and achieve still more in the challenging years ahead. □

(Thomas is Administrator of EPA.)

A Revolution in Auto Design

by Karl Hellman

Many factors influence the composition of the fleet of cars that Americans buy and use. The state of the national economy, how much money people have to spend, how confident they feel about the future, and the price of gasoline are all known to affect the kinds of cars people buy. Regulations have also influenced the design of cars, especially emission standards and fuel economy requirements.

The first nationwide car emission standards were effective in 1968 (prior to the formation of EPA), but it was the changes to the Clean Air Act made in 1970 that focused attention on cars as major contributors to pollution. Congress wanted our cars to be ten times cleaner in just five years! This was a monumental technical challenge to the automobile industry which claimed that the timetable was too short and that the reductions couldn't be met. The early 1970s were thus a contentious period, full of wrangling over emission standards and timetables, and some timetable extensions were granted.

Major technological approaches became evident right away. It was apparent that radically new propulsion systems such as batteries or fuel cells were not going to be implemented in such a short time-frame; therefore, conventional engines were going to have to meet the standards. For the tenfold reduction in emissions needed, cleanup of the emissions outside of the engine looked like the approach with the highest potential. After massive research and development efforts by the automobile industry, emission control systems that used catalysts were generally selected as having the most promise. These systems were phased in during model year 1975.

(Hellman is Chief of the Controls Technology and Applications Branch at EPA's auto emissions laboratory in Ann Arbor, Mich.)

Early signals were sent to the energy industry by the car makers that a new kind of gasoline was going to be needed for nearly all of the 1975 models, a fuel that did not have any lead in it because lead would destroy the catalyst's cleanup effectiveness. EPA worked with the automobile and energy industries to develop requirements for the availability of this new gasoline, and the partnership in providing the engine control systems and the necessary fuel was formed. This joint government/industry partnership continues today, working somewhat more smoothly now than it did initially.

Just as the automotive industry was coming to grips with the emission control requirements, Congress handed industry another difficult task: achieve roughly a twofold increase in average fuel economy within ten years. In addition, a "gas guzzler tax" would be applied to individual car models having poor fuel economy.

Therefore, by the mid-1970s, the automotive industry was faced with the twin challenges of making tremendous improvements in emissions and fuel economy performance. The car industry's efforts in response cost more than America's Apollo program.

The best way to track the progress made in controlling emissions from cars is to look at the quality of the air we breathe. Carbon monoxide is a good marker pollutant to study, because most of the carbon monoxide in our air comes from cars.

Air quality monitors are located at selected sites throughout the country. Data from one monitor near 45th Street in New York City, a site known to be heavily impacted by traffic, indicate that since the mid-1970s the number of times per year the air is unhealthy because of carbon monoxide has been reduced by over 90 percent.

Tail pipe hydrocarbon emissions provide another indication of how clean the new cars are. Tail pipe hydrocarbon

emissions come from what the engine doesn't burn and what the catalyst doesn't convert into harmless carbon dioxide and water. Today's cars emit only three-tenths of one percent of the fuel they consume as tail pipe hydrocarbon emissions, a tremendous accomplishment.

Steve Delaney

New cars lined up in a dealer's lot display stickers with information for consumers.

Since the mid-1970s, car fuel economy has also improved dramatically. On the average, new cars now get almost double the miles per gallon that they did then. No other consumer product has improved in efficiency as much.

What are the reasons for these great improvements in car emissions and fuel economy?

The simple answer is that everything has changed. Engines, transmissions, and bodies have all been redesigned and improved.

The accompanying table describes the typical new car then and now.

The table shows great changes in every category except one: interior room. Even though cars are lighter by half a ton now, and may be smaller on the outside, on the average the interior room has remained the same.

Other changes have also resulted in improvements. For example, maintenance intervals for spark plug and oil changes have been increased due to new technology and the use of unleaded gasoline.

The advances in technology have allowed us to have cleaner air and increased mobility at the same time. Future improvements in car emission technology can allow this trend to continue.

Although things are getting better, our efforts must be maintained because there are still major parts of our country that have unhealthy air. In some of these areas, EPA and the state and local governments are now asking the public to make sure that cars are tuned up correctly and that they aren't tampered with in a way that increases emissions. The service industry is also encouraged to learn how to tune up cars for low emissions. With EPA's help, state and local Inspection and Maintenance programs are tailored for each area to ensure that the most cost-effective emission reduction is attained.

All in all, the U.S. program to control emissions and improve fuel economy of cars has been one of the most successful carried out by any governmental agency anywhere in the world during the past 10 or 15 years.

The partnership formed among EPA, the automakers, the energy industry, the service industry, and the public has been successful. While we have not yet achieved 100 percent success, we have made tremendous strides. □

The Average Car - Mid-1970s and Now

	Then	*Now*
Engine		
Size (cubic inches)	290	180
Number of cylinders	8	4
Ignition system	points and condenser	electronic-high energy
Fuel metering system	carburetor	fuel injection
Kind of gasoline	leaded	unleaded
Emission controls	air pump	catalyst system
Transmission/Drivetrain		
Type	automatic	automatic
Speeds	3	4
Lockup	no	yes
Drive wheels	rear	front
Body		
Weight	4100	3100
Room (cubic feet)	110	110

Ohio Utility Takes a Giant Environmental Step

by Jack Lewis

On May 31, 1985, EPA Regional Administrator Val Adamkus, Ohio Governor Richard Celeste, Ohio Congressman Douglas Applegate, and Ohio Edison President Justin Rogers, Jr., gathered at Ohio Edison's W. H. Sammis power plant in Stratton, Ohio. These officials had come together to celebrate the completion of the most massive and expensive pollution control "retrofit" ever undertaken at a North American power plant.

It was a journey toward mutual understanding and respect between the public and private sectors.

Adamkus, who administers EPA's Region 5, spoke of the magnitude of this engineering and construction undertaking. "Early in the process," Adamkus stated, "I visited this site. I was impressed with the scope of the project and the vision that fostered it, and while I had confidence in the concept and believed in the plan, I had reservations also. The enormous scope of the task was staggering.

"Today the retrofit is a reality. As you all know, the road toward that reality was not always a smooth one. But it represents a journey toward more than the engineering accomplishment which we note here today. It was a journey toward mutual understanding and respect between representatives of the public and private sectors."

"Retrofitting" is the technical term for the process of renovating an existing facility to meet more modern needs and standards than its original designers envisioned. Even though Ohio Edison's W. H. Sammis plant is one of the largest ever built in the State of Ohio, the price tag of the Sammis retrofit was only $2 million less—in 1985 dollars—than the original cost of the entire plant: $440 million in 1971 dollars.

The first of Ohio Edison's Sammis boilers began producing electrical power in 1959. During the next twelve years, six more boilers went into service. The 2,233 megawatt capacity of the completed plant made it by far the largest unit in Ohio Edison's 12-plant network of coal-fired electric power plants.

Today, as much as 40 percent of all Ohio Edison electricity can come from that one power plant at any given time. Since 1971, the Sammis plant has been serving over 970,000 customers inhabiting a 9,000 square-mile area in central and northeast Ohio as well as western Pennsylvania.

By the mid-1970s, Ohio Edison's Sammis plant had become one of the worst industrial polluters in the Northeast. Every year it was spewing from 85,000 to 100,000 tons of particulate matter (fly ash, dust, etc.) into the air over Ohio, West Virginia, and Pennsylvania.

Ohio Edison's tardiness in reaching compliance with the Clean Air Act put the company on a collision course with EPA.

When originally built between 1959 and 1971, the plant was outfitted with electrostatic precipitators designed to remove 97 to 99 percent of particulates. That design potential presupposed the burning of high-quality coal.

The low- and medium-quality coal actually used at Sammis in the 1970s caused the plant's particulate removal rate to hit abysmally low levels ranging from 25 to 90 percent. These poor rates of particulate removal fell far short of

(Lewis is Assistant Editor of the EPA Journal)

Ohio's standard of 99.4 percent, which became federally enforceable in 1974.

Ohio Edison's tardiness in reaching compliance with the Clean Air Act put the company on a collision course with EPA. Rather than undertake a massively expensive retrofit in the 1970s, Ohio Edison continued to operate its outdated pollution control devices.

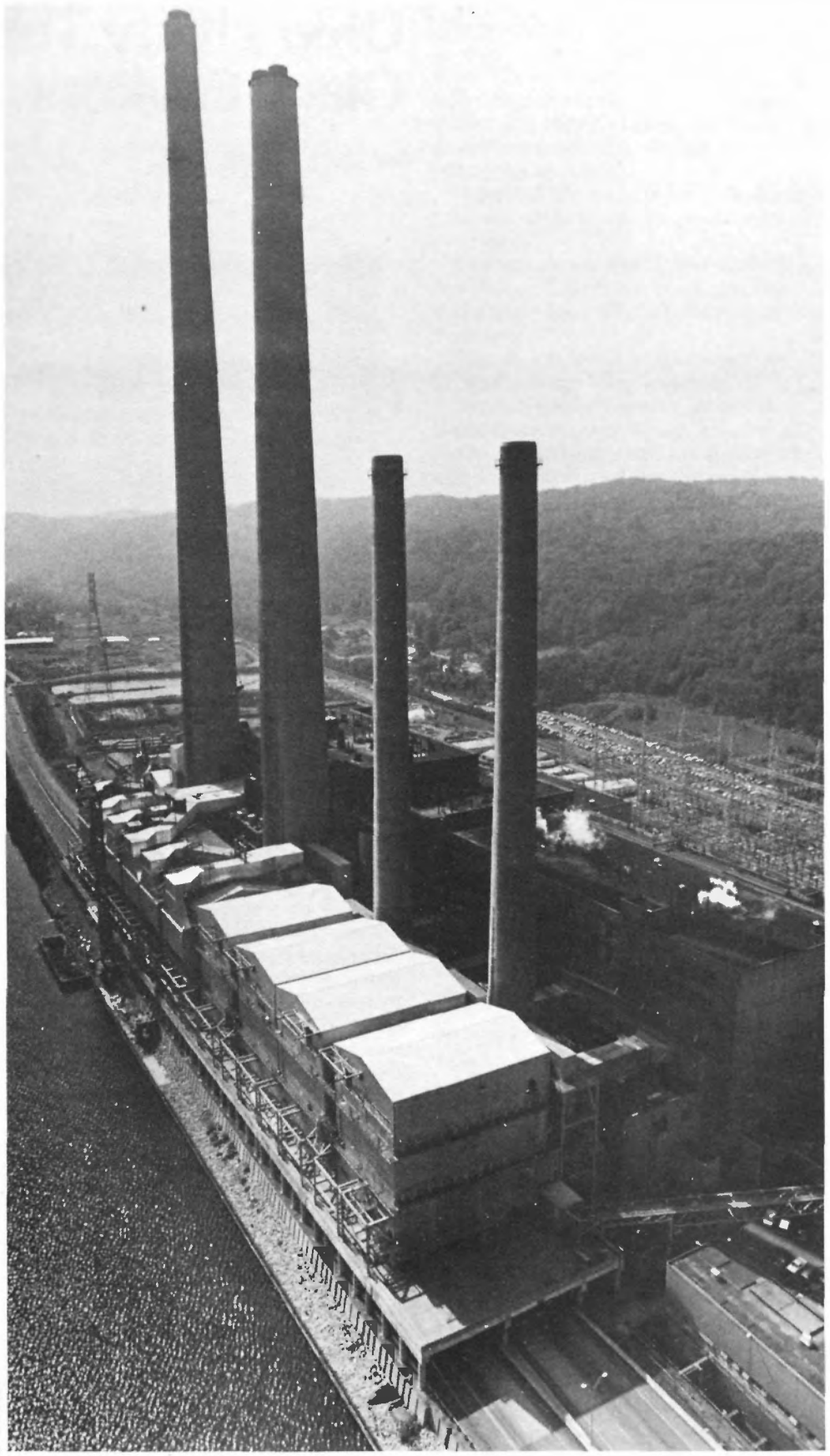
After repeated warnings from EPA, the company switched to higher grades of coal in 1979. This move was only a stopgap measure, however. It ended Ohio Edison's violation of federal emission limitations for sulfur dioxide and nitrogen oxides. But it left the problem of particulates unsolved.

Better quality coal did mean fewer particulates, but the reduction in particulate emissions still left Sammis far short of Ohio's standard of 99.4 percent particulate removal. Nothing short of a drastic renovation—or retrofit—of the Sammis plant could raise its actual particulate removal rate to the state standard.

The unusual nature of this engineering design made the logistics of construction a great problem.

As early as 1979, officials at Ohio Edison commissioned engineering designs for improving particulate removal rates at the Sammis plant. But a variety of factors, including a coal miners' strike, caused the company to delay implementation of this phenomenally expensive retrofit package.

In 1981, EPA obtained a consent decree that compelled Ohio Edison to take action. Under the negotiated settlement, Ohio Edison was ordered to pay fines totaling $1.7 million for its violations of the Clean Air Act. The consent decree also set rigid deadlines



Ohio Edison

Ohio Edison's W. H. Sammis power plant stands to the right in this picture, which is dominated by the four baghouses (foreground) and two electrostatic precipitators (background) built on a 915-foot-long concrete platform above Ohio Highway 7.

for cleanup of particulate emissions coming from the Sammis plant.

Justin Rogers, Jr.—who became Ohio Edison's President early in 1980—saw the wisdom of salvaging the huge Sammis plant through a massive environmental retrofit. Not even the pricetag of $438 million could shake his resolve.

Several factors influenced Rogers' decision. First, the Sammis power plant was still "young" by industry standards. The life expectancy of the plant had been 30 to 40 years when it was built between 1959 and 1971. Thus, by 1981, the oldest boiler unit at Sammis was 22 years old and the newest only 10. To build a comparable facility from scratch would have cost much, much more than its 1971 pricetag of $440 million.

Attaining lawful levels of particulate removal was the central objective of the Sammis retrofit, and Ohio Edison has met that goal.

Sound planning and solid execution were particularly vital to the success of this project, which entailed erecting six colossal particulate removal devices on a 915-foot-long concrete platform above Ohio Highway #7. The unusual nature of this engineering design made the logistics of construction a great problem, almost as great as the problem of devising an emissions limitation system capable of removing more than 99.4 percent of particulates.

Ohio Edison made its task easier by cooperating fully with EPA at every stage in the design and construction of the Sammis retrofit project. According to EPA engineer Michael Valentino, who monitored the project from the agency's Region 5 office in Chicago, Ohio Edison has been "most cooperative, willing to volunteer any needed information." In Valentino's opinion, Ohio Edison has made the Sammis retrofit "a model of efficient planning and solid engineering."

When all seven Sammis boiler units are in operation, compliance with Ohio's particulate emission limitations is achieved on a boiler-by-boiler basis at all the boilers. Each of the boilers is connected to a new electrostatic precipitator or baghouse, which removes particulates from boiler unit exhaust.

Baghouses were selected for installation on boiler units 1 to 4 because—unlike electrostatic precipitators (ESPs)—their performance is largely unaffected by the amount of sulfur in the coal burned. This enables units 1 through 4 to run on low-sulfur coal. Boiler units 5 to 7, which are connected to electrostatic precipitators, burn medium-sulfur coals from Ohio and western Pennsylvania.

Thus, some units at Sammis burn dirtier coal than others. Each unit, however, is now well within federally enforceable emission limitations for particulates. Attaining lawful levels of particulate removal was the central objective of the Sammis retrofit, and Ohio Edison has met that goal.

The plant also remains in compliance with federal standards for sulfur dioxide and nitrogen oxides. Ohio Edison brought Sammis into compliance with these standards in 1979, when the company started to burn higher-quality coal.

Today the Sammis plant continues to emit legally permissible but significant quantities of sulfur dioxide and nitrogen oxides. These pollutants are of concern because they are thought by many experts to be key components of acid rain.

A possible means of further curbing these gases is slated to be tested at another Ohio Edison facility that appears destined to make environmental history. Many miles north of the Sammis plant, Ohio Edison has a much smaller coal-fueled power plant. This is the Edgewater plant—located near Lorain, Ohio, on the shores of Lake Erie. Edgewater has been selected for a major environmental experiment funded by EPA, the State of Ohio, Ohio Edison, and the engineering firm of Babcock & Wilcox.

Ohio Edison has offered one of the boilers at its Edgewater facility for the testing of Limestone Injection Multi-staged Burners (LIMB) technology. The boiler in question is the 105-megawatt #4 boiler at Edgewater. This boiler will be used to determine whether LIMB can control the sulfur dioxide and nitrogen oxide emissions.

The LIMB method consists of a combination of two different technologies: an advanced burner design to reduce nitrogen oxides; and the injection of an alkaline sorbant (such as lime or limestone) directly into boilers to reduce sulfur dioxide emissions.

Testing on the LIMB technology is scheduled to begin in mid-1987. The total cost of the LIMB demonstration will be $16 million. EPA has agreed to pay $6 million—more than a third of the total cost of the LIMB testing. It is hoped that the LIMB project will generate a retrofit technology capable of dealing with sulfur dioxide and nitrogen oxides as effectively as the Sammis retrofit has dealt with particulate matter.

Because of the success of its Sammis retrofit, Ohio Edison is able to continue providing the vital resource of electricity to the communities it serves while at the same time reducing damage to the environment from particulate pollution. EPA is pleased with the progress Ohio Edison has made at Sammis, and is even more pleased with the commitment to future progress Ohio Edison has made at Edgewater. □

Discarding the Litter Habit

by Judy Roumpf

"Drink right from the can. No empties to return." This was the compelling message of advertisements that announced the first steel beverage cans. But the ad's picture also showed a trolling fisherman conveniently throwing his can in a lake. Manufacturers may still boast "no deposit, no return" to potential customers, but they now discourage littering and solid waste pollution.

This is but one change in the packaging industry. Just what has happened to packaging in the U.S. since Earth Day 1970? Has environmental awareness and interest in recycling had any effect on packaging?

Many American communities have nowhere to put their trash. Citizens oppose new landfill sites, and the promise of waste-to-energy incineration plants has not been realized. Ground-water contamination from leaking disposal sites is a major environmental problem.

A significant portion of this nation's discards is packaging, estimated by the EPA at about one-third of all municipal waste. This packaging takes many forms, from empty cereal boxes to soft drink cans, catsup bottles, and fast food hamburger wrappers.

In 1971, the domestic packaging industry shipped $21.5 billion of goods, an increase of 60 percent from just eight years earlier. By 1983, shipments jumped another 137 percent to $51 billion. This growth has often outstripped the rise in use of the products enclosed by the package. For example, from 1963 to 1971 food packaging tonnage increased 33.3 percent per capita while food consumption only grew 2.3 percent. Americans are buying products in smaller sizes and this increases the volume of packaging wastes.

Competition within the booming packaging sector is intense. Packaging materials such as metals, glass, paper, and plastics vie for market share. While consumers may not be aware of the behind-the-scenes battles, they certainly are aware of the results. Let's look at soft drink and juice packaging. Predominantly sold in glass, these beverages then became available in steel cans, which were then supplanted by aluminum containers. Since 1978, more and more soft drinks are packaged in plastics while juices now come in multi-layered (plastic, metal, and paper) boxes.

Similar developments have occurred in food, health care, and household goods packaging. It appears that the paper and metal one-quart oil can is a thing of the past. Barbecue sauce is in plastic containers, frozen foods are in new multi-layer pouches, and the glass milk bottle is now considered a relic. The whim and fancy of the American consumer can drive a product seller toward a new package in just a few short months.

The consumer acceptance of can recycling startled packaging producers.

The result is that we no longer seem to have steel can producers and glass bottle makers. To hedge their bets, most firms are joining the enemy. Continental Can was one of the first into plastic bottles, National Can also owns glass plants, and Sonoco Products—the leading paper grocery bag producer—is also one of the biggest manufacturers of plastic sacks.

These and other firms are spending huge amounts of research, development and marketing monies to find new forms of packaging. Coca-Cola is testing a plastic soft drink can, and considerable research is under way to develop an aluminum food can.

Most packaging ends up in a community's landfill. It's a waste of natural resources and energy, although packaging also assures us of a healthful diet, fresh and undamaged products, and a convenient, carefree lifestyle. The American way of life cannot do away with packaging, but can we be assured that environmentally sensible forms of packaging are used? In the last 15 years, three forces have been at work to pressure packaging makers and users to consider environmental issues. Let's look at each.

The public's interest in waste recycling has been a major part of the high level of environmental interest in this country. With over half of all Americans involved in some type of recycling, the packaging industry has certainly taken heed.

It basically started in the late 1960s when Reynolds Metals, the big aluminum producer, began to purchase old aluminum cans. Because of its relatively high value as a metal, the aluminum can became the recycling success story of the 1970s and 1980s. Now more than one-half of all the aluminum cans used in the U.S. are returned for recycling. About 5,000 recycling centers purchase cans, with the elderly, poor, and young being major suppliers. Numerous charitable groups raise funds by collecting cans for recycling.

The consumer acceptance of can recycling startled the aluminum companies and other packaging producers. The vast success had several major effects. First, it proved that people weren't hesitant to separate their containers and to store them for recycling. It also provided a consistent source of cheap metal to the aluminum companies, allowing them to more effectively compete against other packaging materials.

Most important, marketing experts recognized that some consumers preferred to buy soft drinks and beer in aluminum containers because the cans were recyclable. Recycling became another determinant of consumer preference.

Other producers of beverage packaging then jumped on the

(Roumpf is the publisher of Resource Recycling magazine, Portland, Ore.)

In the days before littering was a major public concern, this ad portrayed a carefree fisherman tossing an empty can into a lake.

bandwagon. Nearly 100 glass plants launched bottle-buying campaigns, and the steel can industry developed a price support program to underwrite the efforts of recycling collectors.

With a solid waste disposal crisis confronting more and more communities in recent years, the public has been made aware of the problems of trash. Garbage is no longer out of sight, out of mind.

Waste production, not waste disposal, is the major problem.

As city councils and town boards studied the options, they soon realized that we just have too much garbage. Waste production, not waste disposal, is the major problem.

And in some communities, citizens have taken action to educate other consumers about over-packaging and about environmentally senseless packaging. For example, a handful of New Jersey and California communities have launched campaigns that involve placing tags on grocery store shelves that rate packaging. For example, a green tag might be used for a refillable soft drink bottle, a yellow tag for a recyclable soft drink can, and a red label for a non-recyclable plastic bottle. Shoppers are then informed of the tagging system and encouraged to select the environmentally proven container.

Though consumer recycling has grown by leaps and bounds and there are efforts to educate citizens about excess packaging, packaging waste grows. A number of states, fed up with overflowing landfills and a littered landscape, have adopted legislation aimed at reducing packaging wastes.

The most famous piece of legislation is the container deposit law enacted by nine states. About 20 percent of the American population lives in communities where deposits are required on beer and soft drink packages. Typically, consumers in those states return some 90 percent of the deposit containers to retailers or redemption centers. The bottles and cans are then sold for recycling, although current plastic recycling markets are so weak that some plastic soft drink bottles are placed in landfills.

Other states have gone in another direction by taxing consumers to fund packaging cleanup efforts. Called litter-tax programs, these projects also attempt to educate citizens about litter problems. Generally, packaging producers and retailers favor litter-tax campaigns over deposit legislation. Less than 10 percent of the population lives in states using this alternative.

Now several states are trying to force the packaging industry into constructive action by passing legislation restricting the use of certain types of packaging. This strategy was first used by Minnesota several years ago when it passed legislation that would restrict the sales of new forms of packaging if such items were found to be more environmentally harmful than existing packaging. The Minnesota system was never put into place due to a number of legal hurdles.

This hasn't stopped other states from trying to retard the growth of non-recyclable packaging. At least six states are considering restrictive legislation this year. For instance, the Oregon legislature may adopt a measure that gives the plastics industry a few years to implement a plastic milk jug recycling program. If industry fails to do so, plastic milk jugs would be banned.

New Jersey has gone a bit further. A mandatory recycling measure supported by Governor Thomas Kean calls for recycling goals to be set for troublesome items such as plastic and bi-metal packaging. Like Oregon, it allows industry a window of opportunity to establish a viable recycling program. If that effort doesn't attain a 55 percent recovery goal, a deposit on such packaging would be initiated, with the funds going for recycling program development. If that second effort falls flat, the items would be banned.

While to date no state legislature has adopted such a measure, there's growing interest from a number of states. The consideration of drastic measures symbolizes the increasing frustration of many decision makers over burgeoning solid waste volumes. Industry is getting a clear message: solid waste reduction and recyclability should become packaging design factors.

In addition, the packaging industry is hearing the concern that it's not doing enough to aid the recycling of packaging. Some industry sectors are beginning to respond. For instance, the plastics industry and others have established the Plastics Recycling Foundation. With a planned $5 million budget, the foundation will develop and promote plastics recycling technologies. Similar efforts are needed if we are to reduce the volume of packaging wastes. □

Strong Incentives for Industrial Recycling

In a quality control check, technicians at an Allied Corporation plant in Metropolis, Ill., test process water from resource recovery equipment. The equipment is used to produce about 8,000 tons of calcium fluoride, or fluorspar, each year by reacting two hazardous wastes from another manufacturing process.

by Steffen W. Plehn and Donald Huisingh

Industry can handle a gallon of waste solvent in many ways.

One approach, used too often in the past, is to pour the solvent on the ground. The liquid will almost inevitably find its way to ground water, where a concentration of a few parts per billion can be sufficient to create a risk to health.

A better approach is to burn the solvent in a boiler. The issue of ground-water contamination is avoided, and some usable energy is produced.

A third and even more desirable approach is to reclaim or recycle the solvent. By converting a pollutant with potential for environmental damage into a resource for future human use, a manufacturer can conserve resources as well as provide environmental protection.

Over the past year, both of the authors have been involved with the issue of waste reduction. Steffen Plehn served on a committee of the National Academy of Sciences (NAS) which looked at approaches to reducing hazardous waste generation. Don Huisingh prepared a soon-to-be published book, *Proven Profit from Pollution Prevention*, which is the source of the case histories used in this article.

The NAS committee found that some very potent incentives are now present to encourage industry to reduce the generation of hazardous waste. These incentives are the result of public awareness and concern, which is expressed, in part, in the laws and regulations which EPA is directed to administer.

The first incentive is the increasing cost of land disposal. In the past, the price of land disposal was low and did not reflect the risks to human health and environment or the long-term costs to society of cleanup and environmental degradation. But the price of landfilling is now rising rapidly, and industry is responding to the increased cost.

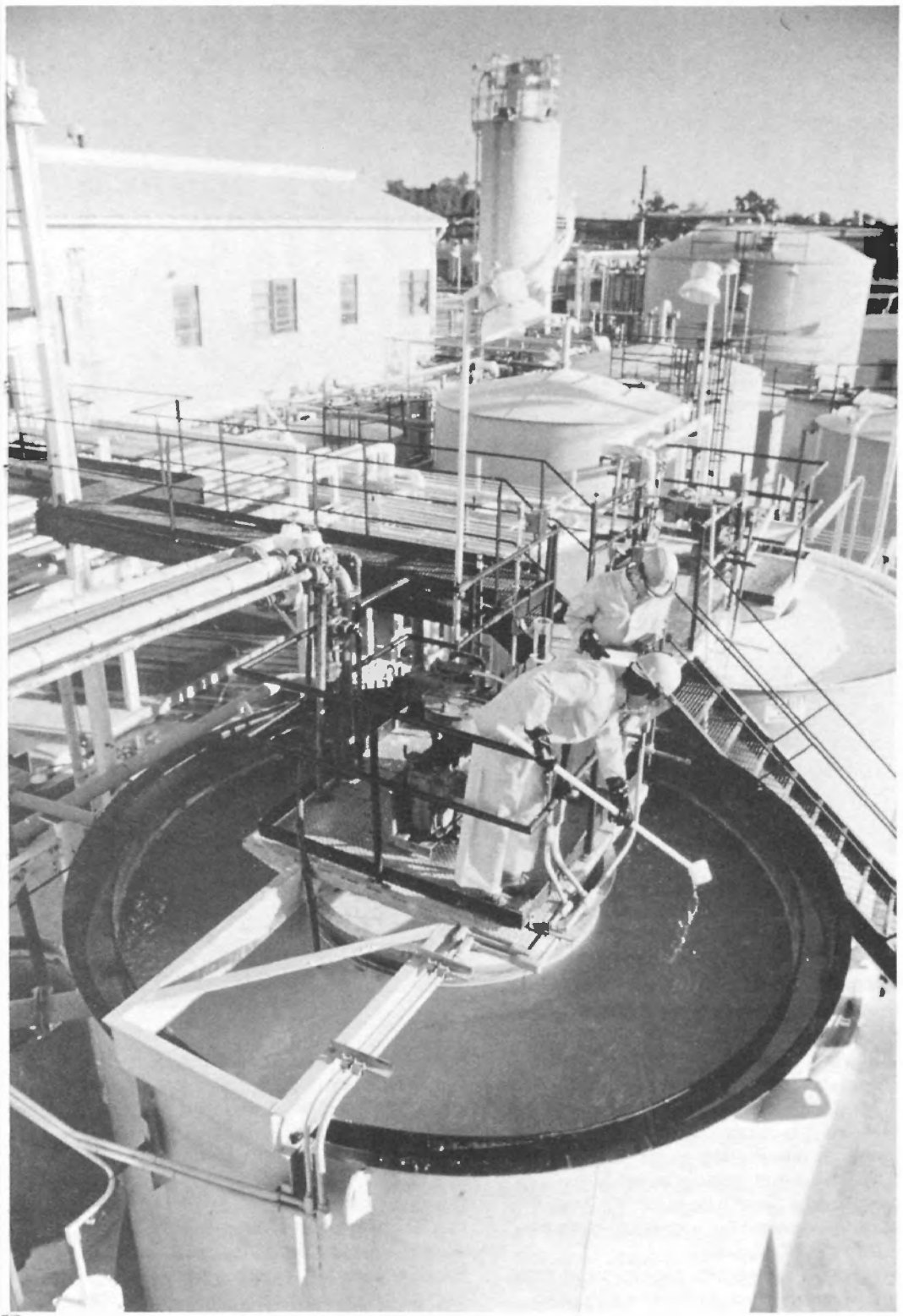
An example of that response is Allied Corporation's investment of $4.5 million in recycling equipment at its Metropolis, Ill., plant. Allied recovers 8,000 tons of calcium fluoride annually. The inorganic chemical is then used as a raw material at another facility. Since 1982, over 1,000 cubic yards of hazardous calcium fluoride wastes have been recycled monthly, saving about $300,000 a year in disposal and storage costs alone. The process also recovers about 1,000 tons of lime annually.

A second incentive is the prospect of substantial financial liability for remedial activities at Superfund sites, with the risk of third-party liability and adverse publicity as well. These liability risks are often perceived as most severe at landfills. Data General Corporation, which manufactures printed circuit boards for computers, initiated a management policy in 1981 that landfill disposal of wastes should be used only as a last resort. Its program to reduce wastes has included marketing activities to find buyers for its wastes, and new operation practices and development of new process chemistry to make its wastes more saleable.

However strong the incentives, the NAS panel found that the waste reduction process has barely begun. "Most waste reduction efforts in U.S. industry are still in their early stages," the report stated. "Many opportunities exist for reducing the generation of hazardous waste." The problem was not perceived as technologically complex. "At the current stage of development of industrial waste management processes across the country, substantial progress in reducing the amount of hazardous waste generated can be achieved by employing relatively simple methods that entail modest capital expense."

That fact—that much waste reduction is rather simple to accomplish—is documented in the following examples:

(Plehn served at EPA from 1975 to 1981 as Executive Assistant to Russell Train and Douglas Costle and as Deputy Assistant Administrator for Solid Waste. He is now Vice President at Fred C. Hart Associates, an environmental and engineering consulting firm. Dr. Huisingh is a Professor of Environmental Sciences at North Carolina State University.)



Allied Corp

• Daly-Herring Company manufactures pesticides and insecticides. The company altered its dust collection equipment so that waste streams coming from various production areas are now collected separately rather than mixed in a single baghouse. The collected materials are no longer contaminated by alternate waste streams, and each is recycled back to the process where it was generated. The firm has eliminated over $9,000 in annual disposal costs and estimates the recovered material is worth more than $2,000 per year.

• Deere and Company reduced its hazardous waste 80 percent by "volume" and over 99 percent by "level of risk" through two key actions: first by implementation of a comprehensive corporate hazardous waste management initiative at each manufacturing unit; and second, by construction of an on-site liquid hazardous waste treatment facility capable of reclaiming waste organic oil compounds and metals from process water, producing a non-hazardous sludge. The recovered oil is sold to an oil recycling firm or reused for machining processes.

• Duke Power Company is one of the major electric power generating firms in the State of North Carolina. A team of staff members was assembled to develop comprehensive low-level radioactive waste reduction strategies. One of the elements of the resulting program was an effort to improve housekeeping activities. Compactible materials suspected of radioactive contamination were segregated by area within the plant into "potentially contaminated" and "not contaminated." Since a significant portion of the material was free of radioactivity, this procedure significantly reduced the amount of hazardous waste requiring disposal.

While basic forces are pushing waste reduction in the right directions, the NAS committee was clear that more needs to be done. Direct government regulation of manufacturing processes was not recommended. Instead, the committee favored an emphasis on access to information about waste reduction. Through a variety of means —education programs, conferences, workshops, and technical assistance—and a variety of institutions—universities, state agencies, trade associations—the emphasis must be on wider dissemination of information on the opportunities that are available and the techniques that have worked. Such assistance is particularly important for small business, which is the segment of American industry most in need of help. □

Pest Management: Pursuing an Environmental Dream

by William Jordan

U.S. Dept. of Agriculture

The pioneers of modern integrated pest management (IPM) had a dream. They saw a time when pests would be controlled by manipulating their ecology. They reasoned that if pesticides must be used—as the founders knew they must—then they would be used like medicine, prescribed by specialists in limited doses for a diagnosed ill, and *integrated* into the overall ecosystem. Robert van den Bosch, a fiery environmentalist who helped develop the basic concepts of IPM, used to say, "We can work out integrated control for any crop in the world, and if we can just get 'em to use it, it'll save their 'fanny.'"

What is practical is what brings in this year's crop and saves the agro-ecosystem for future crops as well.

Even though these pioneers were university men, theirs was a practical dream. To a farmer it may have seemed idealistic, because to a farmer what is practical is what brings in this year's crop. But to an ecologist, what is practical is what brings in this year's crop *and* saves the agro-ecosystem for future crops as well.

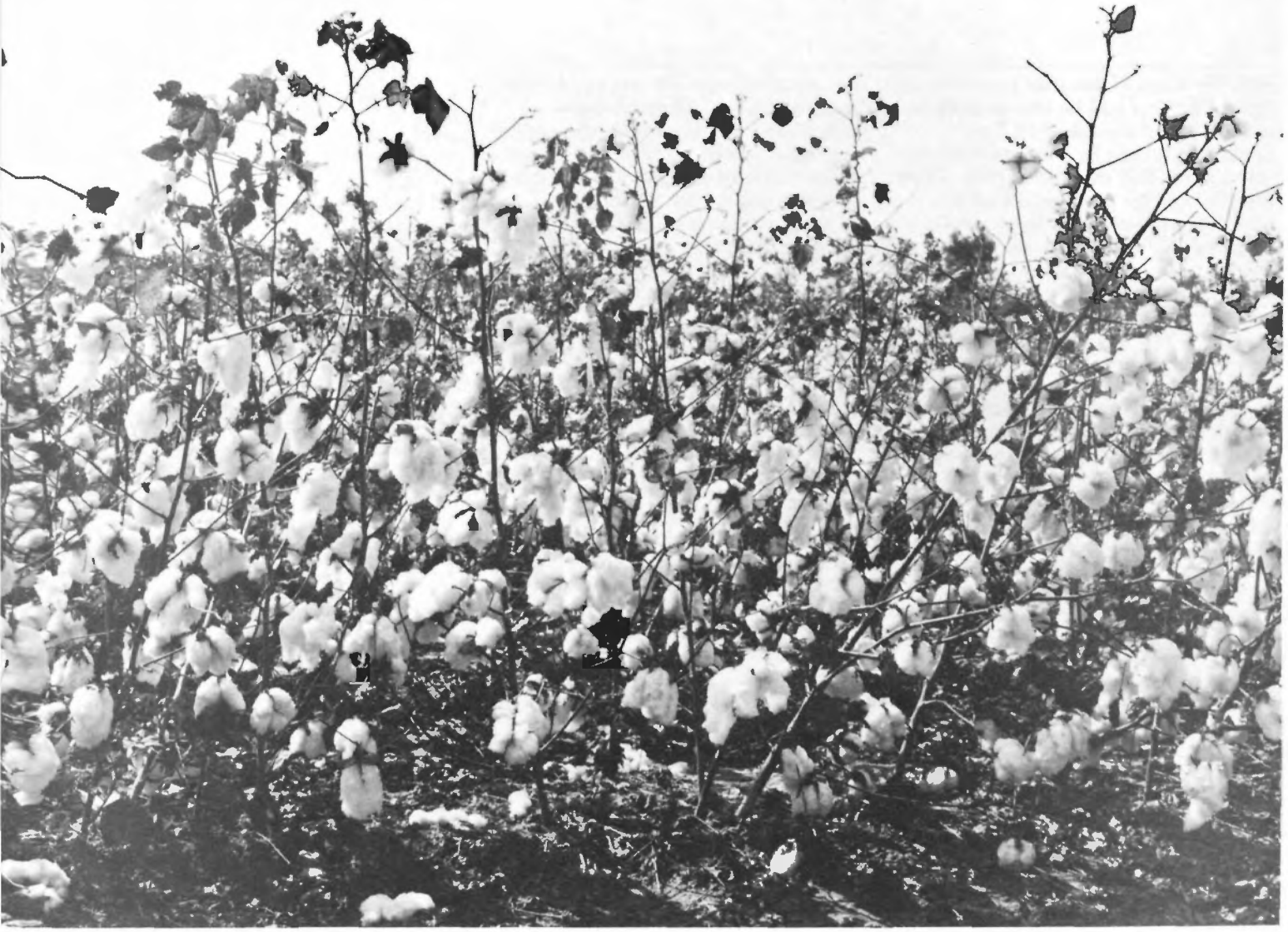
It was a long-term, panoramic dream, and it came alive under the overcast gloom of *Silent Spring*. The goal was to create an agricultural ecosystem that could be sustained perpetually. One of the first steps was to reduce the amount of pesticide used; as a very attractive side-effect, the costs would also be cut.

Has the dream come to pass? Looking back over the past 15 years or so, the answer appears to a very equivocal "yes and no."

On the positive side, there is no doubt that IPM can be made to work. Cotton in California's San Joaquin Valley is a key example. Cotton is the biggest cash crop in the state, and it used to be the largest consumer of pesticides. Fifteen years ago it was common for farmers to spray 10 to 12 times per season for a conglomeration of bugs and worms straight out of a nightmare. Old-timers talk of schedules where they sprayed on the same morning each week whether the fields appeared to need it or not. Today a typical ranch sprays 1 to 1½ times a season for mites, and it sprays only if an application seems warranted. IPM specialists keep a careful watch on pest species throughout the season, recommending a pesticide strike only when the infestation reaches a proven danger point. As a result, pesticide costs are tremendously reduced and the yields are as high or higher then they've ever been.

Other examples exist around the country. Alfalfa, apples, soybeans, and California citrus are considered classic successes. If you accept the view from the U.S. Department of Agriculture (USDA), the list goes on from here. Cranberries, hay, rice, raspberries, potatoes, and peanuts, to name a few, have all needed less pesticides or

(Jordan is a science writer in Long Beach, Calif., with a doctorate in insect ecology.)



Cotton fields in South Carolina. According to the author, cotton and soybeans are the only two major crops in the country which have come under real ecological management.

suffered less injury and economic loss. The statistics look impressive indeed and the list is growing.

Most impressive of all, the concept of IPM is said to be spreading to the grass roots. According to David McNeal, head of the USDA's cooperative extension IPM program, farmers are using various methods without even knowing what the term "integrated pest management" means! At the same time, they're being educated about IPM by a vast network of farm advisers administered jointly by the USDA Extension Service and the state and county departments of agriculture. If you listen to the government establishment, you get the impression that IPM has conquered the world, that the dream has been realized.

Agriculture is nothing more than the manipulation of the Big Ecology.

But if you listen to the original pioneers, things are not what they seem. In fact, something is rotten in the state of pest management. According to early leaders like Vernon Stern of the University of California at Riverside and Andrew Gutierrez of the University of California at Berkeley, IPM has become a buzzword, something you say in order to sound respectable. As insect ecologists, they feel that the concept of pest management has shifted subtly but massively away from its original center within the pest's ecology. The USDA's McNeal verified this, claiming that "crop ecology is now the focus and bug ecology has got to fit into this." In other words, integrated pest management no longer means what it used to. What it now means is that you "look at all the tools available and use the most appropriate." The pest's ecology is no longer seen as a unified component, but something you can chip off in little bits to fit the overall scheme of crop economics.

The primary goal of the new IPM is once again to bring this year's crop in with the lowest production costs and the highest yields. A stable, good-yielding agro-ecosystem 20 years down the line—to say nothing of a healthy environment—is a secondary goal at best.

On the surface this seems logical: after all, the yield is what you do agriculture for. If you can't pay the bills you're not going to be in the business of farming very long. But in fact, it's a fals logic. It comes from a poor understanding of how nature works. The basic reality is that agriculture is nothing more than the manipulation of the Big Ecology all around us, and pest ecology and crop ecology are integral parts of it. To see the crop as the basic reason for being is like seeing the earth as the center of the universe,

with the sun and the stars revolving around it. You may be able to explain heavenly motions this way, but navigation would be a real adventure.

In the original concept of IPM, if you want to manage pests realistically, you've got to steer by a fundamental knowledge of the organisms' habits, needs, cycles, enemies, and so on. Most important, you've got to accept the creature as something impossible to eradicate. You've got to adjust the crop to reduce the pest, not reduce the pest to fit the crop. Doing it this way has the tremendous advantage of counteracting the pesticide/herbicide approach, which clearly does not work over the long term.

Just as clearly, the approach now touted as IPM is not working in many parts of the country. One of the worst and most ironic examples of this occurs on cotton in California's Imperial Valley, a region less than 200 miles from the San Joaquin Valley with the finest cotton IPM in the world. Cotton growers in the Imperial Valley now spray 10 to 15 times per season to control the pink bollworm. But it's still called IPM.

A failed crop can bring extinction and the temptation to spray—"just for insurance"—is often impossible to resist.

Pesticide/herbicide dependency seems to rule most of the nation's major crops. Of soybeans, cotton, corn, and wheat, only cotton and soybeans are coming under real, ecological management, and only in certain regions at that. Robert Metcalf, a world-renowned pesticide expert at the University of Illinois, claims that a crop like corn, which carries a billion-dollar pesticide tag (primarily for soil insecticides and herbicides), would do fine with just 10 to 20 percent of the total usage if wisely applied.

There is, of course, the obvious question of why things are as they are. If the original IPM was such a powerful method, why hasn't it won the day?

In answering this, you could start pointing fingers. You could blame the pesticide manufacturers. The USDA estimates that the total cost of pesticides used will run to $4.5 billion for 1985; the manufacturers are not complaining about business. They advertise relentlessly through the media and through a system of pesticide salesmen. Robert Metcalf calculates that radio commercials accounted for a total of about 40 hours of air time in rural Illinois this spring. Coming in 30 or 60-second spots, you get some idea of how all-pervasive this campaign is.

The entire practice of treating the soil before planting may be on the verge of uselessness.

But advertising is central to a free enterprise society, and to blame the pesticide companies for trying to make a profit shifts the blame from the real culprit—just plain old human nature. Without getting into detailed analysis, suffice it to say politics follows closely in arrears of big money. And farming is scary, a sort of yearly crap shoot for your farm if you're a smaller operator. A failed crop can bring extinction, and the temptation to spray—"just for insurance" —is often impossible to resist. The manufacture of pesticides remains a vigorous, healthy industry for the same reason as the manufacture of vitamin pills remains strong.

And so—no, the whole dream of ecological pest management has not come to pass, not if you take the original concept to heart. The basic philosophy of agriculture has changed very little since the early Seventies, because the basic system of agriculture—the methods, materials, and attitudes—has not changed.

So now is probably not the right time to tally up the IPM score sheet. The time may be arriving very soon, however, and like all changes in nature and evolution, it will be forced upon us. It will come through the rise of pest resistance, and now, something even more ominous than that. According to Metcalf, the entire practice of treating the soil before planting may be on the verge of uselessness. It turns out that certain bacteria seem to have evolved new strains that actually thrive on herbicides and insecticides as food. Today, a soil treatment lasts only 1/10th as long as it used to, which makes it a needless expense. The implications are revolutionary. It's a comfort to know that IPM is already proven. □

Public Opinion: Behind the Transformation

by Riley E. Dunlap

Public concern with environmental problems escalated rapidly in the late Sixties, and reached a climax with the celebration of the first Earth Day (April 22, 1970). In a 1965 Gallup poll, the public ranked "reducing pollution of air and water" ninth among a list of ten national problems deserving government attention. But only five years later, a 1970 poll conducted right after Earth Day using the same question found pollution control near the top of the list, running a close second to crime reduction. The actual percentages selecting pollution as a problem deserving government attention more than tripled from 1965 to 1970.

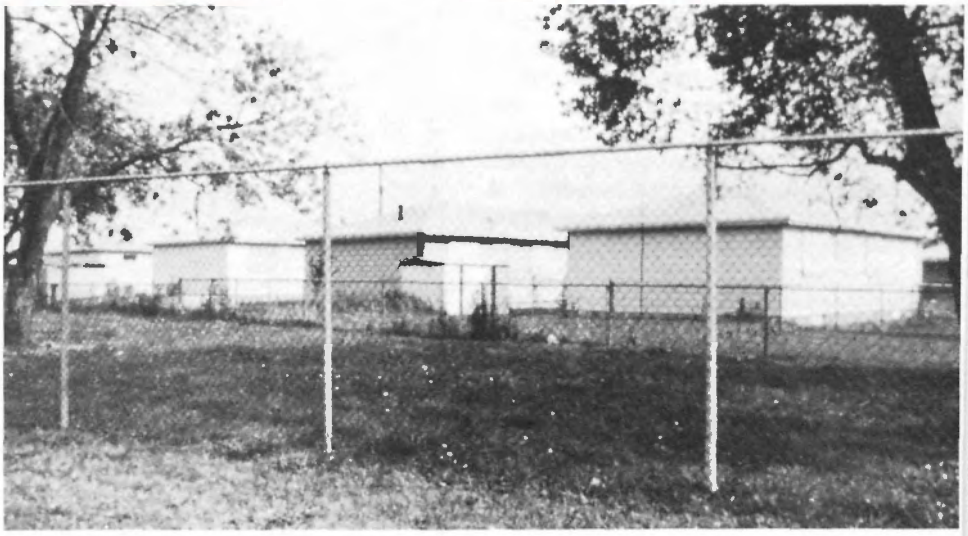
Given the exceptionally high level of public concern with environmental problems in 1970, it should not be surprising that several studies found a decline in such concern over the next few years. The most dramatic results were reported by Louis Harris, who found the percentage of the public volunteering environmental problems as one of the "two or three biggest problems" facing Americans declining from 41 percent in 1970 to only 6 percent in 1975.

It would be incorrect, however, to conclude that public concern for environmental quality largely disappeared by the mid-Seventies. On the one hand, questions such as those used by Harris (where respondents volunteer what they see as the most pressing problems confronting themselves and/or the nation) measure the salience or prominence of problems more than they do commitment to solving them. On the other hand, social problems in our society have traditionally enjoyed only temporary salience, quickly passing through what Anthony Downs calls the "issue-attention cycle." A combination of governmental ameliorative efforts, the expenditure of large sums of money, and eventual media boredom leads to the rapid replacement of old problems with new ones on the public agenda.

There is a good deal of evidence indicating that while the salience of environmental problems declined significantly after 1970, public commitment to solving them has remained surprisingly strong. Although the available trend data do not begin until 1973, two particularly good measures of public commitment to environmental protection show the unexpected persistence of high levels of such commitment. First, since 1973 the National Opinion Research Corporation has been asking national samples whether we're spending "too little," "about right" or "too much" on "improving and protecting the environment." In 1973, 61 percent said "too little," 26 percent "about right," and only 7 percent "too much" (the rest said "don't know"). The percent indicating "too little" was being spent on the environment slowly declined during the Seventies, reaching a low of 48 percent in 1977 and again in 1980. In recent years, however, it has increased, and in 1984, 58 percent said "too little," 31 percent "about right" and only 7 percent "too much" was being spent on environmental protection (with 4 percent saying "don't know").

A similar pattern emerges on a Roper Organization question which asks respondents, "Do you think environmental protection laws and regulation have gone too far, or not far enough, or have struck about the right balance?" In 1973, only 13 percent of a national sample said that environmental laws and regulations had "gone too far," while 32 percent said they "struck about the right balance" and 34 percent said they had gone "not far enough" (with 21 percent saying "don't know"). The percentage indicating "gone too far" slowly increased up to 25 percent in 1980, although the percentage indicating

Love Canal, 1982: Abandoned homes are boarded up and fenced off prior to demolition. The author states that environmental disasters such as Love Canal have increased public commitment to environmental protection.



New York State Department of Environmental Conservation

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"not far enough" was still 33 percent that year. This slight trend has been reversed in recent years, as in 1983 (the last year for which data are available) only 14 percent said environmental protection laws had "gone too far," while 30 percent said they "struck about the right balance," and an unprecedented 48 percent said they had gone "not far enough" (while only 9 percent said "don't know").

Two aspects of these trends since 1973 deserve emphasis. First, unlike the salience of environmental problems,

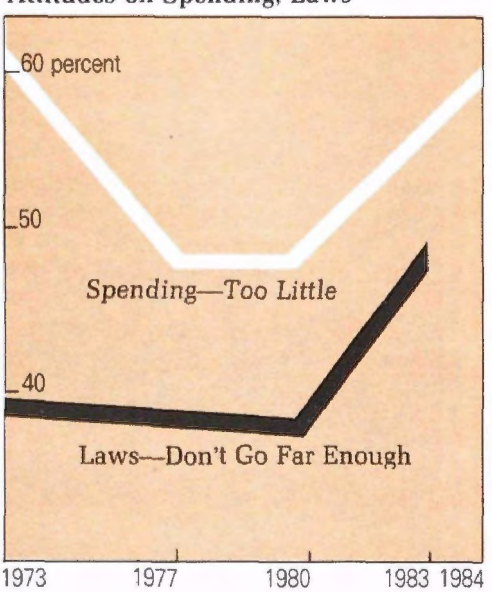
Surprisingly, the Eighties have seen an upswing in public support for environmental protection.

which admittedly declined considerably by the mid-Seventies, public commitment to protecting environmental quality remained surprisingly strong throughout the decade. Second, and even more surprisingly, the Eighties have seen an upswing in public support for environmental protection.

Before trying to explain the persistence and recent upward swing in public commitment to environmental protection, I would like to provide a better sense of the state of public opinion on environmental issues in the Eighties. I will do this by focusing on important environmental policy issues, beginning with the revisions of the Clean Air and Clean Water Acts. During 1981 Louis Harris asked whether "Congress should make the Clean Air Act stricter than it is now, keep it about the same or make it less strict" in three national surveys. In each survey roughly half of the public (46 to 51 percent) said that Congress should keep the Act about the same, while the percentages in favor of making it stricter (29 to 38) clearly outweighed those in favor of making it less strict (12 to 17 percent). A similar Harris question on the Clean Water Act in 1982 revealed even stronger support for continued environmental protection. Sixty percent of a national sample wanted the Clean Water Act made stricter, 34 percent favored keeping it about the same, and only 3 percent wanted it made less strict (while another 3 percent were not sure).

These high levels of support for strong environmental regulations are consistent with the results of questions designed to gauge the public's willingness to accept tradeoffs between environmental protection and economic growth. For example, a 1982 national survey by *Research and Forecasts* found twice as many people agreeing that "we must accept a slower rate of economic growth in order to protect the environment " (49 percent) as agreeing that "we must relax environmental standards in order to achieve economic growth" (24 percent). Another 24 percent agreed that "we can achieve our current goals of environmental protection and economic growth at the same time" (while 3 percent didn't know). Given the emphasis on improving the state of our nation's economy in recent years, results such as these are surprising and reveal a strong commitment to environmental protection by the American public.

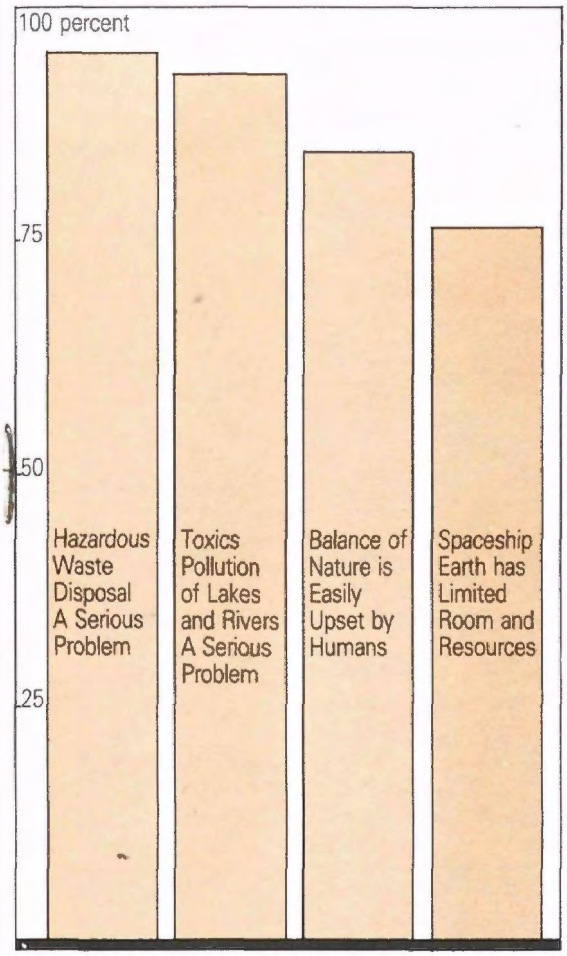
Attitudes on Spending, Laws



After describing the issue-attention cycle that led him to be pessimistic about the future of our nation's commitment to environmental protection, Anthony Downs suggested a number of reasons why the environmental issue *might* buck the odds and remain high on the public agenda. Two seem particularly pertinent in hindsight. First, environmental pollution is more visible and clearly threatening than many social problems; and second, pollution affects virtually everyone, rather than just a small segment of society. These two factors may have become even more significant than Downs imagined in 1972.

The past 15 years have been marked by the continual discovery of new, and often quite serious, environmental problems, a trend which likely reflects both growing damage to ecosystems as well as increased scientific scrutiny of such damage. The result has been that the notable progress in cleaning up many waterways and in improving urban air quality is generally overshadowed by all the attention given to acid rain, soil erosion, toxic wastes, and other problems. These problems are not only seen as affecting virtually everyone but, particularly in the case of toxic waste contamination of ground water, as representing a very serious threat to public health. The fact that the public is continually bombarded with news of newly discovered and potentially disastrous environmental problems (e.g., Love Canal and Times Beach) has surely played a major role in keeping public commitment to environmental protection at a high level. Such news suggests that governmental ameliorative efforts have not been adequate to keep up with the emerging problems.

The idea that the continual emergence



Attitudes on Environmental Concerns Early 1980s

of new and often dangerous environmental problems has been a major factor in keeping public commitment to environmental protection unexpectedly high during the past 15 years is bolstered by a variety of data. For example, a 1982 Louis Harris survey revealed the exceptionally high levels of public concern over the health hazards of environmental problems. Ninety-five percent of a national sample viewed "disposal of hazardous wastes" as a "serious problem" and 93 percent viewed "pollution of lakes and rivers by toxic substances from factories" as a "serious problem."

The endless discovery of such problems, despite all of the efforts and money spent on environmental protection in recent years, also seems to be contributing to the public's gradual acceptance of a somewhat more "ecological" orientation. Thus, the 1982 *Research and Forecasts* survey found 84 percent of the public agreeing that "the balance of nature is very delicate and easily upset by human activities," and 76 percent agreeing that "the Earth is like a spaceship with only limited room and resources." Although there are not national trend data available, I think it is highly unlikely that the general public would have shown this degree of ecological awareness back in 1970.

While the foregoing may help explain why public commitment to environmental protection has persisted so solidly since 1970, and to some degree why it has recently risen, I don't think the recent upsurge in environmental commitment is due solely to the increased visibility of toxic wastes and similar problems. Rather, I think it reflects another aspect of the issue-attention cycle. A major reason problems disappear from the public agenda is that after the passage of legislation and the establishment of regulatory agencies designed to "solve" the problems, the public has a tendency to assume that "government is taking care of it, so we don't have to worry about it." This attitude likely contributed to the diminished salience of environmental problems in the Seventies, but in the eyes of many people it became an inappropriate attitude once the current Administration took office.

The endurance of public commitment to environmental protection since 1970 must be regarded as miraculous.

The Reagan Administration's anti-regulatory orientation, and the appointment of controversial figures such as James Watt and Anne Gorsuch to key environmental positions created a situation in which many people felt that the federal government could no longer be relied on to protect the nation's environment. This is reflected in the 1982 *Research and Forecasts* survey which asked, "How much confidence do you have that the Reagan Administration will provide sufficient protection for our natural environment?" Only 13 percent of the public said "a great deal," while 19 percent said "none at all" (42 percent said "some," 23 percent said "little" and 3 percent said "don't know"). This distrust is also reflected in the fact that several major environmental organizations such as the Sierra Club experienced dramatic membership increases during the early Eighties, often recruiting around the theme that citizens need to take action to protect the nation's environment because government can no longer be trusted to do the job.

The combination of the increasing emergence of serious environmental problems and a decline in confidence that such problems will be handled by the appropriate government agencies accounts, I suspect, for the recent upswing in public concern about environmental protection. Whether this upward trend continues will depend, in part, on public perception of the Reagan Administration's commitment to environmental protection. The decline in controversy at EPA and the Department of Interior has likely led to a more favorable perception in this regard.

If the dramatic rise in public concern with environmental problems in the late Sixties was a "miracle of public opinion," as one analyst put it, then the endurance of public commitment to environmental protection since 1970 must be regarded as somewhat miraculous as well. That this commitment has survived for 15 years, after the expenditure of sizable amounts of money and effort and in the face of energy crises, economic hard times and an anti-regulatory climate, is a strong indication that the American people have come to place a high value on environmental quality. Twenty years ago industry could justify its pollution by pointing to jobs and economic growth. Since Earth Day this has become unacceptable to a large portion of the public, as most people seem to want economic growth balanced with environmental protection. This has been a profound change in our society. □

Looking Ahead

by Clifford Russell
and Paul Portney

A helicopter applies pesticides to a Florida orange grove. Applications like this, which can lead to ground-water contamination, illustrate the interrelatedness of environmental problems.

When people are queried about environmental regulation and asked to contemplate its good and bad effects, the images recalled are generally the obvious ones. They may relate stories of particular rivers that have been cleaned up and air pollution problems that are no more. They might cite estimates of the cost of pollution control over the past year or decade or perhaps for some future period, as well as the growth of EPA and the numbers of regulations it has issued. All these images are helpful to some extent, for such evidence does suggest that the quality of the nation's air and water has improved, albeit at considerable expense.

The majority of citizens do not regret the basic decision to push toward a cleaner environment.

It also appears that the shift in public attitude that made environmental regulation possible has survived these successes. Polling results suggest that environmental awareness remains alive and well and that the majority of citizens do not regret the basic decision to push toward a cleaner environment despite the costs and despite the extra burdens imposed on individual and corporate actions. Further, though there have been exceptions, environmental issues have so far not divided region from region or rich from poor in the ways that early analyses predicted.

But if a retrospective look is to help in the future, it is not sufficient to stop with a chronicle of successes. We must look to see what groundwork has been laid for the long run. A decade and a half, after all, is not a very long time, and the residuals from human consumption and production will be with us always.

From this perspective it seems fair to say that the record is mixed—or that the effects have been modest. Consider four long-run concerns and how we stand with them:

- How are we dealing with the interrelatedness of environmental problems?
- How are we dealing with the interregional character of major emerging problems?
- What kind of long-run incentives are we providing to private decision makers?
- And perhaps more fundamentally, how are we reconciling opposing views of what environmental regulation is all about—ethics or engineering or economics?

There is no doubt that the environment must be managed with a broad view toward all potential problem areas—including the troposphere and atmosphere, the land and water surfaces, and aquifers. Horror stories abound about the results of ignoring this proposition. Most often they involve the transfer or escape of untreated wastes from one medium to another, where, in our ignorance, we do not anticipate the results. Thus, putting hazardous chemical wastes into open landfills once appeared a cheap and therefore clever strategy. Similarly, laws mandating air or water pollution control have left us with mountains of solid waste we find hard to ignore but harder still to dispose of safely.

It hardly needs saying that neither our laws and regulations nor our form of legislative oversight are set up to deal with this reality. Rather, for historical and political reasons our environmental statutes often emanate from different congressional committees and consider problems one at a time and in isolation. A question for the future is whether this will continue to be so or whether we can advance to coordinated environmental management. Experiments by EPA and research by outside experts are now addressing this question. The results may or may not lead to sweeping changes in the current system, but it is at least clear that there cannot remain unregulated "sinks" that allow for the cheap disposal of residuals. The "spaceship earth" metaphor is a powerful one in this regard—there simply is no "elsewhere" on a heavily populated planet.

There simply is no "elsewhere" on a heavily populated planet.

Above, we said that surprisingly little interregional conflict has occurred over environmental regulation. Acid rain, however, *has* set region against region. Analyses of the phenomenon have generally stressed long distance transport of sulfur and nitrogen oxides from areas where emissions are heavy to areas where acids are deposited. Ozone is also thought to "migrate" from region to region. When this is the structure of the problem, solutions must either boldly impose costs on one region and

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U.S. Dept. of Agriculture

confer benefits to another, or must involve transfers of one sort or another in the opposite direction so that the gainers pay for their gains. Neither outcome is easily legislated in our system.

However, the parts of the environmental puzzle addressed in the main by the major statutes have been local. That is, the statutes are written as if discharges and effects, costs and benefits, are located in the same region. This, coupled with the national uniformity generally required in standards, has tended to short circuit interregional squabbling. But things will not be so simple in the future. Indeed, the past five years have already seen half a dozen or so attempts to force EPA to judge interstate frays over cross-boundary pollution. These attempts have been sidestepped in one way or another, often because of the technical difficulty of resolving the disputes.

As our technical understanding of long-range pollutant transport improves, however, it will probably be increasingly difficult for EPA (or the Congress) to avoid judgments and solutions. There is no reason to expect this necessity to be confined to sulfur or nitrogen oxides or hydrocarbons discharged to the atmosphere. Nonpoint sources of water pollution, for example, may well be concentrated in upstream, heavily agricultural states, so that a major effort to reduce this form of "discharge" may impose costs largely on the agricultural sector and confer benefits largely on those downstream who withdraw water or use it for instream recreational uses. Even more threatening could be the interregional movement of contaminated ground water. If a major regional aquifer becomes contaminated in one state, those jurisdictions "downstream" will want action, probably dramatic and expensive action, to protect their uses.

Crafting individual solutions for problems with well identified winners and losers is not easy.

Existing legislation is not well designed to deal with such problems and, as has been said, crafting individual solutions for problems with well identified winners and losers is not easy. The litigative alternative is slow and uncertain. This inability to handle interregional problems, then, is one potentially major flaw in our foundation for the future. It almost certainly requires a generic solution before particular interests are committed in a particular battle. Such a solution might involve some taxing and transfer scheme aimed at spreading costs beyond the identifiable region or group "causing" the problem. Whether this could be so precise as to attempt to tax away the benefits from the "victim" group is another matter, one related to the moral or ethical views of pollution.

The U.S. pollution control laws crafted in the 1970s have at their heart an ethical view that was translated into a pollution control imperative that stressed "doing your best" at all times. That is, the idea was to put dischargers under constant pressure to adopt the best existing technology. The problem with this approach is that by "ratcheting down" the discharge standards each time technology improves, any incentive for dischargers to seek technology improvements themselves is removed. The burden of supporting research, of convincing reluctant sources that new developments really work, and of gathering evidence sufficient to justify characterizing them as "best" (practicable, conventional, available, or whatever) falls entirely to the EPA or to the struggling manufacturers of pollution control devices. In other words, we lose the input of the regulatees themselves.

A related long-run matter is the monitoring for, and enforcement of, continuing compliance. Studies of monitoring activity and continuing compliance, whether by government itself or by private organizations, have agreed that while self-monitoring by sources is generally required, very little is being done to check up on, or even to stay current with, the self-reported data. Such fragmentary evidence as exists further suggests that rates of noncompliance are substantial. This problem is related to the technology incentives issue because the strong focus on technology and its installation embodied in the existing laws is reflected in an emphasis on monitoring for *initial* compliance—that is, for the installation of the desired technology. While it would be an overstatement to say that the current practice is to check on the installation and initial operation of pollution control equipment, and then to ignore what happens day to day, it is certainly true that the monitoring efforts being made do not even begin to approach those that would be necessary to produce a long-run incentive for continuing compliance.

For the long run, pollution sources should face a reasonable probability of detection and a realistic penalty when contemplating violation of existing requirements for day-to-day or week-to-week discharge limits. And they must be able to capture some substantial part of any reduction in the cost of meeting those limits brought about by the development and introduction of new technology.

As indicated above, the environmental legislation of the past decade reflects in some of its key features an ethical view of pollution: that pollution is a wrong *in itself*. This contrasts with the view that pollution is, at its heart, a problem of supplying the proper signals to private or public decision makers. In this latter view, some pollution is inevitable because of the laws of conservation of mass and energy that prohibit us from truly getting rid of anything. Pollution control simply means changing the form, substance, or timing of discharges. Too much pollution is likely to be the result of the operation of an unregulated free market. The job of government is to balance the benefits of pollution control (however defined and measured) against its costs and to choose discharge limits for particular places or substances, or other policy instruments so as to achieve what the market by itself cannot. In this view, what is wrong is for a source to exceed its discharge limit or to practice fraud in its self-monitoring report. Discharges within the defined limits are not seen as wrong.

Pollution is a ubiquitous problem and not simply a short-term ethical aberration created by modern market societies.

The ethical view of pollution as intrinsically wrong leads to a long-run goal of zero pollution and to the continuing interim requirement to do the best that existing technology will allow. The cost in incentive terms of this approach has already been noted. The ethical view is also reflected in the position that, like freedom of speech or the right to keep and bear arms, citizens have an inalienable *right* to be free of all environmental risks. In the view of some, this right extends even to the most sensitive individuals and covers even relatively minor health effects. If pollution is "wrong" but temporarily necessary, the logic runs, perhaps we can at least eliminate essentially *all* its deleterious effects.

This contrast in views between pollution as a wrong and pollution as a necessary inconvenience is reflected in continuing tension within EPA. It is manifested primarily between those who would increase the role of cost-benefit or risk-benefit analysis in decision making and those for whom such exercises are at best useless and at worst immoral. Notice that this debate is not over the *capabilities* of cost-benefit analysis—what can and cannot be measured—but over whether any measuring *should* be done.

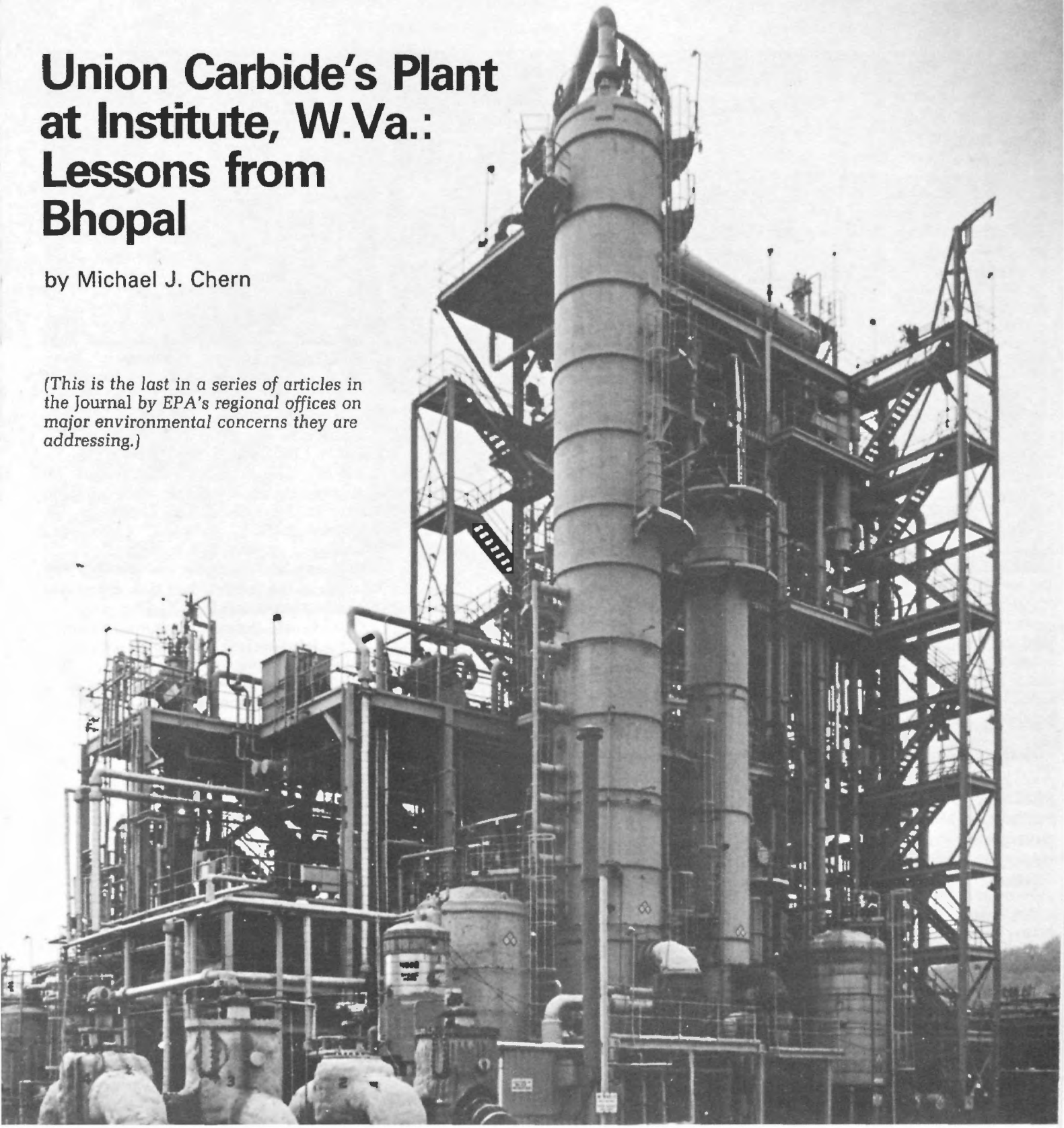
This is not a healthy tension, it seems to us, because the absolute character of the ethical view rules out analysis generally. It discourages the seeking of information about what can be or is being achieved and at what prospective or actual cost. Much more importantly, it would put environmental regulation on a different plane from other government activities, even medical research and the support of the medically indigent, that might offhand be seen as having at least as great a claim to this ethical standing. Moreover, the laws of physics, within which we have no choice but to operate, do tell us that leftovers (residuals) are inevitable. Thus, we must decide what to do with them rather than whether to allow them. Our choices can range over the form the leftovers can assume and the timing and place of their discharge to the natural environment. (We can reduce the total amount through recycling. But we can never push it to zero.) Recognizing that pushes us toward weighing options.

Thus, in our view, one important piece of foundation building for the long-run success of environmental policy is to recognize the uncomfortable fact that pollution is a ubiquitous problem and not simply a short-term ethical aberration created by modern market societies. With this lesson in mind, we can prepare to pass from the substantial successes of the past decade to dealing with the less exciting but no less important business of managing society's residuals into the indefinite future. □

Union Carbide's Plant at Institute, W.Va.: Lessons from Bhopal

by Michael J. Chern

(This is the last in a series of articles in the Journal by EPA's regional offices on major environmental concerns they are addressing.)



Union Carbide Agricultural Products Co., Inc

In this manufacturing unit in Institute, W. Va., Union Carbide produces methyl isocyanate by reacting phosgene and monomethylamine.

On December 3, 1984, an event occurred that will never be forgotten by the chemical industry or those involved with it. An estimated 2,000 people were killed and tens of thousands injured when a massive leak of highly toxic methyl isocyanate (MIC) occurred at a Union Carbide Corporation plant in Bhopal, India. Just

The control room for Union Carbide production of methyl isocyanate in Institute, W. Va.

as Three Mile Island forever changed the life of the nuclear power industry, Bhopal has become a watershed for the chemical industry.

The Bhopal disaster caused American political leaders, environmentalists, and citizens to ask if the same kind of accident could happen here. Public attention here focused on the only plant in the United States that manufactures MIC: Union Carbide's facility in Institute, W. Va., in the Kanawha River Valley near the state capital of Charleston. Federal and state regulatory agencies, at the urging of area political leaders, decided to conduct a multi-media inspection of the entire Institute plant, even though Union Carbide had already shut down the MIC production unit on its own.

The inspection revealed that existing environmental regulations were not principally designed to prevent catastrophic accidents.

An interagency inspection team—consisting of representatives from EPA Region 3's Wheeling Field Office, the federal Occupational Safety and Health Administration, the West Virginia Department of Natural Resources, and the state Air Pollution Control Commission—arrived at Institute four days after the Bhopal accident. The inspection reviewed compliance with state and federal air pollution, water pollution, hazardous waste, toxic substances, and occupational safety regulations and permits. EPA's on-site inspection was supplemented by a comprehensive review of compliance records at the Region 3 main office in Philadelphia.

Although the inspection revealed that no major environmental violations had occurred at the Institute plant, EPA officials realized that the compliance review did not really address the issue of overall plant safety. In fact, the inspection clearly revealed that existing environmental laws and regulations were not principally designed to prevent catastrophic accidents but rather to limit routine and expected pollutant discharges.

There was no reason to believe that the MIC unit at Institute was any more dangerous than hundreds of other chemical production units.

This past February, while EPA was working on the safety issues left unresolved by the inspection, Union Carbide announced tentative plans to restart the MIC production unit some time in April. EPA immediately decided to form an intergovernmental task group to review the entire MIC unit in order to ensure public safety would not be harmed by the restart.

This decision was, in many respects, a revolutionary one. Although a number of statutes give EPA broad authority to take action to prevent an "imminent and substantial endangerment" to public health or the environment, the agency had never invoked this authority in a similar situation. Aside from the disaster at Bhopal, half a world away, there was no reason to believe that the MIC unit at Institute was any more dangerous than hundreds of other chemical production units operating in the United States. Nevertheless, Union Carbide agreed to cooperate fully with the review team.

The federal/state task group was chaired by EPA Region 3's Environmental Services Division Director, Greene Jones. It was composed of the same agencies that conducted the first compliance inspection, with additional support provided by the Federal Emergency Management Agency. The evaluation covered such areas as the equipment and procedures used in the production, handling, and storage of MIC; the emission control and detection systems; the plant safety program; and emergency response plans.

While the federal/state task group was conducting its evaluation, Union Carbide was independently improving the safety systems used at the plant. Many of the improvements that the task group was prepared to suggest had been anticipated by the company and changes already proposed. EPA also asked the company to make additional changes to the unit to further enhance safety.

The most significant equipment changes included:

- Replacement of brine coolant with chloroform for MIC storage tanks (the introduction of water into the storage tanks at Bhopal may have caused the accident);
- Installation of additional monitoring and alarm equipment;
- Alterations to the emission control systems to increase capacity and reliability;
- Installation of an air-sampling leak detector;
- Installation of a computerized system to help predict the direction and concentration of a chemical plume in the air if a leak occurs.

In conjunction with the task group's review of the plant equipment and safety procedures, the Regional Response Team (RRT), an

Union Carbide Agricultural Products Co., Inc

intergovernmental organization which coordinates federal response to emergency situations, was reviewing emergency response plans for the Union Carbide plant and the Kanawha Valley. The RRT looked at five different plans covering the plant: two by the state, one by the county, one by an area industrial council, and one by Union Carbide.

Despite the voluminous nature of the plans, the RRT found that coordination between them needed to be improved, lines of communication and authority needed to be more clearly established, an inventory of hazardous materials in the area had to be obtained, and response personnel needed more protective equipment and training. A summary of the RRT findings and recommendations was made available to the involved parties, and commitments were obtained to make the necessary changes in response plans. Some of the changes actually were made while the review process was still under way.

On April 15, following the completion of the task group and RRT reviews, and the commitment of Union Carbide to make equipment improvements before the startup of the MIC unit, EPA issued a report on the safety of MIC production at Institute. Based on the new production and storage equipment, operating procedures, emission control systems, monitoring and alarm systems, and emergency response plans in use at the plant, the report concluded that the restart of MIC production did not substantially endanger public health.

No one is prepared to guarantee that a catastrophic release can never occur.

MIC production resumed at Institute on May 4 with EPA and other federal and state representatives on-site to monitor the operation. Although the start-up went without incident, no one is prepared to guarantee that a catastrophic release can never occur. EPA Regional Administrator James M. Seif said, "With any major chemical plant we can never rule out with 100 percent certainty the possibility of human error or equipment malfunction. However, Union Carbide's early detection systems help ensure that the company has ample opportunity to prevent a major release if a problem develops."

The Bhopal incident has led many people to question how far federal and state governments should go in assuring that all reasonable measures are taken to prevent and respond to catastrophic releases of toxic chemicals. A number of options are now being nationally debated. One option is additional federal regulation of the chemical industry including uniform national safety standards.

Another option would be to give the states the primary responsibility to oversee chemical plant safety. This option is based on the belief that a case-by-case detailed evaluation of each plant is probably necessary to reveal improvements that should be made, and that state pollution control agencies are in the best position to provide this kind of evaluation and to tailor improvement programs appropriate for the local conditions.

The amount of further regulation may also be influenced by the response of the chemical industry to the situation.

Whatever happens, it is safe to say the chemical industry will never be the same again. □

(Chern is a writer/editor in the Office of Public Affairs in EPA's Region 3, Philadelphia, Pa.)

Soul Searching in the Chemical Industry

by Geraldine Cox

The accidental release of methyl isocyanate gas in Bhopal, India, late last year prompted deep soul searching among U.S. chemical makers for better ways to deal with hazardous materials. The result: the public will get more information about chemical hazards and extra help in handling them if emergencies do occur.

Even before the cause of the accident could be determined, chemical companies began "white glove" inspections of operating procedures in plants worldwide. They made sure that the elaborate safeguards built into process units over past decades were still running smoothly. Then industry experts gathered at the Washington headquarters of the Chemical Manufacturers Association (CMA) to decide what should be done differently in the future. CMA's 175 member companies represent more than 90 percent of the total production capacity for basic industrial chemicals in the United States. Action was directed toward expanding services that protect public health and safety and working with Congress on effective legislation.

The search for appropriate responses involved virtually every Association committee and task group and hundreds of industry volunteers. This pool of experts shaped the concept of industry-wide efforts to be taken through CMA. Two major programs evolved.

A Community Awareness and Emergency Response (CAER) program expands the industry's involvement in local emergency response planning. It will also make sure that communities are aware of the right steps to take to protect public health and safety from potential chemical hazards.

At the same time, a National Chemical Response and Information Center (NCRIC) is being established to improve the industry's ability to respond to emergencies and to provide hazard information to the public.

Both initiatives reflect CMA's view that the industry is responsible for the safe manufacture and transportation of its products. It has an obligation to provide information about hazards associated with the manufacture, storage, use, and disposal of its products to employees, neighbors and customers.

In reviewing safety practices immediately after the accident, we found a need to integrate our emergency response plans with those of the community. Sometimes, several uncoordinated scenarios for coping with emergencies exist in the same locale. In one instance, a chemical company had its own idea of what to do. And the state rolled out still another set of contingency plans. Part of CAER's role will be to unite such efforts so they function smoothly in an actual emergency.

To make sure the plans relate to community needs, local chemical plant managers will serve as catalysts in developing the CAER program, working with emergency response officials, other area industries, and interested citizens. The program calls for information to be communicated continuously to the public about chemical plant operations, how they relate to the community, and how emergency response procedures function.

The community awareness portion of CAER will demystify chemical manufacturing. The industry is often perceived as shrouded in secrecy, operating behind a cloak. Part of the reason is that the chemical industry is a "high-tech" industry that's hard to understand. Another factor is that the understandable news media focus on disaster, or threats of danger, has heightened the public fear of the unknown.

In removing our cloak, we intend to show people that there's nothing sinister about our operations. In fact, we've been doing a lot of things to make our industry safe for ourselves and our neighbors. We intend to show the many programs on line to prevent problems and control the rare emergencies that do happen.

We are seeking to build the public's trust. We feel the way to accomplish that is to become more open. How will it happen? Some companies have already begun by conducting plant tours, building good working relationships with community leaders, and setting up centers where neighbors can drop by to discuss questions or concerns.

Chemical manufacturers in Louisiana, a leading chemical-producing state, are moving en masse toward a new "sunshine" policy. Fred Loy, executive vice president of the Louisiana Chemical Association said that "since the disaster in Bhopal, people are wondering if chemicals can be made safely. The public has a right to know, so the Louisiana chemical industry will open its doors and let them judge for themselves."

Their program includes a series of safety and emergency response seminars, held on plant sites, for community leaders, public officials, and the news media. A symposium is set for the fall to discuss the present state of

(Dr. Cox is Vice President and Technical Director of the Chemical Manufacturers Association.)

Chemical Manufacturers Assn

An emergency response team implemented through CHEMNET (Chemical Network) rushes experts and equipment to the scene of a serious chemical accident.

emergency preparedness in Louisiana and options for improving it.

New Jersey's chemical industry is also involved. Two hazardous materials advisory councils at the county level have raised $400,000 to help emergency response crews throughout the state get specialized training in managing hazardous materials emergencies.

Another key element of CAER is the concept that the public should have access to information on hazardous chemicals. This community right-to-know policy will provide the public with information we now give to our employees. The material safety data sheets (MSDS) developed by companies under the federal Occupational Safety and Health Act are an example of the type of information that will be made available. MSDS's provide detailed information on the hazards, properties and effects of chemicals.

The other major initiative, the National Chemical Response and Information Center, will supply hazard data on chemicals during emergencies, route non-emergency inquiries to appropriate information sources, and manage a network providing direct assistance for handling chemicals involved in accidents. In effect, it will become an information switchboard for anyone wanting help from the chemical industry.

The operation is being built around the Chemical Transportation Emergency Center (CHEMTREC), the industry's 14-year-old transportation emergency hotline service. CHEMTREC provides information on chemicals to emergency service personnel —such as fire, police and rescue squads—during transportation accidents involving chemicals. It is recognized by the U.S. Department of Transportation as the key source of emergency information on hazardous materials involved in transport accidents.

The new center is expected to become fully operational this fall. Four new programs will be added to this existing service. An expanded CHEMTREC will provide information and assistance for all major chemical emergencies, not just those related to transportation. This arrangement will include a telephone bridge between emergency room physicians and company medical departments to expedite emergency treatment for toxic exposure.

A chemical network (CHEMNET) of chemical company and for-hire emergency response teams will be implemented to put chemical experts at the scene of serious accidents in minimum time. A toll-free number will be available to refer routine public requests for information to chemical companies and other qualified sources. Training materials will be developed for fire, police, and medical services first responding to chemical emergencies.

While CMA was hammering out these programs, toxic air pollutants became a major environmental issue in the 99th Congress. Interest centered around the question: "Could a leak like the one in Bhopal happen in the United States?"

In April, Rep. John Dingell (D-Mich.), chairman of a House oversight and investigations subcommittee, asked CMA for information about how the industry handles hazardous air emissions. To find the answers, plants in three geographical areas were surveyed. They are in the Baton Rouge-New Orleans corridor, the Philadelphia-Wilmington-South Jersey area, and the Niagara Falls-Buffalo area. These centers of chemical industry activity represent different types of chemical processes, physical features, and regulatory controls.

The survey of CMA member company plants collected two types of data: 1) information about the systems in place for monitoring and detecting routine and accidental releases of chemicals, and 2) types of emergency response programs in use involving plant personnel or plant and local emergency response crews. The information has been compiled by CMA and forwarded to Rep. Dingell.

Safety is a number one priority among chemical makers, and the effort shows. The National Safety Council judged the chemical industry to be the safest of 42 basic U.S. industries last year, an achievement that the chemicals sector has earned for three of the past four years.

But an industry that depends on hazardous materials for many basic feedstocks can never rest on safety records. While Bhopal was an aberration, the industry is taking giant strides toward reducing the chance that it will ever happen again. □

EPA Goes Underground at Kentucky Superfund Site

by Susan Tejada

Explorers make their way through the water-filled passage of a cave under Bowling Green, Ky. Some water contamination was evident when this photo was taken in 1982. Three years later, complaints of toxic fumes from the caves prompted an EPA emergency response under Superfund.

In the 1930s and 1940s, the Lost River Cave was the coolest hot spot in Bowling Green, Ky. Before the days of air conditioning and climate control, this was one place in town that was never too warm. Dancing couples whirled away sultry summer nights, fox trotting on the huge dance floor just inside the cave's entrance. Lost River Cave was a subterranean nightclub.

In 1985, the nightclub is long gone. Instead of the strains of big band music, what comes wafting up from this underground domain today are toxic fumes.

Bowling Green is the largest city in the United States built entirely over a cave system.

Bowling Green sits atop a sinkhole plain. According to Dr. Nick Crawford of Western Kentucky University, it is the largest city in the United States built entirely over a cave system. The sinkhole plain resembles "a landscape of funnels," Crawford says. The sinkholes direct storm water runoff into the caves in the underlying limestone. Toxic wastes have also entered the caves, and EPA and the State of Kentucky are now trying to determine what the wastes are, how they got there, and how to mitigate the problem.

Several theories, says Crawford, explain how contaminants move underneath Bowling Green. Chemicals that were spilled onto soil over a period of time may be carried by rainwater into the aquifer, where they travel rapidly through limestone. As the chemicals volatilize, the caves fill with fumes. This could account for the fact that fumes are strongest after a heavy rainfall. Another possibility is that contaminants collect in natural traps in the cave system. Chemicals floating on top of underground streams may stick to the walls and ceilings of caves when the water recedes, forming a kind of stinking, giant bathtub ring under the city. Leaking underground storage tanks and deliberate discharge of chemicals into sinkholes may also be contributing to the fumes in the caves.

EPA became involved with the Bowling Green site in mid-1984, following complaints of toxic fumes in several residences. Fred Stroud, an On-Scene Coordinator from EPA's Region 4 office, had preliminary air samples taken. "They went way off the scale," Stroud recalls, "showing the presence of organics."

Stroud then turned to EPA's Environmental Response Team (ERT). Using more sophisticated instrumentation, ERT collected air samples from various residences in July and November of 1984. Further sampling was conducted at two schools in February, 1985.

Benzene levels documented by the residential sampling were, according to a later review by the Centers for Disease Control (CDC), "too high for non-occupational settings." In addition, some substances detected at the schools—benzene, toluene, and chlorinated hydrocarbons—were highly toxic, and others—alkane hydrocarbons—were explosive at high concentrations.

In March of this year, CDC issued a public health advisory for Bowling Green. "Although the relationship between contamination in caves [underneath Bowling Green] and fumes in buildings is hypothetical," the advisory states, "sufficient evidence has been collected to indicate that the presence of cave contamination and building fumes are probably related . . . The presence of chemicals in the cave system under Bowling Green, Ky., may represent a potential long-term health concern to persons living in the community. Long-term exposure or frequent intermittent exposure to benzene would represent the greatest public health concern since benzene has been associated with leukemia, bone marrow depression, neurological depression, and kidney and liver damage. High levels of volatile hydrocarbon chemicals also pose an explosion hazard."

EPA launched a Superfund emergency response to meet the hazards spelled out in the public health advisory. Working with state and local officials, the agency installed ventilation systems to mitigate the problem of toxic fumes. Now in place in the ground near the four homes having the worst fumes, each vent is a roof-level stack topped by a fan that pulls fumes away from both the cave passages and the homes. The local school district installed similar ventilation systems at two schools. Dispersed in the atmosphere, the fumes are believed to be harmless. "We still have fumes," says Stroud, "but at least we're keeping them out of the buildings."

EPA is also trying to locate the contaminants and their source and to determine if they have accumulated in one place where they can be collected and pumped out. This difficult task is further complicated by the fact that there is no ready access to the subterranean labyrinth where the contaminants float on sub-surface streams. An EPA team that includes Crawford and some of his students from the university's Center for Caves and Karst Studies must make that access.

First they drill exploratory wells on the spot of underground voids. At the outset they had to drill many small wells looking for voids. More recently, they have used microgravity studies to

(Tejada is Associate Editor of EPA Journal.)

pinpoint the exact location of the voids.

The entry team then goes down through entrance wells, which are only 30 inches in diameter, often landing knee-deep in underwater streams. Obviously, these are not people who mind tight spaces or wet feet. A smoke ejector fan brings in fresh air and blows contaminated air away. When conditions warrant, team members wear full-face respirators. They keep wet suits on hand, should the water get too deep. They are aided by a cave radio system, down-hole video cameras, and ERT's on-site mobile lab that can perform specialized analyses on the spot.

Despite the high-tech gear, the explorations are still somewhat hit or miss, as evidenced by this excerpt from a daily activity report on the site: "On May 20th two teams of cavers entered Robinson Cave. One team mapped 800 feet upstream and explored another 800 feet discovering several new leads to other passageways. The second team pushed downstream to explore and map the downstream section. Downstream push ended when the stream ran under a cave wall and disappeared."

At this time, work in Bowling Green continues on locating the contaminants, but major questions remain. How did they get there in the first place? Has there been continuous, deliberate discharge? By whom? For how long?

Everyone was putting something there at some time or other.

The State of Kentucky is investigating industries in the Lost River drainage basin in an attempt to answer these questions, and EPA is assisting with dye traces and analytical work. Dye is injected in places such as the storm drains of industrial facilities. Cavers then attempt to map the path of the dye underground by using dye indicators placed at selected locations throughout the cave system. So far a connection between industrial discharge and the fumes in the vented homes has not been proven. But the state has already cited six factories that it discovered had either accidentally spilled or deliberately discharged wastes directly into the aquifer. "It looks like everyone was putting something there at some time or other," Stroud remarks.

"It's pretty critical to this town to do something about this situation," concludes Crawford. In addition to the danger of explosions and the potential health threat posed by chronic exposure to the fumes, there is the additional problem of ground-water contamination. The sinkhole plain in Bowling Green, Crawford explains, "is the type of landscape most vulnerable to ground-water contamination."

While the fans atop the vent stacks continue to blow fumes away from threatened homes, EPA presses on with the search for the Lost River contaminants. "Whatever we do here," Crawford told a reporter last spring, "will end up in the textbooks." □

Helping the Oysters Get Along with the Cows

by Bob Jacobson

Dairy farmers in Oregon's Tillamook County are proving that people can eat Tillamook cheese without having to give up Tillamook oysters. Cows and oysters can coexist.

That's good news for gourmets, but even better news for local shellfish growers whose livelihood depends on the oysters they raise in Tillamook Bay, 60 miles due west of Portland on Oregon's Pacific Coast. The bay produces 80 percent of the oysters commercially harvested in Oregon. There are a lot of oysters in Tillamook Bay.

There are also a lot of Tillamook County dairy cattle: 19,000 of them on 118 separate dairy operations. Each year, these cattle produce 275,000 tons of manure. And that can cause problems, especially in a climate where rainfall ranges from between 90 to 150 inches a year. With all that moisture and with five major watersheds draining into the Tillamook Bay basin, runoff can easily carry fecal coliform bacteria into the shellfish beds.

One day in 1977, federal Food and Drug Administration officials told Tillamook oyster grower Sam Hayes that they were closing the bay to commercial shellfish harvesting because of unsafe levels of fecal coliform bacteria, and that it was illegal for him to sell his oysters.

Hayes got together with other oystermen and called on EPA and local and state agencies for assistance.

(Jacobson is Regional Press Officer in EPA's Region 10 in Seattle, Wash.)

Researchers traced the source of the contamination to animal waste. Hayes and his group approached the Tillamook Creamery Association, which is made up of dairy farmers, to ask for their help. For the oyster growers, things were bad and getting worse.

Now, in 1985, the situation is good and getting better. Tillamook Bay shellfish bed closures are much less frequent. Fecal bacteria levels have been significantly reduced in the streams flowing into the bay, according to Ernesta B. Barnes, EPA's regional administrator in Seattle.

"While credit belongs to several government agencies for getting things started, it has been the Tillamook Creamery Association and individual dairymen who have actually been getting things done," Barnes says.

The farmers built cement tanks for holding manure, curbs around barnyard areas to prevent runoff, cattle crossings over streams, roofs and rain gutters for holding pens and feeding stations, and they installed gutters in buildings to carry fecal material to safe distribution sites.

EPA helped to get things started in 1979 with a grant to the Oregon Department of Environmental Quality. The purpose of the grant was to develop a water quality management plan for the Tillamook Basin. The Department got the ball rolling by working closely with the Division of Soil and Water Conservation within the Oregon Department of Agriculture, and with the Tillamook County Soil and Water Conservation District.

The District turned out to be a key player. By 1980, it had developed an agricultural nonpoint source pollution abatement plan. If nonpoint source pollution was ever to be controlled, said the planners, heavy reliance must be placed upon dairymen using waste management practices individualized to each farm. The plan recognized that what was best for one dairy might not work at another, and that no uniform set of management practices would work across the board. It was the conclusion of the Tillamook County Soil and Water Conservation District that, for its plan to succeed, best management practices (cleanup plans) should not be imposed by law or regulation on each farm. Since management practices had to be tailored to each individual dairy, compliance should be on a voluntary basis. The question then became: How do you get the dairymen to volunteer? And how will dairymen know what is really best suited for each of them?

The U.S. Department of Agriculture made it easy for dairy operators to volunteer with the 1981 funding of a Rural Clean Water Project for the Tillamook Bay area. A chief feature of the project was the offer of federal money to share costs for instituting best management practices. More than $3.4 million in cost-sharing funds has been awarded to local dairymen.

In deciding what was best for each of them, the dairymen had the benefit of technical assistance from the Soil Conservation Service. The solutions varied dairy to dairy, but the most common best management practices were found to be the installation of underground concrete storage tanks for animal waste, application of manure to fields during appropriate soil and climatic conditions, addition of gutters to barns to control runoff, and construction of fences to keep cattle out of streams.

Many of the dairies have already improved their handling of animal wastes and are using the controls needed to reduce runoff. The dividends are becoming apparent. Sampling of streams flowing into Tillamook Bay has been limited, but measurements show that fecal bacteria levels now range from 15 to 50 percent of what they were before the Rural Clean Water Project.

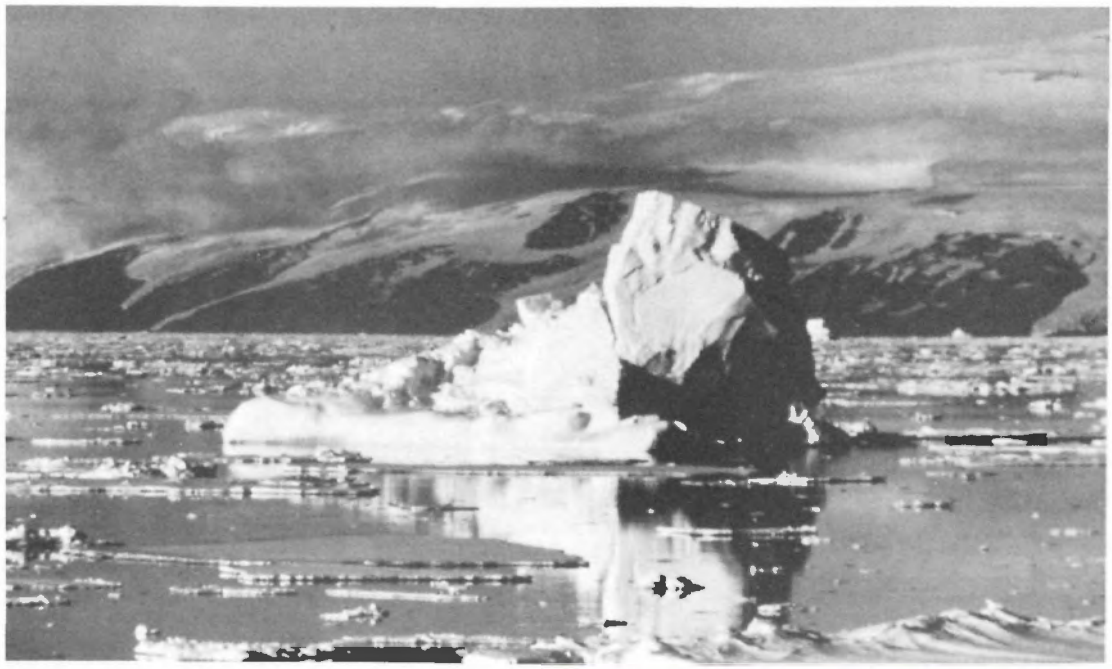
Improvements should continue as more dairymen begin implementing best management practices and as other non-agricultural sources of nonpoint pollution come under control. Local and state governments are correcting failing on-site septic systems and upgrading the operation of five small sewage treatment plants.

Elbert Moore, a nonpoint source pollution expert with EPA's Northwest regional office in Seattle, is one observer who has been encouraged by the Tillamook Bay experience. "Technically, we know how to solve nonpoint pollution problems," says Moore. "On a small scale, for example, putting up a fence around a stream to keep animals away can reduce fecal coliform levels in that stream almost immediately. On a large scale, we can also control nonpoint pollution. All it takes is the will to do it and individual initiative to get it done."

The farmers, the soil conservation district, and all the others in Tillamook County not only have had the will, they have also shown the way. □

Pollution Over the Arctic

by Glenn E. Shaw



U.S. Coast Guard

A floating iceberg accents an Arctic landscape.

At the turn of the century, polar exploration was in its romantic era. Although there were reports of ice blocks, pressure ridges, hidden crevasses, whiteouts, horrid winds, starvation, and death, at least the air was clean!

Two generations later, substantial change is evident in the Arctic. The polar landscape is dotted with drilling rigs, Caterpillar tractors, pipelines, and roads. There has been a northward migration of industrialization. And with it, there is a northward migration of air pollution. It's called Arctic haze, a phenomenon which is beginning to receive considerable attention.

So far as I am aware, Arctic haze was first noted by Murray Mitchell, Jr., a weather officer based in Alaska in the 1950s. Mitchell heard crews returning from weather reconnaissance flights talking about peculiar bands of soot above the polar landscape. He checked the reports out and found that the fliers' observations were correct. He later told me the haze bands "were very apparent." From their coloration and the way they scattered light, the haze bands, Mitchell deduced, were composed of small particles that were not snow or ice crystals. But their origin was a mystery. Mitchell wrote an article about the Arctic haze, but nobody took it very seriously. The idea of pristine polar expanses stretching on and on was too deeply entrenched.

A few years ago, a review paper was published on the composition and extent of small atmospheric particles from manmade sources and natural sources like sandstorms. The scientist authors assumed—as was only natural to do—that the planet's atmospheric particle count approached zero as one went towards the North or South Pole. They were, in fact, nearly correct. For most intents and purposes, there is an absence of particles over and around Antarctica and, in most times of the year, the same is true over the Arctic.

But from January to April, Arctic air turns turbid. Not terribly so, but enough to cause subtle visual effects: slightly milky skies and, sometimes, dusky bands against the twilight. But it takes a careful observer to notice that anything's amiss without going aloft and seeing the haze bands edge on, as Mitchell did in the 1950s. Then the visual effects are amplified, and the haze layers can be pretty distinct.

Measurements made in 1972 showed that the Arctic haze cuts down the direct beam of sunlight by about 10 percent, but some of that 10 percent is "recovered." That is to say, the haze scatters the light, whitens the sky a bit in the process, and reduces slightly the amount of direct sunshine. Though the effects of the haze on solar radiation are relatively small, Arctic pollution is Arctic-wide; it affects an area roughly the size of North America.

It is interesting to note that the haze in the Arctic is almost entirely a result of human activity. Sometimes natural material—for example, wind-lofted dust from the high latitude eastern Asian deserts—enters the Arctic, but these are rare events.

We can make such statements confidently because it is possible to identify the broad geographic regions which are the sources of the Arctic air pollution. We do this by looking at the chemical signatures of the microscopic haze particles themselves. A tracer system to help do this detective work was developed by Ken Rahn, a research professor, and his colleagues at the Center for Atmospheric Chemistry Studies at the University of Rhode Island.

The particles that cause the Arctic haze have travelled along pathways in the air thousands of miles long. During their travel, some of these particles of microscopic pollution stick together, new particles condense and grow from the gas stage, very small particles are lost by diffusion to cloud droplets, and larger particles are lost by falling out. In short, the chemistry of the polluted air changes as it travels.

But we can still use certain chemical tracers to determine where the pollution comes from. Such information is basic to learning how to prevent or control the Arctic haze.

With the tracers, we have found that the predominant source of the Arctic air pollution is Eurasia, especially the central Soviet Union and most probably the heavy industrial belt located along the Urals. Coal-based industry in eastern Europe and the petroleum-based industries in central Europe also seem to be contributors. North America, however, is a minor contributor to Arctic haze.

We are now in the position of knowing that the Arctic is somewhat polluted. We have at least a rough idea of the temporal and spatial occurrence of the pollution and the responsible source regions. But so far, very little is known about the possible ecological and climatic impacts from Arctic pollution. To properly assess these, further research will be required. □

(Shaw is a professor of geophysics at the Geophysical Institute of the University of Alaska.)

Update

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

AIR

Toxic Air Pollutants

A national strategy has been announced by EPA to reduce the risks from toxic air pollutants. At the same time, EPA announced a decision on five chemicals for federal regulation under the hazardous air pollution control provisions of the Clean Air Act.

EPA's strategy for controlling the air toxics problems calls for:

- Expanding the focus of the national air toxics control program from solely regulating individual pollutants to also regulating multiple pollutants from different source categories;
- Expanding the program to reduce risks in specific communities with air toxics problems;
- Increasing federal support of state air toxic programs so that states can improve their capability to deal with air toxics within their borders;
- Improving emergency preparedness and response for sudden, accidental releases at all levels of government;
- Beginning new efforts that will give the public the information it needs to prevent, prepare for and respond to toxic accidents.

Final Smokestack Height Rules

New regulations have been set by EPA which limit the use of tall smokestacks to disperse air pollution from industrial sources.

The regulations limit the extent to which industries can disperse pollutants into the atmosphere through tall stacks instead of installing additional control equipment to reduce emissions of the air pollutants.

The new rules will require states to revise their clean air plans (State Implementation Plans) to determine what additional reductions are necessary for those companies whose stacks are taller than allowed. EPA expects that the Clean Air Act regulations will affect primarily the electric utility industry, some of whose coal-fired power plants use tall stacks to disperse sulfur pollutants high into the atmosphere.

EPA estimates the regulations will result in potential sulfur dioxide emissions reductions of up to 1.7 million tons per year by 1995.

Nitrogen Dioxide

EPA has decided to retain the existing national ambient air quality standards for nitrogen dioxide and has deferred a decision to establish a short-term standard until it better understands the health effects of short-term nitrogen dioxide exposures.

The Clean Air Act Amendments of 1977 call for a review every five years of all national ambient air quality standards, which are designed to protect public health and welfare. Those amendments also require that EPA establish a short-term (one to three hours) health standard unless there is no significant evidence showing that it is required to protect public health.

Fuel Economy Credits

EPA announced final rules granting automakers fuel economy credits for 1980 and later model year vehicles to compensate for changes in the agency's vehicle test procedures.

The corporate average fuel economy (CAFE) standards established by Congress and the Department of Transportation are based on a 1975 EPA test procedure. EPA has changed the test a number of times since then to improve its accuracy. But because the changes took some fuel economy points away from each model tested—making the CAFE standards for the automakers' fleets more stringent—EPA is required by the Federal Energy Policy and Conservation Act to grant them fuel economy adjustments to compensate.

Ford Recall

Ford Motor Company is recalling approximately 119,000 1981 model year passenger cars to assure that the vehicles will meet federal exhaust standards for hydrocarbons and carbon monoxide.

The affected 1981 model year cars are Ford Mustang, Grenada, Fairmont and Thunderbird models and Mercury Capri, Zephyr, Cougar and XR-7 models equipped with 4.2 liter or 5.0 liter, eight-cylinder engines. California vehicles are not included in the recall.

Ford decided to recall the cars after EPA testing revealed they exceeded the 1981 hydrocarbon and carbon monoxide exhaust standards. The repair will consist of replacement of the carburetor choke pulldown motor.

Fuel Blending Violations

A civil penalty of $650,000 is being proposed by EPA against the Imperial Petroleum Corporation of Seattle for improperly blending alcohols with unleaded gasoline. EPA sent Imperial, a distributor of gasoline in the Seattle area, a notice of violation, which cites the company for violations of the Clean Air Act fuel regulations. Specifically, Imperial is charged with manufacturing an illegal unleaded gasoline blend from December 1983 through September 1984.

Agency investigators documented at least 61 occasions during a three-month period last spring when the company allegedly blended too much alcohol (methanol and ethanol), with unleaded gasoline and sold it to eight service stations in the Seattle area. On four other occasions, Imperial illegally blended lacquer thinner with unleaded gasoline before delivering it to several of the eight retail outlets involved.

Car Importer Indicted

The Department of Justice and EPA announced that a grand jury has handed down a criminal indictment against the owner of a California-based automobile import and emission testing facility which had submitted false emission test results on imported cars to EPA.

Named in the indictment is Albert Mardikian, owner of Trend Import Sales and Albert Mardikian Engineering of Orange County, Calif. The U.S. Attorney's office in Los Angeles has filed 35 felony charges against Mardikian. The counts allege that he submitted false information to EPA and used the U.S. mails to defraud the government.

HAZARDOUS WASTE

Largest Superfund Settlement

The federal government; the State of Indiana; the County of Monroe, Ind.; and the City of Bloomington, Ind., have reached a hazardous waste settlement with Westinghouse Electric Corporation to clean up contamination from polychlorinated biphenyls (PCBs) at six sites in the Bloomington area. EPA estimates the settlement is worth between $75 and $100 million.

Resolution of this enforcement case represents the largest hazardous waste settlement in the history of the agency. It is a comprehensive agreement which provides for the ultimate destruction of the PCB wastes, rather than long-term landfilling.

The six sites are known as Neal's Landfill, Neal's Dump, Lemon Lane Landfill, Bennett's Dump, Winston-Thomas Sewage Treatment Plant, and Anderson Road Landfill.

State Actions

Chief Judicial Officer Ronald L. McCallum of the EPA has held that the agency cannot take a hazardous waste law enforcement action when a state authorized by EPA to run its own hazardous waste program already has taken reasonable and appropriate action. This decision will

reassure the states that EPA will fully support their actions to enforce compliance with hazardous waste rules.

McCallum's decision upheld a decision by Administrative Law Judge Spencer T. Nissen. Nissen dismissed an attempt by EPA's San Francisco regional office to take an enforcement action against the BKK Sanitary Landfill in West Covina, Calif., after the State of Calif. has acted. EPA and the state had inspected the hazardous waste facility in June 1983 and found a number of violations of the hazardous waste laws, including a faulty containment and ground-water monitoring system.

Cleanup of Chem-Dyne Site

EPA has reached a $19 million settlement with 158 companies to clean up subsurface soil and water contamination at the Chem-Dyne hazardous waste site in Hamilton, Ohio.

The companies, primarily waste generators who sent their wastes to the site, have agreed to long-term pumping and treating of the contaminated ground water, the installation and long-term maintenance of an impermeable clay and synthetic cap on top of the site, excavation of highly contaminated soils, demolition of buildings, and an extensive ground-water monitoring program.

The companies have agreed to take all necessary steps to remove the contamination threatening public water supplies, which serve 60,000 residents.

Earthquake Exercise

In late June, EPA Headquarters and Region 9 participated in the Federal Emergency Management Agency's (FEMA) RESPONSE '85 Earthquake exercise in Los Angeles, Calif. The exercise was designed to provide a "real world" test of the "National Plan for Federal Response" to a catastrophic earthquake.

RESPONSE '85 was a disaster simulation exercise which involved state, local, regional and national response to a major earthquake on the San Andreas Fault in California. While many of these plans have been independently exercised, RESPONSE '85 was the first major exercise testing such plans in an interactive environment.

While all significant issues learned from the exercise have not yet been identified, areas that are being closely examined are intra-agency communications, institutionalizing designated points of contact for program offices, and ways for EPA to improve its overall participation within the federal family.

PESTICIDES

Captan

EPA is proposing to cancel all food uses of the pesticide captan after determining that dietary exposure to this product may pose an unreasonable risk to public health.

Captan is a fungicide registered since the early 1950s and is used on a variety of fruits and vegetables as well as non-food products.

EPA's proposed actions are based on evidence that captan produces oncogenic (tumor) effects in mice and rats and, therefore, may pose a potential risk of cancer to consumers through dietary exposure and to workers through dermal (skin) exposure and inhalation. Because EPA lacks reliable residue data, the agency based its estimated dietary risks for captan on worst-case assumptions about health effects. The worst-case assumptions are the highest permissible residues (tolerances) of captan that would be allowed in foods.

TOXICS

School Asbestos Abatement

EPA is awarding $45 million in grants and loans to the nation's most needy schools to help abate asbestos hazards.

EPA has selected 341 schools from 4,800 applicants to get federal funds under the Asbestos School Hazard Abatement Act of 1984 (ASHAA).

To help all schools, EPA is pursuing a variety of federal assistance measures under a new group called the Asbestos Action Program, including helping states set up certification programs, establishing training centers, and expanding and updating guidance and technical assistance.

Under ASHAA, EPA may award a loan of up to 100 percent of the cost of a specific abatement project. These no-interest loans are repayable over 20 years. If the agency determines that an applicant cannot complete an abatement program with a loan, the applicant will be eligible for a grant of up to 50 percent of the cost of an abatement program. Grants and loans are also available in combination.

Chemical Notification Violations

Six chemical manufacturers are being fined a total of $6.9 million by EPA for failing to notify the agency before they began manufacturing new chemicals.

The companies are BASF Wyandotte Corp. of Wyandotte, Mich.; Ciba-Geigy Corp. of Hawthorne, N.Y.; BASF Systems Corp. of Bedford, Mass.; Union Carbide of Danbury, Conn.; Dow Corning Corp. of Midland, Mich.; and Tremco, Inc. of Cleveland, Ohio, which is part of Akron Adhesives, a wholly-owned subsidiary of B.F Goodrich Co. (BASF Systems and BASF Wyandotte are wholly-owned subsidiaries of the West German company BASF AG, and are independent of each other).

EPA said the companies specifically violated Section 5 of TSCA which requires all firms to notify the agency 90 days before they manufacture or import a new chemical.

4,4'-MDA

EPA is formally referring the chemical 4,4'-MDA to the Occupational Safety and Health Administration for possible regulation.

4,4'-MDA is short for a chemical called 4,4'-methylenedianiline.

About 98 percent of the 400 million pounds of 4,4'-MDA produced in the U.S. each year are used to make methylene diphenyl diisocyanate (MDI), which is used, in turn, to make polyurethane foams and elastomers. The chemical is also used to make products such as epoxy resins, wire coatings and dyes.

EPA has decided to refer to OSHA a report which concludes that the manufacture and use of 4,4'-MDA presents an unreasonable risk of cancer to workers.

Since all known exposure to 4,4'-MDA occurs in the workplace, EPA is exercising its referral authority under Section 9 of the Toxic Substances Control Act by giving OSHA the first opportunity to regulate exposures to 4,4'-MDA.

Asbestos Protection Rules

Under an EPA action, federal asbestos safety rules would be extended to state and local employees to protect them from the potential hazards of asbestos abatement work.

EPA is making the rule immediately effective to make sure that it covers asbestos abatement activities planned for this summer.

The rule, issued under authority of the Toxic Substances Control Act (TSCA), will extend Occupational Safety and Health Administration (OSHA) worker protection requirements to state and local employees, including school maintenance workers such as janitors who perform asbestos abatement work.

Appointments at EPA

Dr. J. Winston Porter

Karen V. Brown

EDITOR'S NOTE: The June issue of the *EPA Journal* reported that Sanford W. Harvey, Jr.'s new title in EPA's Region 4 is Deputy Regional Administrator. Mr. Harvey's actual title is Associate Regional Administrator. The Deputy Regional Administrator of Region 4 is John A. Little. The editors of the *EPA Journal* regret any confusion that this error has caused.

Dr. J. Winston Porter has been nominated for the position of Assistant Administrator for EPA's Office of Solid Waste and Emergency Response.

Since 1976, Porter has been with J.W. Porter & Associates, a management and engineering consulting firm. Previous experience also includes work with the Bechtel Group, where he served as a vice president for international operations.

Porter received his doctorate in chemical engineering in 1966 from the University of California at Berkeley.

Francis S. Blake has been confirmed by the U.S. Senate as General Counsel for EPA. He will serve as the primary legal adviser to the Administrator.

Before coming to EPA, Blake specialized in environmental, utility, and administrative law. From 1983 to the present, he was a partner in the firm of Swidler, Berlin and Strelow, Chtd., and from 1978 to 1981, he was an associate with the firm of Leva, Hawes, Symington, Martin, and Oppenheimer.

Between 1981 and 1983, Blake served as Deputy Counsel to Vice President Bush, as well as Deputy Counsel to the President's Task Force on Regulatory Relief.

From 1977 to 1978, Blake served as a law clerk to Justice John Paul Stevens of the U.S. Supreme Court; from 1976 to 1977, he clerked for Judge Wilfred Feinberg of the U.S. Court of Appeals for the Second Circuit.

Between 1971 and 1973, Blake was a legislative aide for the Joint Committee on Social Welfare of the Massachusetts State Legislature.

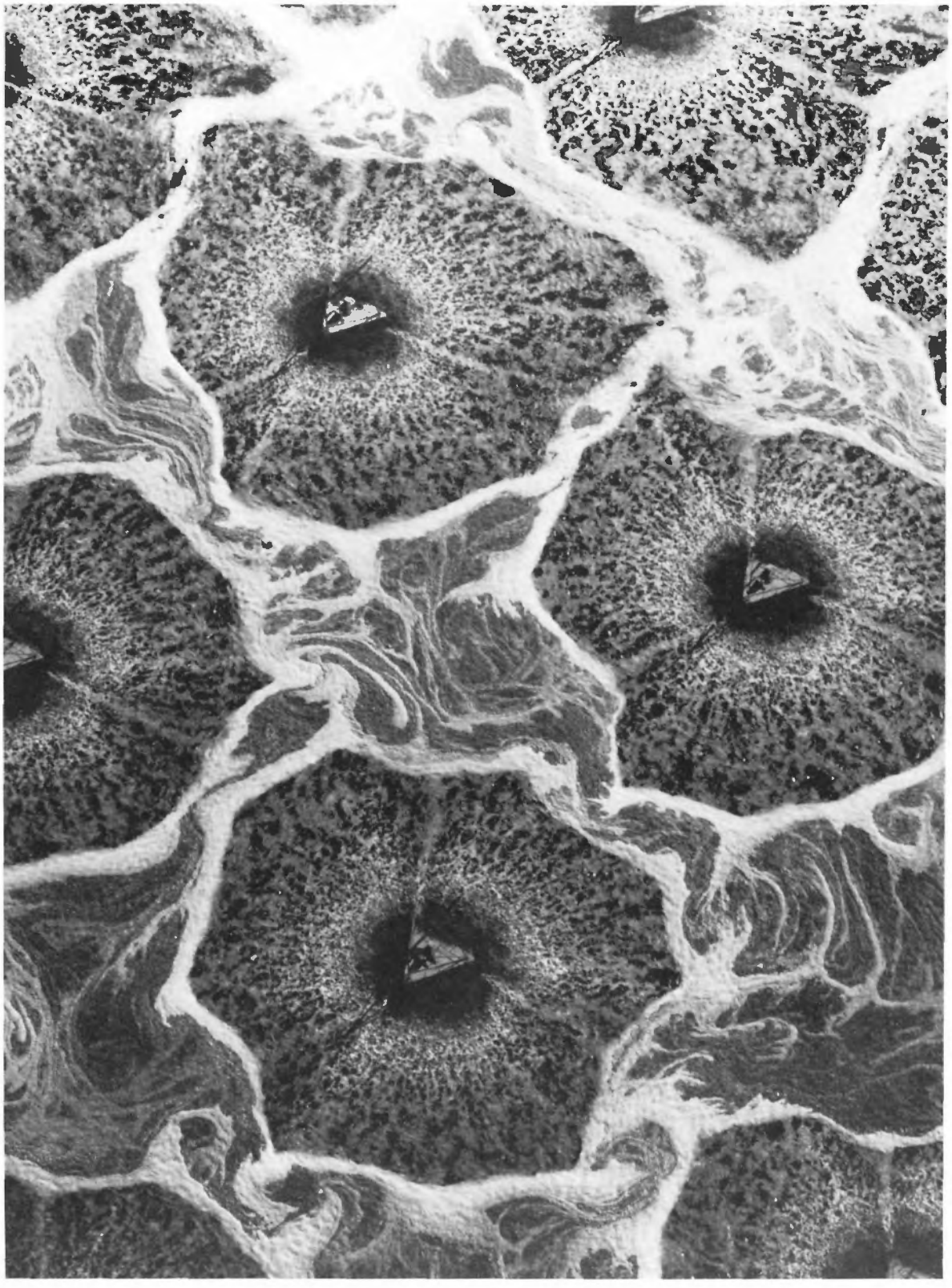
Blake graduated magna cum laude from Harvard in 1971 with a degree in government. He received his law degree in 1976 from Columbia University Law School.

Karen V. Brown has been appointed Small Business Ombudsman in the Office of Small and Disadvantaged Business Utilization. In addition to helping small businesses understand and comply with environmental regulations, Brown will be responsible for increasing agency awareness of and consideration for their special problems and concerns.

Brown has been with EPA since 1981, where she has held management positions in the offices of the Administrator, Deputy Administrator, and Assistant Administrator for Solid Waste and Emergency Response.

Before coming to EPA, Brown had been a chemist and environmental specialist with the District of Columbia's Environmental Health Administration and with two business firms.

She received a B.S. in Biology in 1975 from the University of the District of Columbia, and has done graduate work in environmental science at George Washington University in Washington, D.C.



Consolidated Papers, Inc

Microorganisms in an aeration lagoon remove biochemical oxygen-demanding substances from effluent. The lagoon is part of the wastewater treatment process of Consolidated Papers, Inc., of Wisconsin Rapids, Wis. From the lagoon, the effluent will flow to a secondary clarifier, and then to the Wisconsin River. A sludge by-product will be used as fertilizer on nearby farms. The company's Water Quality Center, which includes the aeration lagoon, is an example of wastewater treatment improvements industry has made as a result of environmental laws.

Back Cover: Aquatic plant flowers on a Maryland pond. Photo by Steve Delaney.

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