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Environmental Perspectives

EPA photograph of Mt. St. Helen's, near Vancouver, WA. Before this volcano erupted in May 1980, EPA's Environmental Monitoring Systems Laboratory photographed the site to detect hot spots. After the eruption, EPA continued aerial photography to document the environmental impact of fallout and floods on the area and to search for missing people and vehicles. *(See related story on page 2).*

Environmental Perspectives

"The environment is everywhere," and environmental concerns range from ocean oil spills to visibility in parks, from PCBs in office buildings to asbestos in schools. This issue of *EPA Journal* includes articles across the spectrum of environmental protection.

Leading off the issue is a feature on aerial photographic work in support of EPA's mission. Another article reports on the Agency's efforts to deal with widespread contamination from PCBs in electrical transformers. A third story explains how a recent EPA proposal would rid this country of asbestos.

A day in the hectic life of a pesticide product manager—one of only nine such employees at EPA—is featured. Another article explains the "R" factor at work as some pests develop resistance to pesticides. Developments that transform the litter of rusting automobile hulks into a useful resource are explained.

An EPA oil spills expert explains why we haven't heard much about big spills in recent years. Another article explores the question of whether environmental disasters result in new cleanup laws. A report chronicles EPA Region 3's organized effort to clean up pollution from oil wells operating in northwestern Pennsylvania.

Steps by EPA and the National Park Service to protect visibility in the national parks are described. One of the fathers of ecology in America—Aldo Leopold—is featured. Another article describes a special office in EPA set up to help small business comply with environmental regulations.

Concluding this issue of the *Journal* is the regular feature—Update. □

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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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Cover: Sign of spring, Photo by Jon Riley, Folio Inc.

Design Credits: Robert Flanagan; Ron Farrah.

On Camera for EPA

by Susan Tejada

Exhibit A: In a Superfund trial, this aerial photograph proved that a waste lagoon (arrow) still existed on the Great Lakes Container Corp. property in Kingston, NH in April 1974.

If Gertrude Stein had said, "A dump is a dump is a dump," she would have been wrong.

In fact, a dump may once have been a farm or a forest, and it may become a playground or a parking lot. How can an investigator find out if today's ballfield is yesterday's hazardous waste site? One way is by asking EPA's Environmental Photographic Interpretation Center (EPIC).

A field station of the Environmental Monitoring Systems Laboratory (EMSL) in Las Vegas, the center is housed in a nondescript concrete building on the Vint Hill Farms Army base near Warrenton, VA. EPIC provides remote monitoring technical support to EPA's four eastern regions. EMSL provides similar support to EPA's other six regions.

EPIC was set up 13 years ago. Today seven EPA staffers and approximately 40 contract employees carry out EPIC's mission: to collect and interpret aerial imagery in support of EPA regulatory and enforcement programs.

Of what possible use are a bunch of old pictures?

Without EPIC, "we would have had to put a search party in a boat on a river that was raging out of control," says Dr. Joe Lafornara, recalling the turbulent floods that devastated Johnstown, PA, in 1977. Lafornara, a member of EPA's Environmental Response Team, helped track oil and chemical spills caused by the flood.

(Tejada is Associate Editor of the EPA Journal.)

"The flights went on every day for two or three weeks," Lafornara relates. Using photos from the flights, "we could pinpoint the precise locations of spills and floating barrels, and dispatch cleanup crews only where they were needed. Without the aerial photography, it would have been impossible. Some of the barrels would probably still be there."

The cameras that proved so indispensable in the Johnstown emergency were encased in a steamer trunk-sized device known as an "Enviro-pod." Designed for portability and compatibility with commonly used light aircraft, the pods are strapped to the belly of the aircraft. Each pod holds two cameras, one shooting at an angle and one shooting straight down.

Unlike conventional framing cameras, these panoramic cameras sweep across the line of flight, producing a high resolution (greatly detailed) strip image. Although EPIC maintains several Enviro-pods at Vint Hill and in the regions, it doesn't have any planes to carry them. Commercial pilots and planes are hired for most missions, with an EPA employee or contractor usually going along to operate the camera.

"We use the Enviro-pod almost weekly," says Jim Butch, who works on wetlands protection issues in EPA's Region 3 office in Philadelphia. "For permitting purposes, we use aerial imagery to learn about the details of an ecosystem. We also use it to identify high-value wetlands," that should not be filled.

"On a sortie basis," says EPIC's Chief, Vernard "Curly" Webb, "there is nothing to compare with the pod. When we need to search for signs of midnight dumping along a railroad track, or inspect a river for floating drums—in other words, when we're looking for something specific in a specific place—the Enviro-pod does the job."

There are times, though, when the Enviro-pod isn't enough. Strapped onto light aircraft that fly at low altitudes, the pod's cameras cannot cover as large an area as they could if flying higher. When large-scale investigations are needed, EPA, through the National Aeronautics and Space Administration, can also arrange for collection of high-altitude aerial imagery such as that obtained with panoramic camera overflights in a U-2 plane flying at high altitudes.

"About once a year we work with NASA," Webb explains. "Next year, at the request of Region 4, we're scheduled to fly over Alabama to inventory strip mines and gravel pits. In 1979, we inventoried Pennsylvania for landfills, dumps, pits, ponds, and lagoons. In 1980, we did the same for West Virginia."

A single frame of film taken from an optical bar camera in a U-2 is five feet long and covers a land area of about 200 square miles! NASA needed only about six hours to film the entire state of Pennsylvania with enough detail to keep EPIC analysts busy for a year.

In a large room at Vint Hill stand units of industrial shelving, stacked with thousands of cannisters of film. In another part of the same room are more shelves, laden with flat frames of film. This is EPIC's film library, full of a lot more than just film. The cannisters and frames on the shelves also contain history.

EPA has exposed more than 3,000 rolls of film. Over the years, other federal agencies have also been amassing aerial photographs. The U.S. Geological Survey, Soil Conservation Service, NASA, U.S. Forest Service, and National Oceanic and Atmospheric Administration have photographed the United States from the air for such purposes as preparing county soil maps, topographic maps, and navigation charts. Some of this photography is preserved at the National Archives,

some at the agencies themselves, and some at EPIC's film library.

So what? Of what possible use are a bunch of old pictures?

For starters, they can help answer the question posed earlier: Is today's ballfield yesterday's dump? EPIC's trained interpreter/analysts can spot

"EPIC puts such a professional product together that it impresses both the prosecution and the defense."

drainage patterns, stressed vegetation, impoundments, land scars, and other signs that might indicate the presence of hazardous chemicals, even if those chemicals were buried long ago.

The use of historical imagery is "fantastic," claims Joe Lafornara. In 1982, Lafornara had to look for traces of dioxin at the site of a former pesticide manufacturer in Edison, NJ. The manufacturing had begun there in the 1940s and stopped in the 1960s. By the time Lafornara arrived on-site in 1982, "there was nothing there but a few concrete pads overgrown with weeds. Without historical photography, we would have had to take random samples over the entire site, almost five acres."

EPIC analyzed aerial photographs of the site going back to the 1940s. As a result, Lafornara explains, "we could pinpoint where the loading and unloading docks had been—the areas where one could expect the most spillage. We knew where the lagoons had been, what the historical drainage patterns had been, even which buildings had been used for which chemical processes. So we knew exactly where we would have the highest probability of finding dioxin. Instead of 800 sampling stations, we only needed 50. Sampling that could have taken up to two months to complete took only one week." The historical photos, Lafornara concludes, "make it immeasurably easier to do an extent-of-contamination survey."

Jim Butch cites another solid reason for using "a bunch of old pictures": they are, he says simply, "great evidence."

Once a wetland has been filled, Butch explains, "it's hard to trace where the original wetland met the upland. People will tell you the fill has been there for years and years. But through historical photography, we can establish that the fill has *not* been there for years and years. The photographic evidence is incontrovertible and court admissible. It helps us get compliance from violators."

Dave Riggs, a criminal investigator based in EPA's Region 4 office in Atlanta, confirms the enforcement-critical nature of historical imagery. "EPIC puts such a professional product together," Riggs says, "that it impresses both the prosecution and the defense. It can be extremely valuable in convincing the U.S. Attorney's office to prosecute a case for EPA, or in convincing a defendant to make a plea."

When the longest federal environmental enforcement liability trial in this country finally ended in December 1985, the photographic work of EPIC had played an important role in a decision that confirmed the authority of EPA to hold hazardous waste generators, transporters, and facility owners and operators responsible for past and future costs of cleanup and for protection of health and the environment.

Continued to next page

Exhibit B: Drums, some stacked on top of each other three deep, at the Ottati and Goss site in Kingston, NH. More than 4,000 drums were counted in this Enviro-pod photograph.

The case involved the Ottati and Goss, Inc., and Great Lakes Container Corporation (GLCC) sites in Kingston, NH. Operations at the GLCC site included a barrel reconditioning plant which functioned for nearly 30 years until 1980. On the adjacent parcel of land, a waste storage and treatment facility operated from March 1978 to June 1979, when Ottati and Goss abandoned operations there.

In May 1980, the U.S. Department of Justice filed a civil action in U.S. District Court in Concord, NH, seeking injunctive relief and costs on behalf of EPA against responsible parties associated with the two sites. EPA had spent about $1.5 million on removal of the drums from the site, and some $850,000 on ground-water and related studies and on preparation of a preliminary engineering plan for a permanent cleanup.

According to Philip Boxell, an attorney with EPA's Region 1 office based in Boston, EPIC's involvement in the Ottati and Goss case "illustrates the invaluable and even critical role it can play in Superfund enforcement." That role focused on documenting the existence of a waste lagoon on the GLCC site, and thousands of drums filled with waste on the Ottati and Goss site.

The generators sued by EPA claimed that few drums had accumulated on the Ottati and Goss site during 1978. Aerial photography proved that this was not so.

At the request of the regional office, EPIC had overflown the site with an Enviro-pod once each year from 1978 to 1980. For the trial, EPIC's Terry Slonecker analyzed photos from those trips. Viewing du-positives, or negatives, through a stereoscope, Slonecker could see the images in three dimensions and actually count the drums, even those stacked two or three deep (see photo above).

"The photography is worthless unless our people hunched over their light tables can extract from it the information they need."

The images revealed that, contrary to the generators' claim, at least 2,048 drums, and perhaps as many as 2,867, were on site in September 1978, and that that number had increased to over 4,000 by November 1979. Along with generator invoices, says Boxell, "aerial photography of the site was critical to demonstrate that, during the early stages of the operation, thousands of drums were on the site contributing to soil, surface-water, and ground-water contamination. The photographs were very important to establish liability."

Historical photography also came into play in the trial. Hazardous liquids from a caustic wash operation and residue from an incinerator had been dumped into a waste lagoon on the GLCC property. The corporation that bought the site in 1973 argued that it did not operate the lagoon. The government disagreed, contending that the lagoon had not been closed until at least the spring of 1974.

During the trial, an aerial photograph of the lagoon area taken for the county in April 1974 by a Massachusetts surveying firm was located (see photo page3). Slonecker rushed to Concord to analyze the photo on the spot, later confirming the results back in Vint Hill on an analytical stereo plotter.

The photograph showed that in April 1974 a lagoon containing liquid *did* exist. It was a depression about 20 by 25 feet, diked on three sides, with light-toned material on the fourth side. Debris and probably drums were located in the general area.

According to Sheila Jones, a Justice Department attorney who also tried the case, Slonecker's testimony played a critical role in determining how long the lagoon had been in operation.

U-2s, Enviro-pods, stereo plotters: the sophisticated equipment at EPIC's command seems like pretty high-tech stuff. But Vern Webb cautions against glorifying the technology. "The photography is not an end product," Webb emphasizes. "It is a means of recording information. The photography is worthless unless our people hunched over their light tables can extract from it the information they need."

As the defendants in Ottati and Goss and others are finding out, the photography does yield that information, and seeing is believing. □

Cornering PCBs

by Margherita Pryor

Binghamton Press & Sun-Bulletin

Cleanup begins following a fire in a state office building in Binghamton, NY, in February 1981. The fire started in a basement transformer vault and spread PCBs throughout the building.

It's early morning rounds in an office high-rise, but the grey mist in the lobby isn't from dawn's early light. An oily, acrid-smelling vapor is streaming from the elevator shaft, and the building lights are flickering ominously as a gagging watchman runs to pull the fire alarm.

It's not hard to find the source of the smoke—a basement room housing four electrical transformers. The room is also the source of noises and vibrations, and worried firefighters immediately arrange for the local power company to de-energize the equipment so they can enter safely. When the power company checks its records, it finds that the transformers contain polychlorinated biphenyls, or PCBs.

At that point, the entire chemical emergency apparatus swings into gear. The building is sealed, and hazardous materials experts, local and state public health officials, and representatives of EPA and the National Institute of Occupational Safety and Health all converge at the scene. Yet despite the clouds of thick black smoke that poured out of the electrical room, no real flame or fire ever appeared.

Not the "Towering Inferno" most of us expect in a catastrophic fire, but it illustrates one of the greatest dangers facing firefighters today—unwitting exposure to toxic substances formed by burning building materials and electrical equipment, including PCB transformers.

The U.S. Bureau of Standards has found that many plastic materials can generate literally hundreds of different combustion products when burned, among them toxic compounds such as carbon monoxide, sulfur dioxide, nitrogen oxide, ammonia, formaldehyde, hydrogen cyanide, and hydrogen chloride. The insulating fluid used in the electrical transformers that provide power to a building can also generate toxic materials when burned, particularly if the fluid contains PCBs.

(Pryor is Contributing Editor of the EPA Journal.)

PCBs belong to the family of chemical compounds known as chlorinated hydrocarbons. PCBs have the extremely useful properties of electrical conductivity and non-flammability, and they are also some of the most stable chemicals known, taking decades to decompose once they enter the environment.

A PCB fire in a museum could contaminate irreplaceable national treasures forever and close the structure for years.

Although EPA issued stringent requirements for PCB disposal in 1978, the National Research Council has estimated that up to 150 million pounds of PCBs have already entered the environment due to indiscriminate dumping and leaks. By now PCB contamination is widespread. The chemical has been found in soil, water, fish, human breast milk and tissue—even in Arctic snow.

People absorb PCBs through food, skin contact, and inhalation. The PCBs accumulate in fatty tissues and body organs, where they remain even after direct exposure ceases. Laboratory tests have shown that PCBs can harm reproductive and developmental processes, and cause gastric disorders, skin lesions, and tumors.

Concerned over these serious health effects, Congress in 1976 banned the further manufacture and sale of PCBs, and EPA began issuing controls on their use and disposal. But PCBs had been used extensively as insulating fluid in electrical transformers and capacitors. This equipment usually lasts 30 years or more. Ten years after the Congressional ban on manufacturing, millions of transformers and capacitors containing PCBs are still legally in use.

Until recently, the major risk of exposure to PCBs was thought to be from leaks and spills and improper disposal of PCBs and used PCB equipment. In 1982, EPA placed tight controls on the use of PCB electrical equipment. But since that time, fires in San Francisco, Tulsa, Miami, Chicago, and Binghamton, NY have shown that fires involving PCB transformers may pose an even greater risk of exposure. EPA estimates that almost 80,000 PCB-laden transformers are used and located in or near commercial buildings such as office buildings, apartment complexes, shopping malls, and subway and train stations—all places where the potential for human exposure is great.

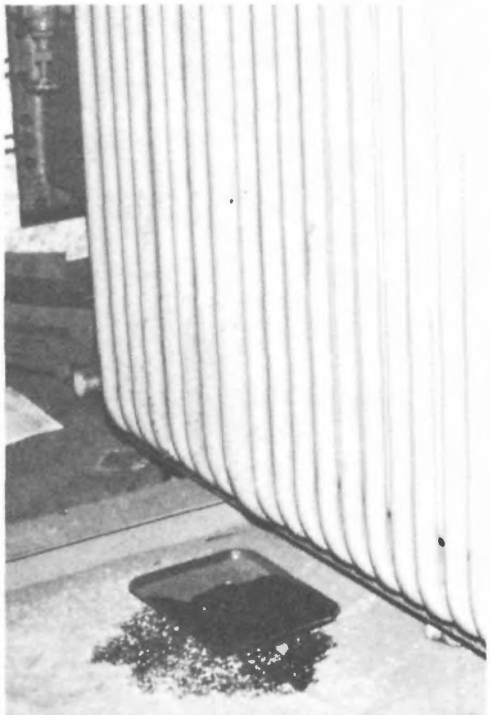
Transformer fires typically occur because of electrical failure in the transformer or its associated equipment. High temperatures and pressures within the unit can cause it to rupture, releasing PCBs and incomplete combustion byproducts in the form of vapor and smoke. These incomplete combustion byproducts can include polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzodioxins (PCDDs), substances more toxic than PCBs themselves. During a fire, these byproducts, as well as PCBs, can spread in smoke, soot, and vapor throughout the interior of the building, resulting in widespread contamination.

PCB contamination doesn't stop inside the building, either. The water, foam, and other materials used to extinguish the fire can be contaminated and must be prevented from entering storm sewers or seeping into the ground. Hoses, equipment, and protective clothing are another contamination problem. Even the equipment used in cleanup can become contaminated.

Regulating PCBs has not been easy, but recent surveys of PCB levels in human tissue suggest that our exposure to PCBs already has lessened.

A 1981 fire in Binghamton, NY, for example, started in a basement transformer vault, but spread PCBs and toxic byproducts throughout the 18-story building through the ventilation system. Five years later, the building is still closed. Almost everything in it, including furniture and office equipment, has had to be destroyed because of contamination. The walls, air vents, and building shafts have required meticulous decontamination with special solvents, and cleanup costs so far have amounted to about $30 million—for a building that originally cost $20 million.

Although the rigors, and expense, of decontaminating a high-rise office building are great, a fire in a museum could pose even more difficulties. Last summer, an inspection of the Smithsonian Institution found leaking PCB transformers in several of the most popular museums. A PCB fire in a museum could contaminate irreplaceable national treasures forever and close the structure for years, as well as endanger visitors and firefighters.



P.J. Walsh

PCB coolant leaks from a high voltage electrical transformer in the Smithsonian Institution's Museum of American History.

Incidents like these convinced EPA that the risks from PCB transformer fires warranted new controls on PCB equipment. In July 1985, the Agency issued new rules that:

- Required PCB transformer owners (usually the utility company or building owner) to register this equipment by December 1, 1985, with fire departments and building owners, as well as to mark the exterior of all transformer locations. All combustible materials within five meters of PCB transformers were to be removed, also by December 1;
- Require transformer owners to notify the National Response Center immediately in the event of a fire-related incident involving a PCB transformer, and to act as soon as safely possible to contain any potential releases of PCB-contaminated water;
- Require the removal by October 1990 of certain commercial-building PCB transformers which are more prone to failures due to electrical faults;
- Require the installation of enhanced electrical protection for other types of PCB transformers used in or near commercial buildings; and
- Ban the further installation of PCB transformers in or near commercial buildings.

Since promulgating these rules, the Agency has been helping transformer owners to comply with the new regulations, and has provided support in responding to PCB and PCDF contamination resulting from PCB fires. EPA has also been working with the federal government's General Services Administration to explore ways to bring the large number of government-owned PCB transformers into compliance with the new requirements. Last summer, some of these transformers were found not only in the Smithsonian, but also in the White House and Executive Office Building and the Washington, DC subway system.

Other PCB issues before the Agency include developing policy for cleaning up spilled PCBs and ensuring safe methods for disposing of PCBs. Currently, the standards for cleanup of areas contaminated by PCB spills or leaks are set at the Agency's regional level, and the result has been differing standards across the country. EPA has been working on a policy to ensure nationally consistent cleanup standards. The development of such national standards has been encouraged by environmental organizations as well as by industry groups and utilities.

Of course, the new removal requirements and the increased emphasis on adequate cleanup will require the availability of safe disposal facilities and disposal methods. Landfilling and incineration are the traditional disposal methods, but there are very few approved disposal sites. Since 1983, EPA has issued nine permits for alternative disposal methods, and is currently reviewing 17 more applications. These applications include disposal alternatives such as chemical treatments, mobile incineration, and physical separation.

Regulating PCBs has not been easy, but recent surveys of PCB levels in human tissue suggest that our exposure to PCBs already has lessened and will decline further as the PCB equipment still in use is removed and disposed of properly. ▫

Moving to Rid America of Asbestos

by Dave Ryan

Magnified closeup of asbestos fibers used in some of the products EPA is proposing to ban.

(Ryan is a Press Officer in the EPA Office of Public Affairs.)

On January 29, 1986, EPA published a proposal in the *Federal Register* to rid the United States of the "miracle" fiber called asbestos.

In the proposed rule, issued under authority of the Toxic Substances Control Act (TSCA), EPA invites public opinion on its intent to immediately ban five major asbestos products and phase out all remaining uses of the substance over the next 10 years.

Why is EPA proposing such a measure for a product long considered so commercially important, and still so pervasive throughout American society?

Asbestos is really a common name for a group of natural minerals—silicates—that separate into thin but strong fibers. The fibers are chemically inert and heat-resistant, and they cannot be destroyed or degraded easily.

Since 1900, over 30 million tons of asbestos have been used in hundreds of products. Much of it was sprayed on ceilings and other parts of schools and public and private buildings for fireproofing, sound-deadening, insulation, or decoration.

Unfortunately, some of the characteristics that make this mineral fiber so useful commercially—such as its great stability—also help make it a dangerous killer when it is breathed in.

Unless completely sealed into a product, asbestos can easily break into a dust or into tiny fibers. These fibers can then float and be inhaled. Once asbestos gets into the body, it can remain there for many years.

"There can be no debate about the health risks of asbestos," says EPA Administrator Lee Thomas. A well-documented cause of lung and other cancers in humans, including mesothelioma (a cancer of the chest and abdominal lining), asbestos is now generating up to 12,000 cancer cases a year in the United States, almost all of which are fatal. Aside from the cancer threat, about 65,000 persons in this country are currently suffering from asbestosis, a chronic scarring of the lungs which makes breathing more and more difficult and eventually causes death.

Cigarette smokers exposed to asbestos face extra risk, having a much higher chance of getting lung cancer than exposed nonsmokers.

Asbestos-caused cancers can remain latent and not occur for 15 to 40 years after the first exposure. EPA also believes that even small amounts of asbestos in the air are dangerous.

Asbestos is released into the air throughout its entire life cycle: manufacturing, use, destruction and disposal. Since substitutes are, or will soon be, available for nearly all uses of the fiber, EPA has no feasible alternative but to phase out asbestos and all its products. This is what the January proposal sets out to do.

Prohibited would be the importing, manufacture, and processing of five products that account for as much as one half of United States asbestos consumption. The bulk of these products are used mainly in the construction and renovation industry. They are:

Saturated and unsaturated roofing felt—This is a product made of paper felt and intended to cover or lie under other roof coverings. Its purpose is to insulate and help prevent corrosion.

Flooring felt and asbestos felt-backed sheet flooring—Used as an underside backing for vinyl sheet flooring, this felt helps maintain original product shape and helps prolong floor life, especially when moisture from below the surface is a problem.

Vinyl-asbestos floor tile—Especially popular for use in heavy traffic areas such as in stores, kitchens, and entry ways.

Asbestos-cement pipe and fittings—This is used primarily to carry water or sewage, and to a lesser extent, as conduit pipe for the protection of electrical or telephone cable or for air ducts.

Asbestos clothing—Not street clothes, but special occupational garments worn by those needing protection from extreme heat, such as firefighters.

What about the rest of the asbestos products in use? EPA is proposing to get rid of the asbestos in these products indirectly by phasing down all domestic mining and importing of asbestos by a certain percentage each year over the next 10 years. This phasedown would be carried out by allowing a company to mine or import an annually decreasing percentage of the amount of asbestos it mined or imported during the years 1981-1983.

EPA estimates that as a result of what it is proposing, about 1,900 cancer deaths from asbestos will be avoided.

In the January notice, the Agency also lays out for public comment three alternatives to this proposal, including grouping asbestos products by use category (such as construction, car brakes, and clothing) and banning them in stages. The goal of all options, however, is the same: the ultimate elimination of widespread asbestos use in this country.

Whatever alternative EPA pursues, it intends that labels be put on all products not immediately banned, warning users that they contain asbestos. EPA hopes that these warnings would encourage users to take steps to reduce their exposure.

For the five products banned under the proposal, EPA is convinced that industry has adequate, readily available substitutes which should minimize the economic impact of this action. The 10-year phase out should give industry time to develop good alternatives for all remaining asbestos products.

EPA estimates that as a result of what it is proposing, about 1,900 cancer deaths from asbestos will be avoided.

The issue of asbestos substitutes is important because Congress requires EPA to take not only health but economic considerations into effect when developing regulations.

For example, vehicle brake manufacturers use asbestos extensively in linings—in fact, brake linings represent one of the main uses of asbestos in the United States—but substitutes are probably not yet available for all applications. For this reason, EPA is not proposing to ban asbestos in brake linings right now.

"In encouraging the development of substitutes, EPA will be promoting a significant reduction in risk," says Lee Thomas. "Currently, products that are replacing asbestos appear to present lower risk. However, EPA will monitor the development of substitutes, and will use TSCA to require testing of substitutes if necessary to ensure their safety."

In fact, American businesses have been significantly curtailing their asbestos consumption voluntarily since the early 1970s, with use in products down from about 800,000 tons annually in the early 1970s to about 200,000 tons a year today.

Partly for these reasons, EPA expects the cost for the average American of meeting the proposed asbestos rules will be small.

Consumer costs, resulting from price increases in asbestos products or substitutes, are estimated at $1.5 billion; spread across the whole population, however, this would average less than $10 per consumer over the next 15 years.

Total producer costs of about $210 million would result when companies can no longer use certain specialized equipment for making asbestos products. Much of this machinery, however, can be readily converted to the production of other goods.

"EPA has weighed the health risks from continued use of asbestos against the cost of the proposed rule," Thomas said, "and concluded that the avoidance of about 1,900 cancer cases and many other cases of asbestos-related disease substantially outweighs the economic effects."

As sweeping as the proposal is, it is just the latest in a long series of actions taken by EPA since the early 1970s to reduce the risks from asbestos.

EPA has issued water pollution standards for asbestos manufacturers, and, under the Clean Air Act, banned the use of most sprayed-on asbestos. The Agency has also taken steps to reduce risks from asbestos already in place in buildings. It has issued an air standard to reduce emissions from asbestos during renovation and demolition; required inspection of schools for asbestos-containing materials and notification of parents and employees if any are found; and established an extensive technical assistance program which provides guidance to public and private building owners on the identification and abatement of asbestos. EPA has also issued a regulation to protect certain state and local public employees who take part in asbestos abatement activities.

Nor is EPA the only federal agency to act against asbestos dangers.

For example, both the Occupational Safety and Health Administration (OSHA) and the Mine Safety Health Administration have set standards for workers on the job (OSHA also plans to lower its workplace standard); the Food and Drug Administration has established rules to prevent asbestos release from some drug-filtering processes; and the Consumer Product Safety Commission has banned the use of the substance in dry-wall patching compounds and ceramic logs.

Federal government actions such as these—capped off by EPA's hard-hitting ban and phaseout proposal—have moved America well down the path towards effective asbestos control. □

(Public hearings on EPA's proposed rules are tentatively scheduled for mid-May; written public comments must be submitted by April 29, 1986).

Of Watermelons, Flea Collars, and Cockroaches

by Carol Panasewich

Last summer, you refused to buy your kids a watermelon because you heard that some watermelons had been pesticide-overdosed and might not be safe to eat. The fleas from your cat have established colonies in your carpeting and upholstered furniture, but you postpone calling in a pest control company because you're afraid of the insecticide spray it would use.

What do you have in common with representatives of a number of chemical companies, environmental and public interest groups, many state, federal, and international officials, and certain upper level managers at EPA?

You all need Jay Ellenberger.

Jay Ellenberger is a Product Manager in the Registration Division of the Agency's Office of Pesticide Programs (OPP). One of only nine such employees in EPA, he and his team of five specialists oversee the regulatory affairs of 80 to 90 chemical insecticides, marketed in approximately 6,000 individual products.

"These are the kinds of cases that keep most people here."

Insecticides help make America a land of agricultural plenty. But they have a dark side, too. If used improperly, some can cause immediate or short-term health problems in people and other accidental victims like birds or pets. Others are potentially less dangerous in the short term, but can accumulate in the tissues of animals, plants, and people where they may cause chronic, long-term health effects like cancer, reproductive problems, or genetic damage.

(Panasewich is a writer in the EPA Office of Pesticide Programs.)

Susan Tejada

Behind a desktop stack of paperwork, Jay Ellenberger handles a telephone inquiry about a pesticide.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA is responsible for registering new pesticide products and re-registering older products, based on a finding that they will not cause "unreasonable adverse effects" to people or the environment when used as directed on approved product labeling. For registration or re-registration purposes, pesticide manufacturers must provide data on each product's health effects, the residues it leaves behind, and how it behaves in the environment. EPA evaluates these data, assesses the risks of the product, and decides whether or not to approve its use.

During this process, it is the Product Manager who receives requests for registration from manufacturers, manages the scientific review of registration data, and pulls the not-always-unanimous results together into a decisionmaking package.

Most of EPA's decisions on pesticides are product-by-product, made by the Product Manager with the assistance of his team. In all cases, the Product Manager is recognized as the Agency expert on the pesticides he oversees and plays an instrumental role in determining the regulatory fate of "his" products.

An entomologist, Jay Ellenberger joined EPA straight out of graduate school in 1974. He has been a Product Manager for the past five years.

This article describes a day in the life of Jay Ellenberger: February 6, 1986.

8:30 a.m.—On the way to work, Ellenberger's wife drops him off at his office in Crystal City, VA. EPA's entire Office of Pesticide Programs is located here, in an enclave of modern office buildings and hotels about 15 minutes from EPA headquarters' main facility at Waterside Mall.

As is often the case, Ellenberger "hits the ground running," when he gets in. In a division where most people arrive early under flextime, a great deal of activity is already underway by this hour. Today, Ellenberger rushes off to a

Jay Ellenberger, left, meets with Douglas Campt, Director of the Pesticide Program's Registration Division.


Susan Tejada

meeting in progress with his Branch Chief, Herb Harrison, and several other Product Managers (or PMs, as they are known inside the program).

Harrison has been asked for a status report on Registration Standards follow-up, and explains what is needed to Ellenberger and his peers. As usual, this information must be generated quickly—Ellenberger's deadline is five days.

Registration Standards development and follow-up provide guidance for re-registering existing pesticides to reflect current scientific knowledge, and it takes as much time and attention as the PM teams' registration responsibilities for new products and new uses.

9:15 a.m.—The meeting breaks up. Ellenberger returns to his office, where telephone messages already cover his desk. He returns a call from the representative of a small chemical company that has been attempting for several months to obtain a "me-too" registration (that is, a registration for a product that is substantially similar to one or more products already registered and on the market) for a corn insect control product containing methomyl. The company recently received word of EPA's approval of its registration request, just in time to start producing, labeling, and distributing its product for the upcoming use season.

By working closely with a major methomyl producer, who already had submitted some of the scientific studies which the smaller company needed to reference, and by gaining the big company's cooperation, Ellenberger was able to "push through" the smaller company's application and register its product in optimal time. In this country's highly competitive, $4.7 billion pesticide business, gaining market entry in time for a crop growing/pesticide use season can mean the difference between economic success or failure, especially to a small company.

Notwithstanding the experience of the small methomyl producer, Ellenberger is quick to point out that "things don't always go the registrant's way." He describes a recent instance in which two small companies were trying to put dog flea collars on the market at the same time. Both were faced with lengthy, expensive, toxicology data requirements. While one company was able to complete the required new studies successfully, its competitor was not. Ellenberger registered the first company's flea collar and sent the second company "back to the drawing board" to rerun needed toxicology studies.

When part of the California watermelon crop was found to be contaminated with aldicarb, the telephones "rang off the hook" for several weeks.

10:00 a.m.—Ellenberger participates in a "dress rehearsal" for his presentation the following week before the Agency's FIFRA Scientific Advisory Panel (SAP). The panel will be meeting to consider the Agency's current scientific and regulatory position on amitraz and two other pesticide chemicals that are regarded as weak cancer agents. Specifically, the panel is interested in these pesticides as examples of when and how EPA assigns a "Category C" (possible human carcinogen) classification to such chemicals. The producers of amitraz also will attend the actual SAP meeting.

Rehearsing his presentation, Ellenberger makes a brief statement on EPA's cancer findings regarding amitraz, and then fields questions composed on the spot by the Secretary of the SAP, Steve Johnson, and Bill Jordan of EPA's Office of General Counsel. Ellenberger calls upon all his familiarity with the chemical and with the regulatory, scientific, and policy issues involved.

He must maintain this detailed familiarity with virtually all of the pesticide chemicals he oversees. In this respect, his job is much like that of an industry representative; the difference is in the focus of their respective efforts and in the size and complexity of their workloads—the industry counterpart may handle only about six chemicals at a time, while Ellenberger handles 80 to 90.

11:00a.m.—On the way back to his office, Ellenberger chances upon an industry representative in the building. They arrange a meeting for the following morning so Ellenberger can obtain additional information to complete a Registration Standards follow-up project.

Ellenberger notes that the cooperative attitude on the part of the representative is typical. Just as the pesticide industry calls on EPA for a great deal of service, so EPA calls on the industry for certain information. Cooperation is, after all, a two-way street.

Back in his office, Ellenberger talks with a member of his team, Dennis Edwards, about a call received that morning from a concerned citizen living in a nearby community. The woman, who is pregnant, is "petrified" because the apartment in which she and her husband live has been sprayed for roaches at the direction of the building manager without her or her husband's prior knowledge or consent. The woman asks whether it is still safe for her to live in the apartment, and whether there is any way that she can reduce risks to her unborn child.

Ellenberger notes that calls of this nature are not uncommon. If callers know which insecticide product was used, Ellenberger or his team members can provide information on the properties and effects of the chemical. If serious effects are involved, the team refers callers first to their physicians, then to the program's Health Effects Section for more detailed information and follow-up. Where pesticide misuse is suspected, the incident is referred to the Agency's Compliance Monitoring Office for investigation and possible enforcement action. (It is a violation of FIFRA to use any registered pesticide product in a manner inconsistent with its labeling. Pesticide misuse is subject, therefore, to civil and criminal penalties.)

Last summer, when part of the California watermelon crop was found to be contaminated with aldicarb, one of Ellenberger's insecticides, the telephones "rang off the hook" for several weeks. The PM teams must weather the crises surrounding their chemicals, without sacrificing any of the routine registration or Registration Standards work.

Before breaking for lunch, Ellenberger calls several pesticide program staff members to check on the status of pending reviews of scientific studies.

One of these calls is to Dr. Stuart Cohen in the Hazard Evaluation Division to learn the status of a review of aldoxycarb, a proposed new insecticide which has been demonstrated to leach to ground water.

During the afternoon, Ellenberger attends one more meeting—this one on the parathion Registration Standard. He conducts more business—primarily with pesticide program staff and industry representatives—by telephone, juggling information about several pesticides. He begins drafting the memo he will submit in response to his Registration Standards follow-up assignment. He signs some 30 letters informing companies of decisions he and his staff have made on the companies' various products.

At any given time, a PM team is working on some 300 registration actions, and completes nearly 2,000 actions a year.

At about 6:00 p.m., he meets his wife for the ride back to his home and greenhouse where, in his spare time, Jay Ellenberger grows orchids.

Each Product Manager and his team face the dual responsibility of handling both the "routine" registration submissions and the Registration Standards development activities scheduled currently for their chemicals. At any given time, a PM team is working on some 300 registration actions, and completes nearly 2,000 actions a year. These actions range from the simple—permission to change a product name, for example—to the complex, like considering whether or not to approve the registration of a new pesticide suspected of causing cancer, or leaching to ground water, or both.

Meanwhile, teams like Ellenberger's are producing an average of four new Registration Standards a year, and following up on a dozen or more standards that have already been produced. Upper management in the Registration Division concedes that an enormous amount of pressure is placed on the nine Product Managers to produce in a timely way.

What is it, then, that keeps Jay Ellenberger and his colleagues going, in the face of this mountain of workload?

For Ellenberger, at least, it is the challenges that lie in sorting out and playing out the most complex—the most "gut-wrenching"—regulatory situations, where human risks must be weighed against economic and social benefits.

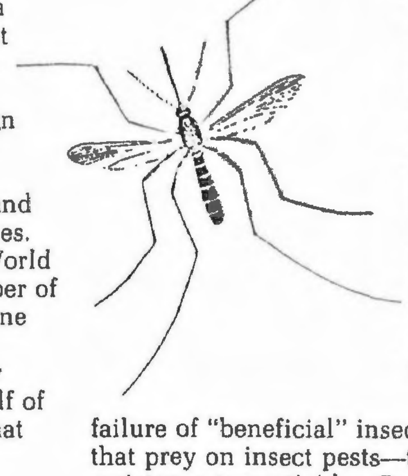
Challenges also lie in breaking new ground, in working through new regulatory questions and problems, and in contributing to decisions that will set precedents for the future. Such currently is the case with a subset of the agricultural insecticides managed by Ellenberger. Used in the fields, they have the potential for traveling through soil and leaching into ground water. The prototype of these insecticides, aldicarb, is currently undergoing an in-depth Special Review of its risks and benefits.

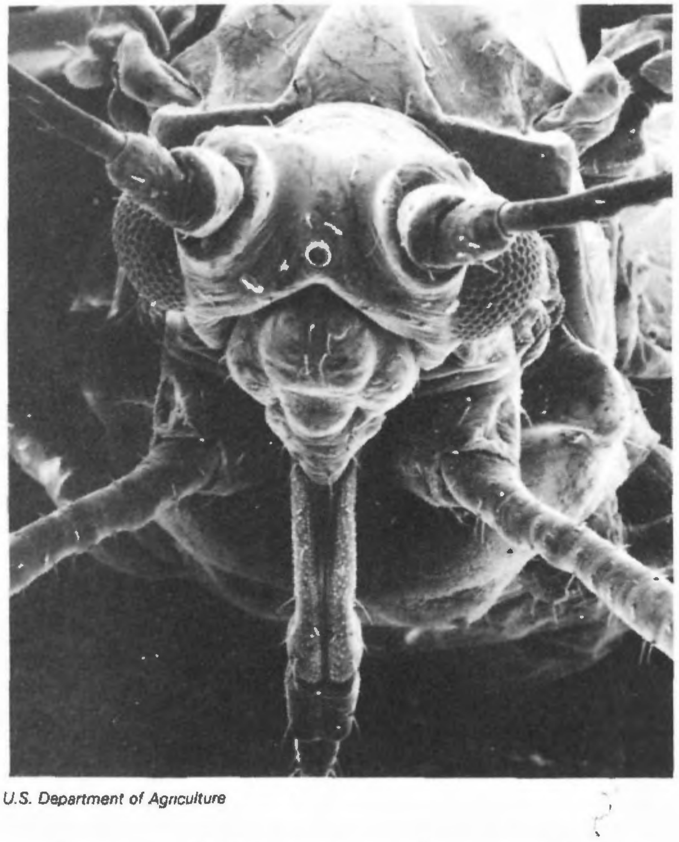
Meanwhile, several proposed new insecticides, most notably carbosulfan and aldoxycarb, are in a holding pattern pending the outcome of more sophisticated and comprehensive monitoring and other environmental fate studies, as well as the outcome of the aldicarb review. Ellenberger and his team are proceeding step by step toward decisions that will set the Agency's policies regarding the registration and use of agricultural insecticides that may leach to ground water.

The give and take in these situations is stressful, but "quite frankly, also interesting," concludes Ellenberger. "These are the kinds of cases that keep most people here." □

Pests vs Pesticides: the "R" Factor

by Julian Josephson





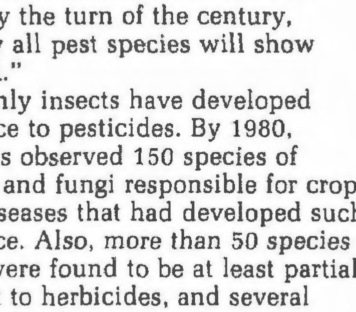
U.S. Department of Agriculture

The "R" Factor is not the title of a spy movie, although the drama it implies is just as intense in its own way. It is "us against them," but us against crop pests rather than foreign nations.

"R" stands for resistance—the resistance or immunity that insect and other crop pests develop to pesticides. According to a 1984 study by the World Resources Institute (WRI), the number of species of insect pests resistant to one or more pesticides almost doubled from 224 in 1969 to 428 by 1980. Entomologist Robert L. Metcalf of the University of Illinois predicts that by 1995 this number could exceed 1,500; by the turn of the century, virtually all pest species will show some "R."

Not only insects have developed resistance to pesticides. By 1980, scientists observed 150 species of bacteria and fungi responsible for crop plant diseases that had developed such resistance. Also, more than 50 species of weeds were found to be at least partially resistant to herbicides, and several species of rodents were showing resistance to poisons. According to WRI, insect resistance alone was costing U.S. farmers $150 million a year in crop losses and increased applications of chemicals in 1984.

Because of the "R" factor, many pesticides no longer prevent insect and other pests from proliferating. The problem is compounded by the apparent failure of "beneficial" insects—those that prey on insect pests—to develop resistance to pesticides. Because insecticides continue to kill "beneficials," but not pests, the pests are no longer controlled by their natural enemies and they proliferate even more rapidly.



(Josephson is Associate Editor of Environmental Science and Technology, a publication of the American Chemical Society.)

The widespread use of pesticides is readily understood when one considers the extent of food and fiber crop losses to insects, fungi, bacteria, viruses, and rodents. In 1977, David Pimintel of Cornell University estimated that such losses averaged more than 40 percent of the world's crops, accounting for many billions of dollars, despite worldwide use of 2.3 billion tons of pesticides that year. These figures are probably much the same today.

When insect pests, such as aphids, flies, mosquitoes, and moths are first exposed to insecticides, almost all of them are killed. For some reason, however, perhaps one or two mating pairs (out of thousands upon thousands) survive the chemical onslaught. Among the offspring of these resistant pests will be a few that are resistant ("R") and many that are still susceptible ("S") to the pesticide. As use of the pesticide continues, the "S" insects are killed off. But more "R" pests are concentrated in the area being sprayed or dusted. Eventually, the "R" pests predominate and the pesticide becomes ineffective. In fact, some pests become resistant to more than one type of pesticide.

Frederick W. Plapp, Jr., and T.C. Wang of Texas A&M University have suggested that the "R" factor in insects develops in three ways:

- An insect may develop an ability to keep more of a pesticide out of its body than a susceptible or "S" insect does.
- Or the pest may develop the ability to secrete enzymes that metabolize and detoxify the pesticide within its body.
- Or the insect may develop a desensitization of the specific body parts through which the pesticide's poison would work if the insect were susceptible.

Bacteria, fungi, and weeds apparently attain "R" in similar ways, especially by developing the ability to produce pesticide-detoxifying enzymes. Also, susceptible bacteria can become resistant through exchange of packets of genetic material, known as plasmids. These are donated by "R" bacteria through a process similar to mating.

Scientists find the ability of insect pests to metabolize and detoxify pesticides especially intriguing. Some suggest that all pests could produce the necessary enzymes. But in the "S" pests, the enzymes are never secreted in amounts necessary to counteract the pesticide. Because of genetic changes, however, "R" pests seem to be able to

An electron micrograph of an aphid, 200 times lifesize. The aphid is one of a growing number of insect pests that has developed resistance to pesticides.

produce perhaps up to thousands of times more insecticide-detoxifying enzymes than "S" pests can. These enzymes chemically change the insecticide's molecular structure, making it harmless to the insect.

Some methods of counteracting the "R" factor in insects exist today. One obvious approach is to stop using the pesticides to which the target insect has developed resistance, and to use alternatives instead. However, the target insect may develop resistance to the new pesticide without losing its resistance to the original one.

Suppose, for example, a leafhopper which spreads plant diseases becomes resistant to the phosphorus-based insecticide malathion. Perhaps a carbamate insecticide, such as carbaryl, does work. Eventually, however, the leafhopper may become resistant to both malathion and carbaryl.

But if the use of malathion is stopped entirely while the carbaryl is applied, would the leafhopper's resistance to malathion eventually disappear? Many entomologists say that the leafhopper's resistance to malathion would decrease, but not to its original levels. If malathion were reapplied, the leafhopper's resistance to that chemical would increase faster than it originally did. The use of alternative pesticides can disrupt the "R" factor for a while, but not eliminate it.

Another approach is trying insect pest management methods that get around the "R" factor. Biological control, for example, calls for introducing a pest's natural enemies or inducing bacterial or viral diseases in the target pest. For instance, lacewings (also called *aphis lions*) are deadly enemies of aphids. The Japanese Beetle's nemesis is a microbially induced illness known as milky spore disease.

Probably no level of "R" can protect an insect pest against a hungry predator. But you can't be certain that predators, most of which are migratory, will remain in a given area long enough to control target insects, and you can't know whether insect pests eventually will develop resistance to miocrobial diseases. Scientists at the U.S. Department of Agriculture's Grain Marketing Research Laboratory in Kansas have noted disturbing indications that this does happen. They have observed the resistance of a species of grain pest to a bacterial disease caused by *Bacillus thuringiensis*, a microbial insect control agent increasingly used by organic farmers and gardeners.

Other weapons in the battle against "R" include using hormones that disrupt the life and growth cycles of insect pests, or chemicals that simulate pheromones or sex attractants that lure pests into traps. Whether pests can develop resistance to these hormones and pheromones is not yet known.

Also, male insects can be sterilized by irradiation; the females that mate with them then lay infertile eggs. Since the sterilization of male insects is not done chemically, the "R" factor should not arise.

In the future, scientists are expected to continue combatting the "R" factor by attempting to counteract the resistance phenomenon directly, and by managing pests in such a manner that the "R" factor's importance is reduced.

George P. Georghiou of the University of California at Riverside suggests three updated methods for combatting "R" in insects directly:

- "Management by moderation" includes such approaches as applying smaller doses of insecticides, using chemicals that break down in the environment shortly after use, and not necessarily trying to achieve a 100 percent insect kill.
- "Management by saturation" calls for finding ways of hitting a target insect with dosages of insecticide high enough to overwhelm the factors that confer its resistance. This strategy also involves trying biochemical attacks on the chromosomes and genes that impart resistance, or using a pesticide together with materials that can neutralize the enzymes the resistant insect produces to detoxify the pesticide. The search is on for such materials.
- "Management by multiple attack" entails using mixtures of pesticides to which the pest is resistant and alternative pesticides against which the target insect has not yet developed the "R" factor, or has lost it. J.D. Gilpatrick of the New York State Agricultural Experiment Station in Geneva, NY, has proposed parallel strategies for managing resistance in bacteria, fungi, and nematodes.

A promising way of reducing the importance of the "R" factor, rather than combatting it head on, may be integrated pest management (IPM). This includes the systematic, balanced use of synthetic and naturally occurring chemicals, biological approaches, and cultural techniques.

Well known examples of naturally occurring pesticides are pyrethrins, derived from a species of chrysanthemum, which control a large number of insect species.

Biological approaches encompass the use of natural enemies, such as birds and "beneficial" insects (for example, ladybugs, lacewings, and mantids) to prey upon pests. They also involve introducing diseases in pest species—a practical example of the age-old maxim that every flea has lesser fleas that bite it. Cultural techniques include growing a greater variety of crops in the same area in which only one crop was previously grown. This limits the amount of food available to the pest of that one particular crop. Crop rotation is another kind of cultural technique.

IPM may soon involve more sophisticated methods. Through genetic engineering, it may become possible to develop crop plants that can produce chemicals that give them an increased ability to repel or kill insects, fungi, bacteria, or nematodes. Another approach may be to use the "R" factor in man's favor; to develop "beneficial" insects that are able to survive and continue to prey on pests when chemical pesticides must be used.

The "R" factor presents a formidable challenge to scientists and others whose job it is to control the pests that attack man's supplies of food and fiber. They are responding with the development of an arsenal of techniques and systems to meet this biological challenge. □

Going to Extremes

Occasionally, an insect not only develops resistance to an insecticide; it actually becomes dependent on the chemical. A species of bees in Brazil seeks, collects, and *eats* DDT! Scientists from the University of Brasilia and the U.S. Army Environmental Hygiene Agency have found that these bees accumulate DDT in their bodies to concentrations as high as 42,000 parts per million, more than four percent of their total body weight. The bees show no ill effects. The normal lethal dose of DDT for bees is 6 ppm.

Shredding the Junk Auto Problem

by James E. Fowler

Rusting automobile hulks were a national problem and disgrace 25 years ago. Now, thanks to changes in scrap processing technology, what was once an environmental liability has been transformed into an economic asset. It will remain a resource we can continue to count on unless the trend is reversed by increasing use of hazardous materials in steel products.

In the 1960s, cars were being abandoned at the rate of one every 30 seconds. It was estimated that 20 to 30 million metal carcasses littered the countryside and city streets. The reason was economic; low demand by foundries and mills for scrap metal from old cars meant low prices for the scrap metal. It was hardly worthwhile to go through the costly and time-consuming process of tearing the cars apart. As a result, there was a nationwide backlog of rusting junkers.

Then the advent of the shredder—a giant machine that literally rips automobiles into fist-sized pieces of iron and steel scrap—turned those cars into a desirable source of man-made raw materials for industry.

Introduced in the 1960s, the automobile shredder produced a uniform grade of ferrous (iron and steel) scrap that could be magnetically separated from nonferrous and nonmetallic scrap in a matter of seconds. Steel mills and foundries could use this type of material in their furnaces and were willing to pay for its uniform iron content. This increased the demand for shredded scrap so that shredder operators could pay more for automobile hulks. The economics of the marketplace responded as collectors and auto flatteners realized they could make a profit hauling old cars to

(Fowler is Assistant Executive Director and Director of Public Relations for the Institute of Scrap Iron and Steel, Inc.)

The advent of the shredder turned those cars into a desirable source of man-made raw materials for industry.

shredders. Technology had not only changed the form of scrap coming from the rusting automobile hulks, but also made possible increased recycling of the junked cars.

At first, the nonmagnetic materials—aluminum, copper, brass, zinc, stainless steel, along with glass, rubber, plastics, textiles, and dirt—were considered a waste byproduct of the shredding process. But the scrap industry soon realized that the 50 pounds of nonferrous metals in the 900 pounds of residue from the shredding of a typical car had a commercial value, if those metals could be recovered from the dirt and glass.

A cost-effective technology was developed, using gravity separation and induction systems to separate the nonferrous metals from the nonmetallic residue and to segregate the various metals involved. Some processors also refine the zinc die cast scrap, often into pure high-grade zinc.

In some parts of the country, the motor blocks are removed prior to processing. One popular brand of wood burning stove is made from motor-block scrap processed in central Massachusetts.

As a result of all these developments, the junked automobile has become the largest single source of recycled scrap in the United States. This is certainly a positive change from the mass abandonment of old cars in the early 1960s, but, unfortunately, the future could see a backwards turn.

The problem is the introduction of hazardous materials into the manufacture of steel products. This may ultimately inhibit or prevent their eventual processing by the scrap industry and the recycling of the metals by scrap consumers. This is a major concern of the entire metallic scrap processing industry.

The issue, from the viewpoint of the scrap industry, is really quite simple: Designers and engineers must consider the recyclability and hazardous waste potential of the materials they use in the manufacture of various products. These critical factors must be considered along with others, such as durability and appearance, and substitutes should be found for potentially hazardous materials.

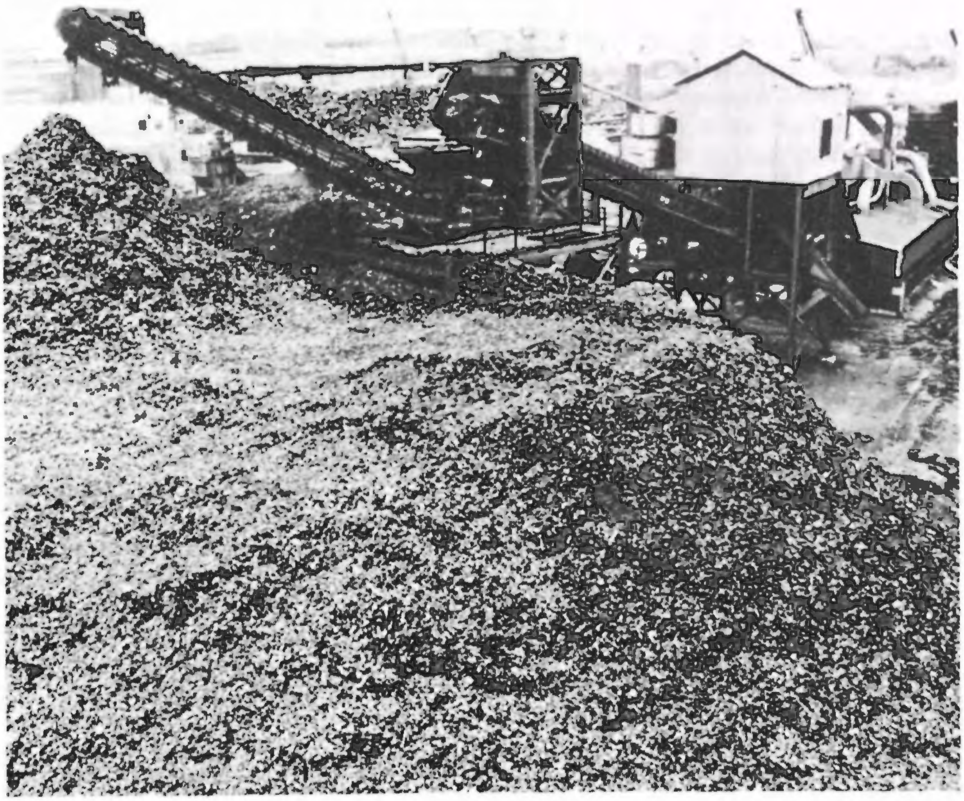
This should be done voluntarily by manufacturers lest it be mandated for them by legislative action, as often happens when environmental concerns are ignored. For example, use of cadmium in manufacturing is banned in Sweden. In the United States cadmium, though a hazardous material, is used as a coating on selected automobile bolts and as a coloring medium in some enameled appliances and other products. As Americans become more concerned with hazardous wastes as a result of publicity surrounding Superfund sites and hazardous materials disaster stories, the safe recyclability of a product should be an important design and sales feature.

For example, a highly visible potential hazard for the scrap industry is the air bag, as presently designed. Its widespread use could become a setback for automobile recycling. The danger is that an undetected unspent canister of sodium azide, used to inflate the bag, could cause an explosion in a scrap processing plant.

The Institute of Scrap Iron and Steel has argued against the wholesale installation of air bags in cars since the concept was first introduced in the 1970s. While the scrap industry claims no expertise in highway safety, it does know a great deal about processing automobiles into scrap and potential dangers faced by workers in scrap processing plants.

Institute of Scrap Iron and Steel

Each one of the junk cars in this heap will yield about one ton of iron and steel scrap. As autos become smaller and lighter, they will furnish less iron and steel for recycling.



Institute of Scrap Iron and Steel

Once a pile of junk automobiles, this mountain of shredded ferrous scrap will be recycled into new iron and steel products.

While the air bag danger is not in the immediate future, because it will be at least a few years before cars with airbags installed in them are ready for the scrap heap (except for experimental models or those involved in accidents), now is the time to solve the potential hazard.

The difficulty with air bags remaining in automobile hulks is that processors are unable to detect their presence. A gasoline tank can be seen by a crane operator when the hulk is being fed into a shredder. But an unspent canister cannot be seen by the operator as the flattened remains of the car are lifted. The scrap industry feels that air bags should not be used until a way is found to eliminate this risk to scrap plant workers.

The air bag is a stark example of what the scrap industry has been saying about the relationship of hazardous materials to metallic scrap processors. The industry believes that the regulation of hazardous wastes should begin at the point where manufacturers add hazardous materials to their products, rather than waiting until just before the products are to be recycled.

As a result of all these developments, the junked automobile has become the largest single source of recycled scrap in the United States.

Fostering and protecting the recyclability of metal products can be quite significant in terms of saving energy and minerals and protecting the environment. EPA has reported, for example, that using scrap leads to a 74 percent energy saving, that producing a ton of steel from automobile scrap takes 8,500 killowats less energy than producing that steel from iron ore. In some areas of the country, that much energy could supply the electrical needs of an average household for an entire year.

In addition, the use of scrap instead of iron ore results in an 86 percent reduction in air pollutants, a 76 percent reduction in water pollution, 40 percent savings in water used, a 90 percent savings in virgin materials used, and a 97 percent reduction in mining wastes.

Relate these figures to the fact that six to nine million cars are processed annually by the scrap industry, and the energy, resource, and environmental savings they represent are tremendous.

These figures and the continuing need to protect the human environment from hazardous wastes of all kinds should encourage design engineers to think ahead about their products. They must think of the materials used, and how they can be recycled, and consider changes in design or materials specification that could make the difference between efficient recycling and hazardous waste disposal. By designing recyclability into every product before it leaves the drawing board, industry can help the nation preserve its finite resources and protect and enhance the environment. □

Oil Spills: No News Is Good News

by L. Michael Flaherty

We haven't heard much about huge oil spills at sea in recent years. The newspapers haven't carried tragic pictures of ruined beaches, tar-soaked waterfowl, or poisoned fish. Much of this is due to a growing awareness on the part of governments and the shipping industry of the importance of protecting the ocean evironment.

Despite precautions and preventive measures, however, latest Coast Guard statistics show that 9 million gallons of oil were discharged into navigable waters of the United States alone over the one-year period 1982-83. Of this total, 1.5 million gallons polluted U.S. territorial waters in Pacific Ocean, while another million gallons threatened the eastern seaboard and the Gulf Coast.

Why No Headlines?

A partial answer to this question is that we have come a long way in spill countermeasure technology over the past 20 years. In the United States, EPA and the U.S. Coast Guard have been at the forefront of research and development efforts to streamline emergency response to potential disasters through the use of new products and techniques and through new computerized decisionmaking tools to make cleanup operations swift and effective.

When an oil spill occurs in shallow water, a dam of baled straw can absorb oil and trap or filter floating debris. In narrow, fast-moving streams, chicken wire can be packed with straw and laid across the stream at an angle. In slow-moving water, small booms with weighted aprons can be used for containment, and skimmers or earthen dikes may be constructed.

But none of these methods is adequate to prevent damage to the environment when a spill occurs on the high seas and threatens shore areas.

Diversion booms, containment booms, skimmers, and sorbents have been used where appropriate for ocean cleanup, or to inhibit a spill's progress. However, EPA now realizes that a key approach to a major ocean spill threatening shore areas is use of chemical countermeasures, such as dispersants, applied at sea before the oil can reach shore.

Oil on a water surface is naturally broken up by the motion of waves. This process, called natural dispersion, is very slow, allowing an oil slick to travel long distances before being broken up completely. The process can take days, weeks, or even months.

Chemical dispersants speed up the natural dispersion process by making it easier for the sea to break up the oil slick. When dispersants are applied, very small oil droplets are formed, and these droplets are dispersed into the upper 3-5 meters of the water column. The droplets rapidly become diluted in the water and move away from the spill site. Dispersion can be almost complete in a matter of minutes.

Chemical countermeasures, chiefly dispersants, still suffer from the stigma that marked them in 1967 when the tanker *Torrey Canyon* grounded on the shoals off the English coast and spilled 30 million gallons of oil onto the shores of Great Britain and France. The *Torrey Canyon* incident prompted the first major international effort to clean up an oil spill, and many mistakes were made. Chief among these was the improper application of chemical products dumped into the water to disperse the oil.

These products proved to be more toxic to aquatic life than the oil itself. Dispersants became associated with grim pictures of massive fish kills, and of waterfowl drowning or dying of hypothermia when the oil covering deprived them of their natural insulation. Though the dispersants used were effective to a degree, the need to reduce toxicity and refine application techniques was clear.

Dispersants on the market today bear little similarity to those used on the *Torrey Canyon* spill. Through research and refinement, today's dispersants are very low in toxicity and, in most cases, are also biodegradable. Application techniques have also been refined to minimize the effect of the oil/dispersant mixture on the environment.

A different lesson was learned in 1978 when the *Amoco Cadiz*, a fully loaded supertanker, lost its steering and drifted onto rocks in the English Channel off the coast of Brittany. Before it broke up, the *Amoco Cadiz* lost almost all of its 59 million gallon load of light Arabian crude and an additional 137,000 gallons of bunker fuel. More than 30 ships responded to this spill, and the French government spent $114 million on emergency response and environmental restoration—a figure that does not even include expenses by other governments, damage to the ship, loss of oil, and military and volunteer labor involved in the cleanup.

Despite all this effort and expense, a lack of contingency planning and cooperation between the British and French governments prevented the use of dispersants on the spill, and the environment suffered significant damage as a result.

Dispersants finally came into their own one year later in 1979, during the Ixtoc episode in the Bay of Campeche off the Gulf of Mexico. A well head blew out and the resulting oil discharge continued for more than nine months, dumping close to 137 million gallons of oil into the water. Flying almost 500 missions, fixed-wing aircraft applied dispersants which proved effective even on this extremely large spill. Less than one percent of the discharged oil reached the Texas coast.

While dispersants are one of the most feasible treatments for spills on the high seas, other products and methodologies now available are recognized as

A vessel equipped with spray booms applies dispersants on a small scale oil spill.

(Flaherty is with the Emergency Response Division of EPA's Office of Solid Waste and Emergency Response.)

In November, 1979, the Burmah Agate spilled 840,000 gallons of oil and burned for 30 days in an accident in the Gulf of Mexico off Galveston, TX.

acceptable under the National Contingency Plan. These include: surface collecting agents (herders); biological additives, which are microbiological cultures, enzymes, or nutrient additives which encourage biodegradation of the oil; burning agents, which improve the combustibility of the materials to which they are applied; and new chemical products such as gelling agents.

Some of these have been accepted by EPA for use in inland waters, but with the exception of the dispersants, none is truly effective for removal of spilled oil outside of quiescent waters.

In 1985, EPA developed and tested an Oil Spill Decision Tree, a computerized system which has the potential of revolutionizing the role of On-Scene Coordinators (OSCs) who manage oil spill cleanups, and of improving contingency planning and training of field personnel.

The decision tree is a straightforward procedure. Observations concerning the nature and size of a spill are put in a portable computer, along with information on the condition of the receiving waters, such as water temperature and salinity, wave height, current direction and speed, and other data. The program takes the OSC through a series of steps to arrive at conclusions regarding the types of countermeasures which should be employed.

The software for the program was developed for the IBM PC in the BASIC programming language. In addition to being easily adaptable to most microcomputers, minicomputers, and mainframes, it can be set up in a multi-user environment so that members of Regional Response Teams in different geographic areas can use the program interactively over the phone, saving time that would otherwise be necessary to assemble the team members. With veteran OSCs feeding accurate, complete data into the system, decisions which previously took agonizing hours to reach can now be made in a few minutes.

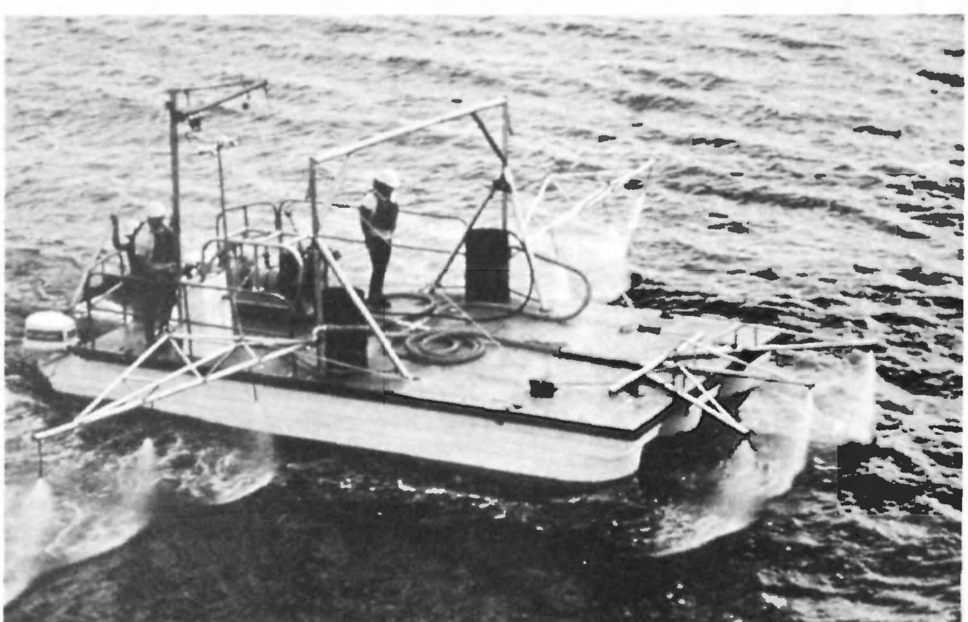
The Oil Spill Decision Tree asks specific questions which must be answered affirmatively before dispersants can be authorized for use. It asks questions like: Is this particular oil dispersible? If so, is the use of dispersants acceptable in this area? Are safe and effective dispersants available or obtainable before the oil slick spreads too far or before the spilled oil becomes weathered so that dispersants lose their effectiveness?

The decision tree also queries about the size of the area covered by the spill, counseling use of helicopters and/or boat spray for dispersant application on small spills, and use of fixed-wing aircraft on large spills. This scientific approach to the application of dispersants was not used in the *Torrey Canyon* incident, when dispersants were more or less indiscriminately dumped at the site.

EPA firmly believes that the dispersants on the market today, if properly applied at recommended rates, should pose no threat to the marine environment at most locations in U.S. coastal waters. Thus, the aquatic ecocycle can be preserved and most of the oil prevented from reaching the beaches.

During his *Ra* expeditions in 1971, Thor Heyrdahl noted that the North Atlantic was so extensively laden with black lumps of floating "asphalt" that there were only three days during the entire voyage of *Ra II* that petroleum pollution was not visible. As late as 1984, the Environment Directorate of the international Organization for Economic Cooperation and Development reported that approximately 400 million gallons of oil were being released into the world's oceans every year. Of this total, it was estimated that over 300 million gallons were from non-accidental discharges, while only 15 million gallons were the result of tanker mishaps.

As long as oil spills continue, countermeasures will be necessary. Countermeasure technology has come a long way, but clearly there is still a long way to go, particularly in terms of increased cooperation between the maritime industry and governments worldwide. The future of the oceans is at stake. □



Do Environmental Disasters Have a Good Side?

by Roy Popkin

It's an ill wind that blows no good, says the proverb, but is it really so? To emergency managers, ill winds—storms, hurricanes, tornadoes—often generate beneficial hazard mitigation legislation at the national or local level. Environmentalists aren't so sure this is true when the disaster involves some form of air, water, or soil pollution. For them, the ill wind carrying leaking chemicals or smokestack wastes all too often is just that—an ill wind.

For people who deal with natural hazards such as floods, tornadoes, fires, earthquakes, blizzards, and droughts, it is an article of faith that it usually takes a major catastrophe to bring about significant hazard mitigation or disaster relief legislation.

Examples of such cause-and-effect relationships are cited over and over at conferences where emergency managers meet:

- Legislation authorizing the U.S.Army Corps of Engineers to build flood control works followed a series of floods in the early part of this century.
- The first national flood insurance program was enacted (but not funded) in 1957, two years after catastrophic floods in the Northeast.
- The 1964 Good Friday earthquake in Alaska led to an Omnibus Disaster Relief bill for that badly shaken state and eventually to legislation in 1969 and 1970 that institutionalized the federal role in disaster relief.

(Roy Popkin joined EPA's Office of Public Affairs as a writer under the Senior Environmental Employee program after retiring from the Red Cross Disaster Service.)

Concern over Los Angeles smog continued, grew in intensity, and precipitated the expenditure of millions of dollars for research.

- In the midst of the Hurricane Betsy relief actions in 1965, Congress amended existing programs to "forgive $1,500" of the amount borrowed under low-interest disaster loan programs. Subsequent amendments, increasing the amount "forgiven," followed Hurricane Camille in 1969, and Hurricane Agnes in 1972.
- Spectacular dam breaks on the Teton River and at Tacoa, GA, produced major dam safety legislation and a dam inspection program.
- Floods in the early 1970s led Congress to expand and fund the National Flood Insurance Program.

Summing up the crisis-to-lawmaking relationship, Professors Ian Burton, Gilbert White, and Robert Kates, in their 1978 book, *Environment as Hazard*, note that all major flood-related laws but one in the twentieth century were preceded by great floods somewhere in the United States.

Does the same proposition apply to environmental crises involving air or water pollution, chemical releases, or poisoning by pesticides?

In their book, these same authors trace a direct line relationship between London's 1952 "killer fog" in which perhaps 4,700 people died, the subsequent Beaver Commission investigation, and England's 1956 Clean Air Act. But they find it more difficult to link the English fog; the 1948 smog that choked out scores of lives in Donora, PA; and a lethal smog that killed hundreds in New York City in 1953 to passage of the Clean Air Act by the U.S. Congress in 1955.

Professor Emeritus Arthur C. Stern of the University of North Carolina would agree. In an article published in the *Journal of The Air Pollution Control Association*, Stern states that catastrophic events in Donora caused only a "ripple of concern," while concern over Los Angeles smog continued, grew in intensity, and precipitated the expenditure of millions of dollars for research as to its cause and cure, research that eventually produced the first of a series of clean air legislative actions.

Although there seems to be a "legislative mythology" that tries to link a number of crisis incidents to laws under which EPA operates, the linkage is only obvious in relation to Superfund and the Toxic Substances Control Act (TSCA), and, in the latter case, even that is subject to question.

There is an obvious relationship between Superfund and the community furor and national media hype in the late 1970s over the impact of abandoned toxic wastes. Public attention focused on Love Canal, Times Beach, and Kentucky's "Valley of the Drums." Within a relatively short time, Congress passed the Comprehensive Environmental Response, Compensation and Liability Act of 1980. This created Superfund, which added cleanup and emergency response elements to EPA's hazardous waste dump permitting and enforcement powers contained in the Resource Conservation and Recovery Act, which passed well before the aforementioned events.

One frequently made connection is that the fire on the oil-polluted Cuyahoga River and the widely reported "death" of Lake Erie had a major impact on implementation of subsequent Clean

At the bottom of a 16 foot deep pit in Kalkaska, MI, representatives of the Michigan Farm Bureau and Department of Agriculture supervise the burial of PBB-contaminated dairy cattle. These cattle were humanely killed in July 1974. By the end of that year, some 9,000 contaminated cows were destroyed and buried in Michigan.

Michigan Department of Agriculture

Water Act legislation. Steadman Overman, Director of EPA's Office of Legislative Analysis, thinks otherwise.

Over the years, those who testified on behalf of water pollution legislation, Overman recalls, "never mentioned either of those incidents. We kept referring back to some cholera outbreaks around 1918 and 1919." Clean water legislation, he believes, was the result of cumulatively mounting national concern and not of single crisis situations.

Overman does believe that a cause-and-effect relationship may exist between episodes of adverse health and environmental effects and the passage of TSCA in 1976. These episodes include Kepone pollution of Virginia's James River, PCB contamination of the Hudson River and other waters, and PBB contamination of dairy cattle in Michigan that generated media coverage of farmers slaughtering their cows.

Experts in hazard mitigation and emergency response seem to be in general agreement that, while so-called crisis or disastrous environmental situations may occasionally have a direct impact on the federal level, they have much more clout at the state and local level, influencing governments to upgrade water quality or air emissions standards, improve treatment facilities, or take other environmental protection actions.

Natural disasters may also be frequently followed by local actions such as improvements in local warning systems, changes in building codes, enactment of hazard-related zoning

Newport News Daily Press Times Herald

A container of Kepone sits on a pier by Virginia's James River, where fishing was banned due to Kepone contamination.

laws, and relocation of populations at risk. But Professor White sees a sharp difference between natural disasters and environmental crises.

Floods, tornadoes, earthquakes, etc., leave highly visible and dramatic scenes of damage in their wake. TV screens are filled with gut-wrenching interviews of the victims. Much less dramatic and compelling are scenes of a burning river, dead cattle, or interviews with people upset about their water or their chances of getting cancer some years down the road.

What's more, White says, the effects of natural disasters are also much simpler to deal with than those of environmental disasters. Natural disasters have an immediacy that can be translated quickly into specific remedial steps, including legislation.

Environmental disasters, on the other hand, are usually extremely slow to become apparent and the harm they cause is often projected in a long-term futuristic sense . Environmental dangers may take decades to reach the stage where a national problem becomes obvious. To the environmentalist or scientist, the dangerous situation may have been there all along, but it can rarely be seen in dramatic TV news footage or newspaper features.

Environmental events, such as Earth Day in 1970 or publication of books like Rachel Carson's Silent Spring, rarely produce a major legislative or regulatory response. Even community-based movements like the Breathers' Lobby of the 1960s tend to fade away after their initial goals are achieved.

Lacking a continuing series of dramatic events like earthquakes, tornadoes, and floods to build their case, environmentalists must, therefore, build a case with scientific research and credibility. They must track national or regional patterns that can become the concern of state and national agencies and legislative bodies. Overflowing sewers and polluted rivers in one area need to be linked in the public mind with similar situations elsewhere. And, because of our national penchant for viewing dangers in the short term, environmentalists need to find ways to create public awareness and concern about problems such as increases in cancer incidence or shortages of safe drinking water that may develop 10, 20, or more years down the road.

EPA's scientists provide an increasingly credible basis for regulatory decisions. Their research and monitoring programs provide the information base on which EPA's risk managers determine the need for and nature of the regulations they promulgate and enforce and are a resource for state and local regulatory actions.

Environmental dangers take decades to reach the stage where a national problem becomes obvious.

But while the San Fernando earthquake and a belief that earthquake prediction capability was just around the corner moved Congress to pass the Earthquake Hazard Mitigation Act of 1977, it is much less likely that there will be comparable opportunities to inspire environmental legislation. The tragedy that cost so many lives at Bhopal was a rare event in the history of the chemical industry. EPA's response to concerns raised by Bhopal—a voluntary chemical emergency preparedness plan based on local initiative—may well be the kind of ongoing response that pays off in environmental safety, and programs like that should not have to wait for a lethal chemical accident to be put in place. □

Fighting Pollution in Pennsylvania's Oil Fields

by Michael J. Chern

A typical oil production operation in northwestern Pennsylvania, with oil well, jack, and stock tank.

The world's first oil well was drilled over 125 years ago near Titusville, PA. Shortly thereafter, oil rigs began popping up throughout northwestern Pennsylvania. Fortunes were being made and little notice was taken of the oil leaks and spills working their way to streams in the heavily forested area.

Today, the center of American oil production has shifted away from Pennsylvania, but oil wells are still an important part of the Commonwealth. A few large companies maintain oil fields in northwestern Pennsylvania, but many fields are run by families or independent operators who work just a few wells. Small operators often wait to inspect their equipment until the oil flow slows or stops. Therefore, oil leaks can go undetected for months, even years. Abandoned leaking wells also present a problem.

These wells are far different from the steel towers pictured in the television series, "Dallas." Surface pumping equipment, which looks a lot like basic outdoor water pumps, brings up the oil and sends it in gravity-fed pipelines to collection points miles away. These pipes crisscross rugged terrain that is often inaccessible except on foot.

He also saw a twig stuck in a pipe to stop a leak.

EPA Region 3 Administrator James Seif toured the area in October 1985 to get a firsthand picture of the problem. "It was disappointing," he said, "to see environmental damage from oil bubbling up from a well and spilling on to the ground because someone had not replaced a 25 cent washer." He also saw a twig stuck in a pipe to stop a leak, and he climbed steep hills to find the sources of oil trickling into streams down below.

EPA and state environmental officials began responding to oil spills and regulating other facets of oil drilling operations in the 1970s after passage of the Clean Water Act. Over the next decade, EPA's Region 3 office responded to many oil spills in northwestern Pennsylvania, including what is now the Allegheny National Forest. Oil drilling there continues because much of the forest land was donated by parties who retained the mineral rights.

In 1984, U.S. Fish and Wildlife Service and other officials pointed out to EPA that some streams were almost devoid of life when they should have been prime trout-breeding areas. Forest officials found birds and other wildlife

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lying dead after becoming mired in oil pools and slicks. There was evidence that oil production contaminants were bioaccumulating in some animals.

The Forest Service was beginning an ambitious program to stop sedimentation of area streams, and the State of Pennsylvania and EPA were asked to step up efforts to stop oil spills and unpermitted discharges into them. It was clear, over the succeeding months, that these and other concerned agencies should produce a comprehensive multi-program effort to save and protect the natural resources of northwestern Pennsylvania.

On July 8, 1985, EPA designated four counties as the site of a "major oil spill with multiple sources" so the Agency could take an organized rather than piecemeal approach to cleaning up the mess. The Coast Guard, which administers EPA's funds for cleaning up oil spills in water, approved $2.5 million for the effort. The Regional Response Team, made up of officials from federal and state agencies responsible for coordinating environmental emergency responses, agreed to support the effort by providing needed technical advice, financial assistance, and staff.

At the same time, EPA's Water Supply Branch was receiving complaints from local residents who claimed their drinking water wells were being contaminated by the improper disposal of oil and gas drilling brines—saltwater fluids containing a variety of sometimes toxic pollutants—which are pumped from wells along with the oil. Brimes were typically discharged into streams without treatment or injected back underground for disposal or to increase the production of old oil wells. A less common practice was to discharge brines into shallow pits, called blow boxes, from which they percolated through the soil to contaminate ground water and drinking water wells. EPA initiated activities to tackle that problem, too.

EPA also recognized that the permitting of oil field brine discharges into waterways had been neglected because many other types of discharges were considered to be more harmful. EPA and the Commonwealth of Pennsylvania hadn't had the resources to mount a major effort to permit the thousands of small brine discharges in the four-county area.

A major step forward in addressing many of the problems was taken in September 1985 when EPA regional management identified oil-drilling activities as a significant environmental problem in an Environmental Management Report (EMR). Management saw the value of expanding the oil spill cleanup effort into a multi-faceted approach to past and present oil problems in northwestern Pennsylvania.

A task force was organized to include representatives from the oil spill response program, the Underground Injection Control program, the wastewater discharge permit program, and wetlands protection program. While each program carries on its activities in adherence to the laws and regulations that govern it, the task force ensures a coordinated effort.

Oil leaks can go undetected for months, even years.

The benefits of the organized approach can be seen in the first phase of the oil spill project. This is a survey to systematically identify actual or imminent threats of oil discharges into waterways within the four-county area encompassing the Allegheny National Forest. Coast Guard teams check out every mile of stream in the four watersheds that drain the forest. They also look for other potential environmental violations such as illegal brine disposal. This information is passed on to other EPA programs or the state for action.

When the teams discover oil in the water, the on-scene coordinator orders an immediate cleanup, although whenever possible, owners or operators of the facility involved are asked to voluntarily clean up.

Most of the information gathered through the watershed survey is analyzed by EPA's national Environmental Response Team in Edison, NJ, and by the National Oceanic and Atmospheric Administration. Findings are ranked according to the severity of the problems.

The cleanup effort has already shown results. For example, a small stream, Pine Run, was devoid of life just a year ago. During the early stages of the oil spill initiative, ten individual spills were cleaned up along Pine Run. A recent bioassay shows that small aquatic life has already returned to the stream.

Other activities may take longer to show actual environmental improvement. EPA's Underground Injection Control program hopes to eliminate unacceptable disposal practices like blow boxes. They also hope to offer to oil well operators a safe alternative for disposing of brines by permitting injection wells that put brine back underground in areas where it will not affect drinking water. An active enforcement program will further assure that the oil industry implements requirements designed to protect underground sources of drinking water.

As another part of the task force effort, Region 3 has raised the priority for issuing permits for brine discharges into waterways. The regional office has offered the state technical assistance in locating unpermitted discharges, and is working with the state and industry to develop a generic brine discharge permit to facilitate the process.

EPA personnel also found increasing evidence that area wetlands were being filled through oil drilling-related construction activities such as access road development and drilling pad and pond construction.

EPA's Environmental Photographic Interpretation Center (EPIC) in Warrenton, VA, will produce and analyze aerial photographs of the forest to assist in identifying both oil spills and wetlands areas. Follow-up field surveyors will seek out illegal filling and take appropriate enforcement action. Prior to initiating any enforcement action, EPA will coordinate with the appropriate parties.

A most important part of the oil field initiative is the outreach program involving the oil industry and area residents. Several meetings have been held in the area to discuss the goals of the project. Although the project was first met with skepticism, EPA's outreach efforts, in conjunction with the Pennsylvania Oil and Gas Association, have produced cooperation. Several oil well operators have initiated cleanups on their own and have improved maintenance of their equipment to prevent spills.

Region 3 hopes to enhance this effort by a series of workshops to educate oil well operators on their responsibilities under environmental law. Seminar topics include oil spills, wastewater discharge, underground injection control, and wetlands programs.

Region 3's northwest Pennsylvania oil fields initiative is an example of the Agency's attempts to implement programs in a way that brings demonstrable environmental results rather than just measuring success by the number of permits issued or enforcement actions taken. A number of individual programs whose goals are quite different have been brought together in a coordinated effort. □

Pollution Where You'd Least Expect It

by David B. Joseph

Richard Frear, National Park Service

In Virginia, a hiker looks out over a view of the Blue Ridge mountains in Shenandoah National Park, where sulfates are responsible for most of the visibility degradation.

You ease your station wagon into the parking lot alongside the Grand Canyon. You've driven your family two thousand miles to see one of the eight wonders of the world. The kids scramble to be the first to drop a coin into the viewing scope on the canyon's rim. They look down at the distant bottom of the great gorge, then across to the other side. Do they see a magnificent and dramatic work of nature? Of course they often do. But on occasion they may see murk and haze, the product of industries, traffic, and other sources of airborne pollutants that may have travelled hundreds of miles from southern California or from the copper smelters of southwestern Arizona.

Visible air pollution in the form of smoke plumes, brown clouds, and gray and white haze is associated in most people's minds with urban and industrial areas. People in Los Angeles know there are days when you can't see the street from the tower room atop City Hall. Denver residents know there are many days when industrial and automotive air pollution blocks the Rocky Mountains from the view of drivers on the highway going past Denver to the airport. And Washington, DC, commuters have driven into town in the morning without being able to see the Washington Monument through a summer's smog.

These same people might not expect to have similar visibility problems in our national parks, especially in parks in isolated reaches of this country.

But, as the National Park Service told a Congressional subcomittee last May, "even in remote areas such as Grand Canyon National Park, visitors sometimes cannot see the opposite canyon rim or the canyon depths because of poor visibility. At Yosemite National Park, smoke from fires sometimes obscures the view of the well-known massive cliffs and domes. In Shenandoah National Park, the 'Blue Ridge' often appears an unnatural white, gray, or brown, and in the Great Smoky Mountains National Park, the natural haze is usually overwhelmed by man-made haze."

The haze-forming particles and gases usually enter the air from industrial and urban areas. The pollutants either absorb or scatter the light, creating uniform or layered hazes and plumes that obscure or discolor the landscape and limit what the viewer can see. A uniform haze is like smog—it impairs visibility in all directions. Layered haze appears as a discolored band across the scene, with a noticeable boundary between itself and the background.

Continued to next page

(Joseph is with the Air Quality Division, National Park Service, in Denver, CO.)

"Visibility pollution" is one of the pollution problems that concern the Department of the Interior and EPA. Since the National Park Service was established in 1916, the Secretary of Interior's mandate has been to preserve and protect the scenery and the natural and historic resources of its lands for the enjoyment of present and future generations.

In response to this mandate and additional goals and requirements of the 1977 Clean Air Act amendments, the National Park Service (NPS) conducts an extensive research and monitoring program to determine the impact of air pollution on visibility of national parks, monuments, and wilderness areas. The NPS also works with the EPA and numerous states to develop regulations that protect visibility.

In Shenandoah National Park, the "Blue Ridge" often appears an unnatural white, gray, or brown.

To determine the seriousness of the visibility pollution problem in the national parks, NPS currently monitors visibility at more than 30 sites from the Olympic peninsula on the northwest Pacific Coast to the Florida Everglades, and from Death Valley, CA, to Acadia National Park on the rocky Maine coast. NPS monitors use color photography, teleradiometry, and the collection and analysis of particles in the air.

The color photography documents the important elements of the scene and how they vary with changing air pollution levels, weather conditions, and sunlight. Teleradiometry uses a special telescope to measure the contrast between the sky in the background and dark landscape features so that changes in contrast caused by pollution or climatic change can be recorded.

Together, the photography and teleradiometry can be used to establish standard visual ranges—the distance from an observer at which a large dark object such as a forested mountain would just disappear against the horizon. Collecting and analyzing small particles in the air gives the NPS scientists a wealth of information on the particles' possible origin and their effect on visibility.

The focus is on very fine particles (those smaller than 2.5 micrometers in diameter—one tenth the diameter of a human hair) which generally cause most of the visibility problems.

What has this NPS monitoring found out?

- More than 90 percent of the time, man-made pollution affected scenic views to some degree at all NPS monitoring sites.
- Best average visibility is in northern Nevada, Utah, and southern Idaho. The area that includes Grand Canyon, Bryce Canyon, and Canyonlands National Parks is next best.
- The lowest visual range in the west is in the coastal areas of California and Washington.
- The very worst visibility recorded by NPS is in the eastern United States, where there are higher relative humidity and background air pollution levels. In the summer of 1983, for instance, the median visibility range at the Shenandoah National Park in Virginia was 19 kilometers, as compared to 100 to 200 kilometers for most western parks.
- Visibility is generally best in the winter and worst in the summer.

The NPS research and monitoring effort has provided much evidence to establish particulates as the major contributor to visibility impairment in the parks. The very fine particles are especially adept at scattering light and producing visibility impairment, much more so than big particles which actually form a larger percentage of the pollution mass. This is particularly true for sulfates, which are the largest single fraction of the total collected fine particle mass.

What's more, sulfates are optically active particles that are very efficient at scattering light and reducing visibility. These particles are the end product of atmospheric chemical transformation of gaseous sulfur dioxide that comes from such air pollution sources as power plants, smelters, refineries, and oil and gas fields.

How pervasive are sulfate particles as visibility impairers? NPS found them to be the number one villain everywhere except in the northwest, where carbon particles took the lead. In the Colorado Plateau, where Grand and Bryce Canyons are located, sulfate particles were responsible for 40 to 65 percent of the visibility impairment and in the Shenandoah National Park for over 70 percent.

In the Southwest, windblown dust, emissions from construction activities, and traffic on unpaved roads contributed 10 to 30 percent of the visibility reduction, while fine-particle carbons and nitrates accounted for another 20 percent.

NPS scientists are beginning to believe that volatile aerosols—small airborne particles that quickly evaporate and are difficult for currently used particulate samplers to collect—may be responsible for a significant share of the visibility problem. One special study at Grand Canyon National Park suggests that aerosols more volatile than ammonium sulfate may account for 30 to 40 percent of the visibility reduction there.

Because sulfates are such an important bad actor in terms of visibility pollution, NPS has conducted extensive analyses to determine where the sulfate aerosols measured at the monitoring stations come from. The agency's scientists developed a technique called "back trajectory residence time analysis" to estimate the probable paths that sulfur particles travel from the original pollution source to the park.

They found, for example, that air masses bringing high sulfur concentrations to Grand Canyon come mostly from urban southern California. Under different climatic conditions the particle-laden air came from the copper smelter regions of southern Arizona. On days when the particle concentrations

National Park Service workers take visibility measurements with a teleradiometer at Wind Cave National Park in South Dakota.

were low and the air clean, the clean air mass was more likely to have come from the north. Similar trajectory analyses were performed in a number of parks and monuments in the West; these results, too, suggested that sulfur emissions from distant urban and industrial source areas contributed to the reduced visibility at those locations.

In the 1977 amendments to the Clean Air Act, the Congress required development of regulations to protect visibility in national parks and

Air masses bringing high sulfur concentrations to Grand Canyon come mostly from urban southern California.

wilderness areas. NPS has been working with EPA and state air pollution agencies to reach this national visibility goal, which includes both remedying existing visibility impairment caused by man-made air pollution and preventing future problems. The amendments directed EPA to develop regulations to assure reasonable progress toward meeting the national goal and to provide the states with guidelines for implementing visibility protection programs through State Implementation Plans.

The regulatory program mandates EPA or the states with federally approved visibility programs to:

- Evaluate and control new sources of air pollution to prevent future visibility impairment in national parks and wilderness areas.
- Evaluate and control significant visibility impairment in such areas that can be traced to specific sources of air pollution.
- Adopt and implement long-term strategies for making reasonable progress toward the national visibility goal.

The program also gives states the discretion to extend the visibility protection to views of specific landmarks or scenic panoramas that can be seen from within a national park but which are outside its boundaries. Such views are called "integral vistas." The states will determine which of these scenic attractions need protection, and how much. NPS is working with the states to help them incorporate consideration of scenic park features in their rulemaking and protective actions.

Although administrative and judicial review actions delayed implementation of visibility actions, EPA published in July 1985 a federal approach to monitoring visibility for 19 states and a plan for determining new sources of parkland pollution in 16 states. Other states submitted State Implementation Plans for EPA review. Because EPA has found 32 states deficient in some aspects of the visibility rules, the Agency intends later this year to propose federal plans to remedy those deficiencies.

The federal monitoring effort involves both EPA and federal land managers in a cooperative network. A technical steering committee which includes members of the associated agencies is implementing the monitoring program and is now in the process of selecting the methods and locations to be used.

In the original 1980 regulations, the EPA focused on visibility impairment caused by single sources because of scientific and technical limitations in identifying sources of widespread regional haze or complex urban plumes. EPA committed itself to dealing with these issues in future rulemakings.

In 1984, EPA's Deputy Administrator established an Interagency Task Force to look at the development of strategies for addressing visibility problems created by pollution-derived haze, to study the links between haze and such problems as acid deposition and fine particulates, and to recommend a five to ten year program to deal with haze. In 1985, the Task Force reported its findings and recommendations in the areas of research needs, policy analyses, and interim regulatory and legislative considerations. The recommendations have resulted in additional research commitments and are being considered in developing federal plans.

In the few years since Congress amended the Clean Air Act to include the problem of visibility degradation, the Park Service visibility and research monitoring program has done a great deal to promote a better understanding of the problem. This program is providing the necessary basis for informed and effective decisions on visibility protection issues, regulation development, and the ultimate success of National Park Service efforts to manage and preserve the parks for present and future generations who want to enjoy the beauty and inspiration that comes from sharing nature's wonders. □

"A Fierce Green Fire": Remembering Aldo Leopold

by Jack Lewis

Aldo Leopold has found a secure niche in the pantheon of American naturalists. It is not uncommon to see his work ranked with that of such giants as Henry David Thoreau, John Muir, and Rachel Carson. Historian Stephen Fox has called Leopold's *A Sand County Almanac* "easily the most admired, most quoted, most influential book in modern conservation," and Leopold's career "perhaps the most distinguished . . . in twentieth-century conservation."

Yet Aldo Leopold is not as well known as the luminaries now judged to be his peers. Several factors have obscured his brilliance. Leopold the man was gentlemanly and professorial, never a self-promoter. Moreover, he did not live to bask in the praise heaped on his most famous book, *A Sand County Almanac*. Thus, the growth of the Aldo Leopold cult has been slow: one enthusiastic reader of *A Sand County Almanac* recommending it to another, in a word-of-mouth network that now embraces tens of thousands of admirers the world over.

Integral to that cult is the story of Leopold's tragic death. On April 21, 1948, Leopold joined the fight against a grass fire that was threatening his rustic farm in the Sand Country of west central Wisconsin. Only the week before, he had received a long-distance call from the Oxford University Press confirming that *A Sand County Almanac* had been accepted for publication. Ironically, some of the most stirring passages in the *Almanac* were devoted to condemning the scorched earth policy of pioneers who had set fires to clear the same terrain decades before.

Now Leopold was face to face with the fiery enemy. Overcome by smoke, he suffered a fatal heart attack. Leopold was only 61 when death enshrined him for future generations as a martyr to the environmental cause.

Aldo Leopold's life began on January 11, 1887, in the small town of Burlington, IA. He was born to a prosperous German-American family that had made its fortune manufacturing fine walnut desks. The Iowa of the 1880s and 1890s was still the luxuriant paradise depicted in the paintings of Grant Wood and the novels of Willa Cather. A huge variety of flora and fauna graced Leopold's childhood environment. The spacious frame house where the future forester and naturalist grew up stood on a bluff overlooking the game-rich marshes of the Mississippi River.

Aldo and his brothers, Carl and Frederick, spent countless hours stalking partridges and ducks in these Iowa marshes. Aldo acquired a passion for hunting from his father, Carl, a sportsman who tried to give all his sons a sense of fairness and self-restraint. To Aldo the boy, self-restraint came to mean sparing the treed partridge and taking aim only at the partridge on the wing. To Aldo the man, self-restraint took the form of substituting bow and arrow for rifle and bullet. But who can doubt that this self-restraint cost a real effort to Leopold, who was capable of writing: "Compared with a treed partridge, the devil and his seven kingdoms was a mild temptation."

Leopold lived most of his life alienated from the attitudes of his colleagues in "the land of neckties and boiled shirts."

There was something almost primordial about the intensity of the young Aldo's bloodlust. Frederick Leopold—Aldo's brother, still hale and hearty at 90-might have been describing Cain himself when he recently recalled: "Father gave Aldo his LeFever, . . . a 16-gauge double. Aldo wore it out. At the rate I was going in my hunting heyday, I could live to be a good many years older than I am now and not have killed near as much game as Aldo did."

Aldo Leopold was, in short, no tree-hugging wimp. He was an avid hunter and outdoorsman with a healthy Darwinian respect for "nature red in tooth and claw." He regarded the hunting instinct as native to man, just as it is to other animals, and he was never one to sentimentalize the never-ending struggle of species against species. Leopold minced no words in *Sand County Almanac*: "If all are to survive," he asserted, "each must ceaselessly feed and fight, breed and die."

Leopold himself was a child of privilege, insulated from the harder realities of social striving. He left Iowa at an early age to enter exclusive Lawrenceville Prep in New Jersey. After spending several years at Yale's Sheffield Scientific School, he became one of the first students at Yale's new School of Forestry.

It was in these ivied bastions of Eastern privilege that Leopold gained his grounding in the sciences, but it was also at Lawrenceville and Yale that he developed the dandified ways that were to mark him for the rest of his days as, quite definitely, "not one of the boys." Leopold took to sporting hand-made shirts and Brooks Brothers suits, and he was visibly proud of his lean form and patrician profile. "He was always well-dressed in the field," one of Leopold's graduate students later recalled, "and around his neck hung that dog whistle and the Zeiss binoculars. He was a gentleman to the core."

When Leopold graduated from the Yale School of Forestry in 1909, he was one of only a hundred trained foresters in the United States. There was a crying need for Aldo's skills in the U.S. Forest Service, an organization Gifford Pinchot had formed in 1905 with the blessing of Theodore Roosevelt. The lands controlled by the federal government were vast, and so were the responsibilities devolving on the first professional forest rangers. Leopold had been a ranger only one year when he was appointed deputy supervisor of the Carson National Forest in north central New Mexico. The following year he was named supervisor. In 1913, Leopold became assistant district forester for the whole Southwest district of the Forest Service.

That same year, Leopold married Estella Bergere, the daughter of a Spanish land-grant family. Aldo and Stella moved into a house near the forest at Tres Piedras, NM, and began to raise a family of five children. Carl Leopold, Aldo's youngest son, now Professor of Horticulture at Cornell, reports that his father "meticulously avoided" forcing the sciences on his

(Lewis is Assistant Editor of the EPA Journal.)

Robert A. McCabe

Aldo Leopold examines one of the thousands of trees he and his family planted on their Wisconsin farm.

children. But all five, perhaps acting out of some subconscious desire to delight their father, gravitated toward the sciences.

Starker, the first-born, who died in 1983, became a wildlife ecologist. His scientific interests most closely resembled his father's. Starker's brother Luna is a celebrated hydrologist, now teaching at the University of California at Berkeley. The next-born, Estella, is a palynologist and geomorphologist at the University of Washington. Her sister, Nina, an ecologist married to a geologist, is the only Leopold child who has no formal schooling in the sciences. She lives with her husband on the old Leopold farm in Wisconsin, which—along with a thousand neighboring acres—is now preserved as "The Leopold Memorial Reserve." The youngest Leopold child, Carl, is not only an expert on plant physiology but also an accomplished classical guitarist.

So honored has the Leopold clan become that journalist George Stanley sees no hyperbole in the statement that the "name Leopold is to wildlife conservation what Fonda is to movies and Bach is to music." It surely is remarkable that three of Aldo's offspring—sons Starker and Luna and daughter Estella—are scientists of such distinction that they have gained election to the National Academy of Sciences. Never before or since have so many siblings from a single family been admitted to the Academy. There is ample reason to believe that not just the genes but the patient tutelage of Aldo Leopold made this feat possible.

Observe the passing of esoteric knowledge from generation to generation. Aldo's brother Frederick speaks of the way their father, Carl—the originating Leopold patriarch—"planted a seed, and it took in all of us. Of course, Aldo developed it further than anyone else. . . . My father remembered seeing the big flights of passenger pigeons. He lived for hunting and the outdoors. He used to tell me his shoes were so bad when he was a boy he had to stuff newspapers in them to keep his feet warm. But he went out nonetheless, in all seasons, and he raised us the same way. He started teaching us to 'read sign' when we were very small. We'd go to a woods or swamp or prairie, and he'd open up a hollow log with an ax and show us the mice and insects living inside. He'd point out where a mink had dug into a muskrat house, looking for a meal. He'd identify the animals that had been around by looking at their scat—'These are a raccoon's droppings,' he'd say. 'Look at the wild grape seeds and skins, and the bits of bleached shells from crayfish he's been eating.'"

Aldo's daughter, Estella, a brilliant exemplar of the current generation of Leopolds, recalls: "Whether we were hunting or not, long walks with Dad always involved ecological analyses. There was much stopping and discussing tracks and sign, what the animal was eating, etc. I don't think he missed seeing much that was going on in the landscape. He knew every species of bird, plant, and mammal, and usually talked about them as individuals. All this made the biotic community very real and exciting."

Later, when Leopold became a professor at the University of Wisconsin, he initiated his students to the mysteries of "reading sign." By the time they completed his series of lectures and field excursions, Leopold expected his students to be able to see patterns hiding in the most disparate evidence. A typical Leopold quiz might present the student with the following particulars: "A road flanked on one side by a subsiding telephone pole, then a pink granitic boulder, bluestem, oat stubble bearing ragweed, some young pine, poorer oat stubble; on the other side a *Silphium*, double-forked sumac, another pink rock, a fence post, and bit of corn stubble. A rabbit lay dead on the road."

Sherlock Holmes himself might have hesitated before answering questions such as these: "How long ago was the last hard winter?" Answer: Two years, a fact that could be deduced from the sumac's double fork. "What sex is the rabbit?" Answer: Male, because females stay close to home in spring. Et cetera.

It was thus through laborious instruction that Aldo Leopold sought to revive the lost arts of the wilderness adventurer. All along, he was well aware of a central irony: namely, that American pioneers schooled in "nature's infinite book of secrecy" could have breezed through the very lessons that dumbfounded their grandchildren and great-grandchildren.

It was in 1924 that Aldo Leopold began his migration from the then-daredevil world of the Civil Service forester to the tamer Groves of Academe. He was 37 years old when he was named associate director of the U.S. Forest Service Products Laboratory in Madison, WI. This lab, located in the same town as the University of Wisconsin, was the major research arm of the Forest Service. Leopold knew of the commercial orientation of most of the research undertaken at the lab, and what he knew made him extremely reluctant to leave the Southwest. He accepted the new position only with the tacit understanding that he would soon become director of the lab.

Four years later, that ambition still thwarted, Leopold quit the civil service and started work as a private forestry and wildlife consultant. He ran a considerable risk in doing so, what with five children and a wife to support, and no private income. One of Aldo's major projects over the next few years entailed conducting a game survey of the north central states for the Sporting Arms and Manufacturing Institute of America.

The year 1933 proved to the world that Leopold's bold gamble had paid off. Not only were the results of his game survey published, to considerable acclaim, but so was his spectacularly successful book *Game Management*, a comprehensive study that was quickly recognized as the classic text on that subject. Leopold's book was so pioneering and so definitive that a group of University of Wisconsin alumni funded a special chair for him as America's first Professor of Game Management. Capping a remarkable year was Leopold's appointment by Franklin Roosevelt to a special Committee on Wildlife Restoration.

Leopold was convinced that ecology, in and of itself, could not protect nature against man.

The Madison campus of the University of Wisconsin is located a few miles south of the state's "Sand Country." Mesa-like bluffs form steep cliffs throughout the Sand Country, an otherwise flat and sparsely populated region known for its sandy and marshy soil. Seeking a weekend and summer retreat, Aldo Leopold picked out "a cheap farm" in a part of the Sand Country extremely vulnerable to April flooding. Unprepossessing though it was, Leopold came to love this farm with a passion approaching delirium.

A Sand County Almanac records Leopold's observations of life on his farm from January to December of a single year. These observations are all variations on the value of "wildness," and the evil of encroaching civilization. Leopold revelled in the wildness of his isolated and marshy farm. He had nothing but contempt for city dwellers who satisfy themselves with limited glimpses of nature and seek dull security "astride a radiator." Even the

University of Wisconsin Madison Archives

Working for the U.S. Forest Service in 1911, Aldo Leopold was in charge of mapping and reconnaissance of the Apache National Forest in Arizona.

business of education practiced in Madison struck Leopold as suspect: "Is education possibly a process of trading awareness for things of lesser worth? The goose who trades his is soon a pile of feathers."

Leopold attached almost mystical importance to one glimpse of wildness he had caught years before in the Southwest. A mother wolf and her pups suddenly bore down on Leopold's encampment. He sent out a hail of bullets "with more excitement than accuracy," then hurried down to watch the death agonies of the mother wolf:

> *We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters' paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.*

Leopold recorded this adventure in one of his Sand County "sketches" called "Thinking Like a Mountain." No one can emerge from a close reading of Aldo Leopold without acquiring some idea, however vague, of what it is like to think like a mountain, a marsh, a crane, a grebe, a jackpine, a burr oak, a meadow mouse, or a hawk. From such exotic excursions into the wild world beyond our overheated doorstep, we emerge more fully aware of what it means to be living, sentient creatures in a hostile world.

There is something wonderfully evocative about certain phrases in Leopold's prose: "What one remembers is the invisible hermit thrush pouring silver chords from impenetrable shadows"; "Through the open window I heard the heart-stirring whistle of an upland plover; time was when his forebears followed the buffalo as they trudged shoulder-deep through an illimitable garden of forgotten blooms."

Leopold was able to wax poetic without descending to the sentimental excesses of the late Victorian happy hearts. In *Round River*, a posthumous collection of prose fragments published in 1953, Leopold heaped ridicule on "the era of dickey-bird ornithology, of botany expressed in bad verse, of ejaculatory vapors such as 'Ain't nature grand?'" But he was also careful to distance himself from the desiccated writing of his scientific colleagues in the academic world.

Leopold was, in other words, that rarity in academia, science, and environmentalism: a self-conscious and highly skilled literary artist. Beneath a cultivated and genteel demeanor, he harbored a poetic alter ego, an untamed Adam of the Arcadian marshes, capable of happiness only in some long-lost age when "man and beast, plant and soil lived on and with each other in mutual toleration, to the mutual benefit of all." As a result, Leopold lived most of his life alienated from the attitudes of his colleagues in "the land of neckties and boiled shirts":

> *There are men charged with the duty of examining the construction of the plants, animals, and soils which are the greatest instruments of the great orchestra. These men are called professors. Each selects one instrument and spends his life taking it apart and describing its strings and sounding boards. This process of dismemberment is called research. The place for dismemberment is called a university.*
>
> *A professor may pluck the strings of his own instrument, but never that of another, and if he listens for music he must never admit it to his fellows or his students. For all are restrained by an ironbound taboo which decrees that the construction of instruments is the domain of science, while the detection of harmony is the domain of poets.*

There is something poignant about that passage, just as there is some suggestion of false modesty in Leopold's reference to himself as "me, a mere professor." Yet Leopold's students report that he cherished being called "The Professor."

Such contradictions are characteristic of Aldo Leopold. Perhaps his valiant death fighting that grass fire in 1948 was in some sense an escape from the soul-rending conflicts that divided him: scientist versus poet, family man versus wild hermit. Over every line of *A Sand County Almanac*, there hangs a heavy shroud of impending doom. Leopold's land was doomed, and so was the scholar-poet uniquely capable of capturing the aura of its vanishing beauty.

His writings have helped to create an atmosphere conducive to environmental progress.

Soil Conservation Service

"Babes do not tremble when they are shown a golf ball, but I should not like to own the boy whose hair does not lift his hat when he sees his first deer." — Aldo Leopold

Leopold had no doubt that the marshes he loved so much faced swift and total destruction. "The marshlands that once sprawled over the prairie from the Illinois to the Athabasca are shrinking northward. . . . Some day my marsh, dyked and pumped, will lie forgotten under the wheat, just as today and yesterday will lie forgotten under the years."

Like many another man obsessed with the threat of oblivion, Aldo Leopold sought strength in science, but he found his only real consolation in art. Even if his marshes were doomed to die, Leopold hoped that his immortal prose poems would keep those marshes alive on the printed page, if not under the blinding sun and the soothing moon. Gentleman, hunter, artist, scientist, genius, Leopold knew that his "minority" view was vastly superior to the muddled thinking of "the shallow-minded modern."

How to transform mass man into a creature less shallow and less destructive was to Aldo Leopold an unanswerable question. He despaired of any real progress toward "land health" as long as Americans took the attitude that government would pick up the pieces after every outburst of mindless rapacity. The clumsy mistakes of the New Deal had cured Leopold of that delusion once and for all. He believed that the best hope for the future lay with schemes of subtle coercion, designed to exploit man's curiosity and selfishness, and channel these powerful drives toward altruistic ends.

Leopold was convinced that ecology, in and of itself, could not protect nature against man. "The question is, does the educated citizen know he is only a cog in an ecological mechanism? That if he will work with that mechanism his mental health and his material wealth can expand indefinitely? But that if he refuses to work with it, it will ultimately grind him to dust? If education does not teach us these things, then what is education for?

"Conservationists have, I fear, adopted the pedagogical method of the prophets: we mutter darkly about impending doom if people don't mend their ways. The doom is impending, all right; no one can be an ecologist, even an amateur one, without seeing it. But do people mend their ways for fear of calamity? I doubt it. They are more likely to do it out of pure curiosity and interest."

In building game management into a profession, Aldo Leopold exploited the bloodlust of hunters fearful of losing their prey, but his objective—then as always—was to "get action from human beings as now constituted." The long-range goal, which Leopold always kept in view, was to use that game consciousness as the leavening core of a wider awareness "capable of expanding in time into that new social concept toward which conservation is groping."

A society sensitive to the demands of animals and plants is today far more a reality than it was in Aldo Leopold's lifetime. His writings have helped to create an atmosphere conducive to environmental progress. Moreover, they have inspired many activists to devote their lives to protecting America's natural treasures.

Shortly before he died, Leopold wrote a tribute to one of his old Forest Service colleagues, C. K. Cooperrider. It appeared in the July 1948 *Journal of Wildlife Management*, the same issue that carried his own obituary. Aldo Leopold might have been describing himself when he spoke of prophets and prophecies: "A prophet is one who recognizes the birth of an idea in the collective mind, and who defines and changes, with his life, its meaning and its implications."

Generations of future Americans will be drawn to the writings of Aldo Leopold, and to his personal example. Aldo Leopold the prophet, still scarcely known outside environmental circles, will always be there to haunt us and to taunt us when we forget the value of pure wildness. The ghost of Aldo Leopold will beckon to us from the marshes as we sit, discontented, in our overheated parlors in front of our flickering video screens. He will be there always, beckoning to us from within the "fierce green fire" where all the splendor and glory of nature reside. His spirit will never die. □

Climbing Compliance Mountain

by Karen V. Brown
and Edgar Berkey

Many owners and operators of small businesses view the task of complying with environmental regulations much like the cartoon hikers beginning to climb "Compliance Mountain."

Up ahead, they can see many obstacles in their path, some easier to overcome than others, a few that seem overwhelming. The best route to follow is not clear, and the climb looks like a formidable challenge. In fact, the top of the mountain—the goal of successful compliance—is not even visible. The situation leaves them wondering and bewildered. How high is the mountain? How long is the climb? And above all, what will it cost before we're through?

To many businesses, achieving environmental compliance can seem expensive and complex. In spite of good intentions, climbing "Compliance Mountain" is not an inviting undertaking. Regulations are difficult to understand, and clear information on requirements is difficult to obtain. Regulators can seem bureaucratic, inflexible, and not really interested in small business needs and problems. Because of these complexities, many small businesses often wonder if it really matters. By virtue of their large numbers, they feel the chances of enforcement are slim.

Unfortunately, this misconception leads some small business people to decide against scaling "Compliance Mountain," even though substances they handle and activities they perform pose potentially serious threats to the environment. Because they are so occupied in operating a business, they often do not realize that unsafe practices in using, discharging, and disposing of chemicals can be harmful even though the volumes involved are relatively small. The collective significance of these actions is far out of proportion to their individual magnitude.

Over the past few years, mounting evidence has indicated that small, uncontrolled sources of pollution can result in serious problems. Toxic chemicals improperly placed on land have contaminated water wells and aquifers. Badly packaged hazardous waste has ignited, injuring workers. And chemicals disposed of in drains have disrupted sewage treatment plant operations. These circumstances have led to increasing regulatory attention at both the federal and state levels.

They are honest, tax-paying citizens, but how far will they go; how far can they afford to go?

During EPA's early years, attention was quite properly focused on major sources of pollution and large industrial dischargers. As progress was made in these areas, it became more and more apparent that further significant improvement in the protection of our health and environment would not occur unless many of the smaller and more numerous sources of pollution (like small businesses) were brought under some form of regulation.

Environmental regulations put into place since 1980 have affected hundreds of thousands of small businesses across the country: from manufacturing and chemical plants to Main Street businesses such as service and retail store operations. Regulations have covered control of air pollution, treatment of water discharges, and management of hazardous waste. Many businesses affected have never before been required to comply with environmental regulations. They are mostly firms having fewer than 100 employees, with no particular employee assigned responsibility for addressing environmental requirements even on a part-time basis.

And more regulations are coming! In a recent review, the EPA Small Business Ombudsman's staff determined that the agency has more than 25 regulations under development that will have a significant impact on small business. EPA is required to consider the effect of these regulations on small business and to develop approaches that can minimize unnecessary burdens. However, this is not as easy as it sounds because of the agency's limited experience in dealing with small businesses.

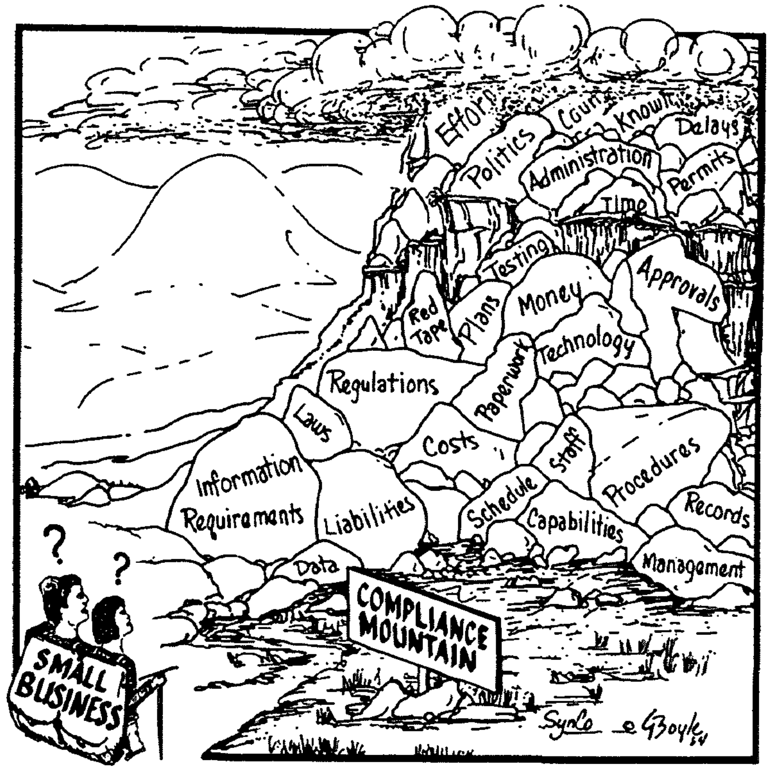
Fortunately, many small business people appear willing to start the climb up "Compliance Mountain" in spite of the many obstacles they will encounter. They are honest, tax-paying citizens, but how far will they go; how far can they afford to go?

If EPA is to successfully promote widespread small business compliance, the agency's traditional regulatory and enforcement approaches will require major alteration and revision. The special characteristics and needs of small business owners and managers will have to be considered in communicating with this segment of our economy as well as developing regulations that minimize unnecessary reporting burdens. Adversarial relationships with regulators will need to be tempered, and the regulators' sensitivity to legitimate small business concerns must be cultivated.

Small businesses play a vital role in our nation's economy. Collectively they produce 40 percent of the gross national product and employ 52 percent of the nation's workforce. They have created 60 percent of jobs recently added by industry. For every R&D dollar spent in

(Brown is EPA's Small Business Ombudsman and Berkey is President of Synco Consultants, Inc.)

our nation today, small businesses are a source of technical innovation 24 times more productive than large companies. It is EPA's continuing task to work toward reasonable environmental regulations that take into consideration the special needs and concerns of this large segment of our economy and to provide it with guidance and assistance in bringing about increased voluntary compliance. It is a sizable undertaking, but a challenge well worth the required effort. □



EPA's Small Business Ombudsman

The position of Small Business Ombudsman, established at EPA in early 1982, involves a rather uncommon task within a federal regulatory agency: to provide assistance to large segments of the community it regulates.

The Ombudsman's functions, located in the Office of Small and Disadvantaged Business Utilization in the Office of the Administrator, are broad in scope and intended to promote cooperative working relationships both inside and outside the agency. Major duties and accomplishments of the Ombudsman over the past three years include:

• **Participation in Regulatory Development.** The Ombudsman's staff monitors and participates in regulatory work groups developing regulations that may have significant impact on small businesses. The staff conveys to group members the needs and concerns of the small business community as they relate to a specific regulation.

• **Small Business Hotline.** A toll-free telephone number (800-368-5888) is operated to provide small businesses with a convenient and confidential way to reach EPA. Currently, the Hotline is responding to more than 400 calls per month, with more than 50 percent related to hazardous waste management issues.

• **Regulatory Information.** The Hotline helps small businesses understand and comply with environmental requirements. Trained staff provides answers to specific questions, as well as assistance interpreting regulations. Requests for EPA reports or documents needed by the callers are filled. A special brochure listing more than 70 publications on environmental subjects of interest to small business has been compiled and sent to over 7,000 organizations which represent small business interests. Last year, more than 10,000 documents were distributed.

• **Communicating with the Small Business Community.** The Ombudsman provides a focal point for communications between EPA and the small business community, actively meeting with small business organizations. At least twice a year, the Ombudsman sends out an informational memorandum to more than 7,000 individuals and groups interested in small business environmental issues to keep them informed on recent developments at EPA.

• **Working with EPA Personnel.** The Ombudsman's staff works closely with other EPA staff members to increase understanding of small businesses. Periodically, the Ombudsman's office prepares a *Small Business Update* for more than 400 managers to keep them informed on important small business problems. A Small Business Task Group composed of senior level managers from EPA program and regional offices led a 15-month effort during 1983 and 1984 to formulate a new strategy, approved by top management, to improve EPA's regulation of small businesses and to encourage voluntary compliance with those regulations.

• **Regional and Program Office Liaison.** Each Assistant and Regional Administrator has selected a person within his or her offices to serve as an official Small Business Liaison with the Ombudsman's office. Inquiries and complaints are often funneled through the Small Business Liaisons for handling and disposition.

• **Dispute Resolution.** The Ombudsman can assist businesses engaged in a dispute with EPA. Individual cases brought to the staff's attention are investigated, facts are determined, and, if warranted, attempts are made to work with the parties toward an equitable resolution. Disputes in an early stage of development can be resolved.

Update

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

AIR

Stratospheric Ozone

The Agency has announced its strategy and timetable for examining the issue of stratospheric ozone protection.

The plan is expected to provide necessary technical information for possible future regulatory decisions on chlorofluorocarbons (CFCs) or other chemicals that may affect the ozone layer.

The plan places emphasis on U.S. participation in current international research and discussion of global strategies for protecting the ozone layer.

In 1978, EPA and other agencies limited the use of CFCs as a propellant in most aerosal spray cans. Several other countries also acted to reduce use of CFCs, but they still are used in this country and worldwide for many industrial and commercial processes, including refrigeration. air conditioning and foam blowing, and as a solvent by the electronics industry.

By preventing most potentially harmful ultraviolet radiation (UV-B radiation) from penetrating to the earth's surface, the ozone layer acts as an important shield protecting human health, welfare, and the environment.

Emission Balancing

EPA is proposing a new policy which would allow industries affected by EPA's new stack height regulations to lessen the costs of compliance by buying reductions from other pollution sources.

The new policy, known as "emissions balancing," if adopted as proposed, would give an industry subject to the stack height regulation the option of contracting with another source of sulfur emissions in the same area to achieve a required reduction in emission. This could be more cost-effective for the industry than achieving reductions at the original source.

The emissions balancing would not eliminate the need to comply with other basic requirements of the Clean Air Act, such as attainment of air quality standards, nor would it allow sources to delay compliance with the stack height regulations. Proposed emission balancing contracts would have to be submitted within six months after revised emission limitations are due at EPA, and would be subject to public review and comment procedures.

HAZARDOUS WASTE

Land Disposal Phasedown

The Agency is initiating a process which will ultimately end the land disposal of most untreated hazardous wastes.

This proposal will ultimately affect 33 billion gallons of hazardous wastes (out of 71.3 billion gallons generated annually) that now are disposed of untreated on land.

EPA is proposing to prohibit land disposal of most untreated wastes containing solvents and dioxins, two of the most toxic and difficult substances to manage through land disposal.

The 1984 amendments to the Resource Conservation and Recovery Act (RCRA), the federal hazardous waste management and disposal law, prohibit land disposal of regulated hazardous waste, over the next five years (1990) unless the Agency determines that a waste can be made safe for disposal through a technological treatment process.

The proposed treatment standard for dioxin calls for incineration to levels where the dioxin contamination cannot be detected. Because no incinerators have been permitted to burn dioxin wastes, EPA is proposing to extend the statutory effective date for two years or until there is certified incineration capacity.

Dioxins are a group of 75 related chemical compounds unavoidably produced as byproducts in the manufacture of some chemical products. Dioxins are highly toxic and have caused cancer and other serious adverse health effects in laboratory animals.

Controls on Spent Solvents

EPA announced that it is acting to bring certain spent solvents considered hazardous waste under control of the Resource Conservation and Recovery Act.

The new regulation will close a loophole that left certain mixtures of wastes containing highly toxic spent solvents uncontrolled. When improperly managed, such mixtures could pose health or environmental hazards.

Previously, EPA proposed to amend RCRA regulation for hazardous waste by redefining the spent solvent listings to include mixtures containing 10 percent or more total listed solvents.

The listings covered only the technical grade or pure form of the solvents, leaving mixtures containing one or more of these toxic solvents unregulated. Agency information indicates that solvents are frequently blended to increase "solvent power" and to achieve faster drying. Such solvent mixtures also may contain from 15 to 50 percent or more of toxic chlorinated solvents. (A solvent is considered "spent" when it has been used and is no longer effective).

PESTICIDES

Daminozide

EPA has announced that a number of interim regulatory measures have been imposed as a condition for the continued use of the pesticide daminozide, also known as alar.

Daminozide is a plant growth regulator used primarily on apples intended for the fresh produce market (38 percent of the U.S. fresh market apples).

The new measures the Agency is imposing include reducing application rates and requiring extensive new data to support continued use.

The exposure reduction measures include a change in the rate of application of daminozide on apples from four to three pounds per acre for mid- and late-season treatments; and setting a production limit on the amount of daminozide that can be produced for use on grapes.

This pesticide promotes uniform fruits and fruit firmness, which reduces bruises in handling and shipping and increases storage life.

TOXICS

Asbestos Violations

EPA and the U.S. Department of Justice filed 11 lawsuits against 28 defendants throughout the nation, charging them with violating Clean Air Act rules protecting people from asbestos exposure during building demolition and renovation.

The cases all involve buildings containing friable asbestos, the type that can be easily crumbled, releasing fibers into the surrounding air where they can be breathed by humans. Inhaled asbestos is a human carcinogen that causes lung cancer and mesothelioma (a cancer of the chest and abdominal lining), as well as asbestosis (scarring of the lungs).

The regulations require the owner or operator of a demolition or renovation firm to notify EPA (and a state agency, if EPA has delegated the authority) in advance of beginning demolition or renovation involving friable asbestos.

If the amounts of asbestos are equal to or greater than 260 linear or 160 square feet, the asbestos must be removed before any wrecking or dismantling that would break up the asbestos material. □

Great blue heron in mating plumage stalks a marsh area along Maryland's eastern shore in search of fish.

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