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# EPA JOURNAL

## Environmental Perspectives

# Environmental Perspectives

For EPA, 1987 was a year of discovery: on the plus side, discovery of new environmental solutions; on the minus side, discovery of some new environmental problems. This issue of *EPA Journal* takes a look at some of these discoveries.

Is a man's home his castle? Rembert Brown of EPA's Office of Public Affairs discusses recent studies that show people may be exposed to more pollution indoors than outdoors. On a more hopeful note, Greg Supernovich of EPA's Region 1 relates a success story in Maine. With citizen input, EPA cleaned up contaminated soil at an infamous hazardous waste site, and is now beginning cleanup of contaminated groundwater.

Dave Ryan of EPA's press office describes proposed new EPA rules for filtering and disinfecting water. Proposal of the rules marks the final chapter in efforts to minimize waterborne intestinal diseases.

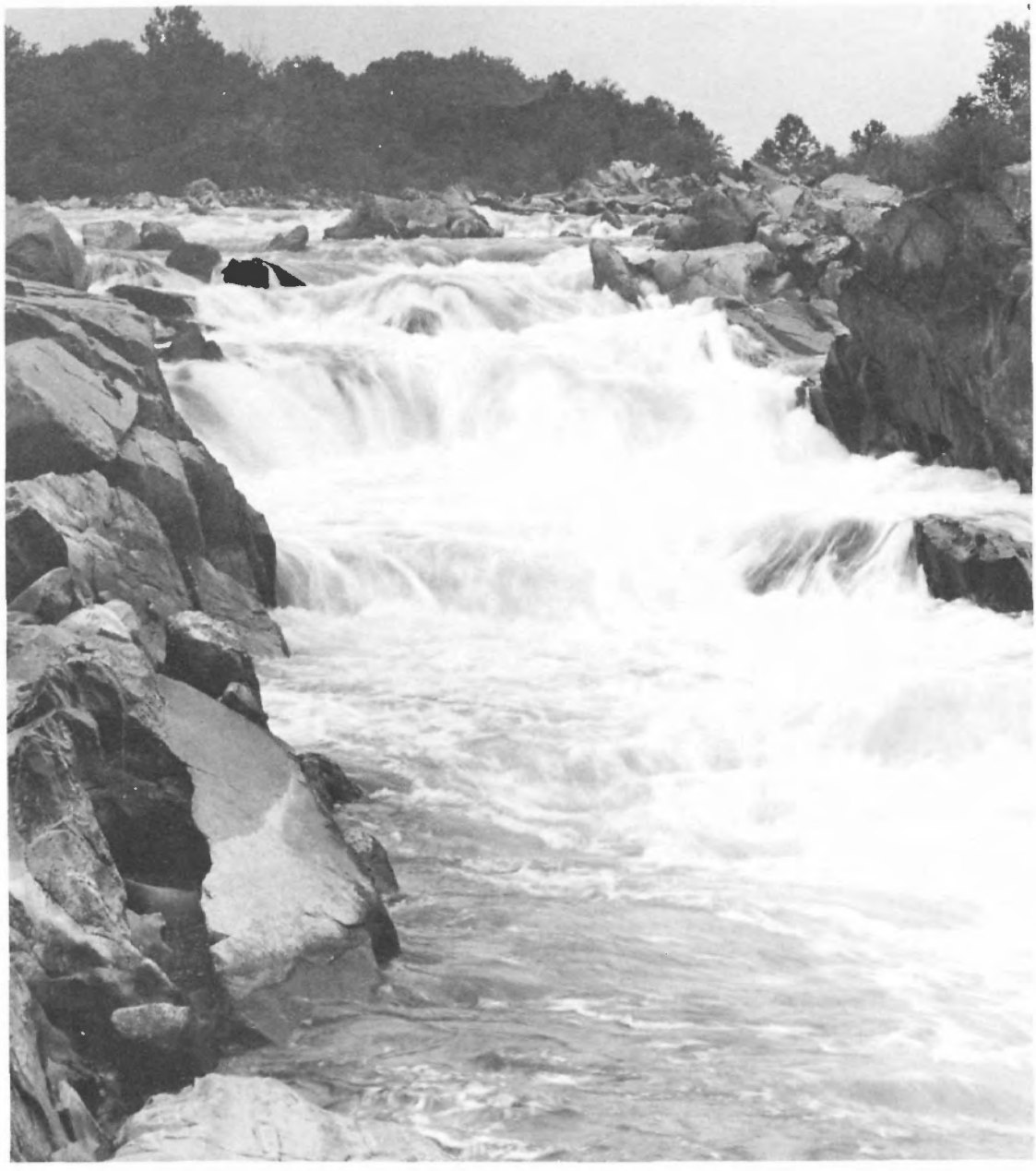
Lee Blackburn of EPA Region 3 describes the resurrection of the Potomac River. More than 400 years ago, the river provided an abundance of food to Indians who fished from its banks. Later on, industrial pollution nearly killed the river, but today fish populations are increasing again.

A subsequent article by Henry Thomas of EPA's Office of Air and Radiation describes how technological advances have led to changes in the National Ambient Air Quality Standard for particulate matter. In another article, David Wann of EPA Region 8 looks at an apparent conflict in the State of Idaho between two industries—logging and tourism—and at the environmental impact on the state of logging practices. Alice Mayio of EPA's Water Office summarizes a report on the 1986 status of surface waters in the U.S.

The following article, by Norman Lovelace of EPA's Region 9, on environmental problems in the Pacific territories makes clear that beautiful tropical scenery can mask trouble in paradise.

People often complain that environmental factors are making them sick. Can scientists prove it? An article by Robert Griffin, a science writer, describes the use of epidemiology to pinpoint connections between the environment and human health. Next, a photo essay chronicles the life of the osprey.

Concluding this issue of the *Journal* are a letter to the editor; and two regular features, Appointments and Update. □



Steve Delaney

The Potomac River at Great Falls.

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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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*Front Cover: January dawn. Photo by E. R. Degginger, Folio, Inc.*

*Design Credits: Donna Wasylkiwskyj; Ron Farrah; James R. Ingram.*

*Correction: As the last issue of* EPA Journal *suggests, environmental risk is all around us. The Journal, itself, discovered it was at risk in selecting photographs. The front cover photograph that was represented to us as being of clear water actually is a pool of mercury, in fact, one of the largest in the world, stored by a quicksilver firm in Spain. EPA scientists recommend that no one handle mercury in the way it is being handled in the photograph, because it is a toxic compound and can be absorbed by the skin.—the Editor.*

# Home and Office: Shelter or Threat?

by Rembert Brown

Recent studies by EPA and other federal agencies have uncovered surprising, sometimes disturbing, facts about the size, scope, and sources of indoor air pollution.

Exposure to indoor pollutants takes place in residences, public and private buildings, and vehicles—collectively classified as "indoor environments." The home, workplace, school, automobile—virtually any enclosed structure—contains hundreds of potential sources of air pollutants, both natural and manmade.

Most people today spend about 90 percent of their time in environments of this kind. Such prolonged exposure explains, in part, the high levels of exposure to indoor air pollutants that take place.

Also contributing is the general "tightening" of buildings—residential and other—that has taken place since the 1970s in the national effort to reduce heating and cooling costs. Buildings are much better sealed and insulated than they used to be. During that same energy crunch, heating and air-conditioning engineers cut back on the amount of fresh air per building occupant. These factors have combined to increase personal exposure to indoor air pollutants.

"Sick building syndrome" is the name given the health symptoms caused when occupants of modern energy-efficient buildings have been exposed to indoor air pollutants. These symptoms can mimic those of many diseases, ranging from colds and flu to more serious disorders. Victims have reported headache, eye irritation, sinus problems, runny nose, cough, shortness of breath, and nausea. Complaints have occurred in offices, schools, health-care facilities, and modern buildings of other types. In addition, some well-recognized diseases— "Legionnaire's Disease" among them—can be spread through ventilating systems.

### Key Exposure Sources

A number of commonly occurring chemicals and other substances are associated with sick building syndrome and other ailments related to indoor air quality problems. To help bring future research efforts into proper focus, EPA has pinpointed several key categories of pollutants and sources within enclosed environments:

- **Combustion sources.** Gas cooking stoves, woodstoves, kerosene heaters, and other unvented heating and cooking units that employ combustion are major sources of indoor pollutants such as carbon monoxide, nitrogen dioxide, and particulate matter.

  Another major combustion source is environmental tobacco smoke (ETS). This term refers to tobacco smoke released in an indoor environment. It is also sometimes called "passive smoking." Chemicals in environmental tobacco smoke include particulates, benzene, styrene, nicotine, and a number of other substances. ETS is believed to pose a significant risk to health, especially among spouses and children of smokers.

- **Materials and furnishings.** Building materials may be the source of asbestos, formaldehyde, and other volatile organic chemicals (VOCs). In particular, paints and adhesives are major sources of VOCs.

- **Biological contaminants.** Molds, spores, bacteria, and viruses find breeding grounds—and transport mechanisms—in auto and building air conditioners, humidifiers, ventilation systems, and building materials.

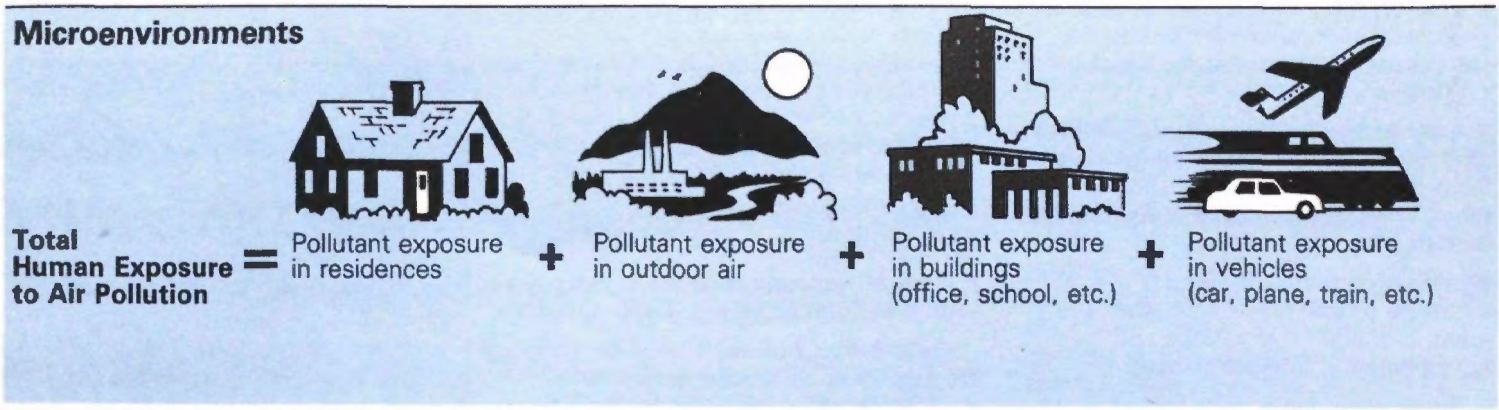
- **Human activities.** The use of many common household products such as pesticides, paints, solvents, cleaning agents, air fresheners, and toilet deodorants may release significant amounts of indoor pollutants. Taking a hot shower can even release low levels of radon and chloroform.

- **Ambient (outdoor) environment.** Several indoor pollutants, among them radon, some termiticides, and combustion products from automobiles, originate outdoors but can collect and concentrate indoors in residences, schools, and other buildings.

*Consult the box on "Indoor Air Highlights" for specifics about major indoor air pollutants, their sources and effects, and what steps you can take to deal with them.*

### How Big a Problem is Indoor Air Pollution?

Since people spend the greater part of their day—and their life—in various indoor environments, it is of compelling importance to seek accurate and early information about the extent to which people are exposed to indoor air pollutants, the health effects which those exposures may cause, and actions people can take to reduce their risk.




Most people spend about 90 percent of their time inside a home, school, office, car, or other closed structure. In these enclosed spaces, they may be exposed to hundreds of natural and man-made pollutants daily.

EPA has conducted a major study which has uncovered some surprising and sometimes disturbing facts about the size, scope, and sources of indoor air pollution. "TEAM," which stands for Total Exposure Assessment Methodology, is an investigation begun by EPA in 1979.

Several thousand randomly selected individuals were screened for age, sex, smoking habits, and occupations until a pool of 600 individuals was located in seven U.S. cities. Individuals selected for the study were then fitted with vest samplers that collected about 20 volatile organic pollutants, including benzene, chloroform, and other solvents, for later analysis in a laboratory.

Participants were asked to answer a questionnaire detailing their activities during the day. They also provided samples of their household water and allowed their breath to be analyzed for a large range of pollutants. In addition, some household backyards were equipped with fixed-site air monitors to compare measurements of personal exposure to those of ambient outdoor air.

Analysis of the exposure data indicated that personal exposure to many chemicals was usually greater, often much greater, than outdoor concentrations of the pollutants. For every one of the dozen or so prevalent chemicals, the mean personal exposures exceeded outdoor concentrations by 200 to 500 percent. This was true even in the two most concentrated chemical manufacturing and petroleum refining areas in the study: Bayonne-Elizabeth, New Jersey, and Los Angeles, California.

Results of the study clearly suggest the major sources of these chemicals are to be found either in the home or in personal activities.

Common activities such as smoking, driving, painting, pumping gas, using air fresheners and moth repellents, visiting a dry cleaner, and even taking hot showers can sometimes dramatically increase one's exposure to these chemicals.

The TEAM study continues, and has been expanded to cover about 40 pollutants, including carbon monoxide, pesticides, and particulates as well as some previously untested volatile organic chemicals. Early findings have been released to the public and Congressional officials.

The variety of chemicals and substances involved, coupled with variations in the levels of individual exposure to them, makes risk assessment a formidable task. Often there is more than one source for a given pollutant, or a variety of different pollutants from different sources can interact in the same indoor environment, with results that are difficult to predict. However, the Agency's Comparative Risk Project has estimated that the risks from indoor air pollution are among the top five environmental problems.

## EPA's Indoor Air Program

Steadily accumulating data about the importance of indoor air pollution convinced EPA of the need for an Indoor Air Program. At present, the Agency's program consists of a small, new, and intensely busy group of five people with an annual budget of $200,000.

Part of the Office of Air and Radiation's program development unit, EPA's indoor air group is charged with coordinating EPA's indoor air activities, assisting in setting research priorities, and carrying out the Agency's responsibilities for disseminating information about indoor air quality. They work in conjunction with the Office of Research and Development, which has a staff of 15 and a budget of approximately $3 million devoted to indoor air research.

The goal of EPA's Indoor Air Program is to provide information to homeowners, consumers, state and local governments, architects, building managers, and others so these groups can make informed choices about how they can reduce exposure to indoor air pollution.

Over the next year, in conjunction with organizations in the public and private sector, the program will:

- Develop a booklet for the general public about indoor air quality.
- Develop a technical manual about environmental tobacco smoke.
- Develop a technical manual about diagnosing, mitigating, and preventing building-related illnesses.
- Prepare a directory of state agencies involved in indoor air activities.
- Provide leadership for the Interagency Committee on Indoor Air Quality (CIAQ), the group that coordinates federal indoor air activities.
- Report to Congress by October 1988 about EPA's findings and recommendations concerning indoor air.

The Indoor Air Research Program has among its priorities the following:

- Developing more sophisticated and standardized methods for identifying the causes and remedies for indoor pollution.
- Conducting studies in test chambers and test houses to measure pollution from potential sources and the effectiveness of proposed mitigation techniques.
- Assessing the health effects of exposure to low levels of mixtures of volatile organic compounds and environmental tobacco smoke.

These formidable tasks came to EPA in 1986 as part of that year's Superfund amendments. These responsibilities are largely in addition to other specific indoor air pollution targets, such as radon, asbestos, formaldehyde, and pesticides.

The Agency's recently expressed policy on indoor air pollution calls for EPA to identify significant indoor air problems and, where appropriate, to carry out one or more of the following mitigation actions:

- Issue regulations under existing statutes including the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Safe Drinking Water Act.
- Implement non-regulatory programs such as technical assistance, training, and information dissemination aimed at building the capacity of state and local governments, the private sector, and members of the public to take appropriate actions.
- Refer problems to other federal agencies with relevant authority.
- Request separate indoor air regulatory authority from Congress if appropriate.

Asbestos and radon, two of the most frequently encountered indoor air pollutants with serious health ramifications, are the subject of major programs carried out by other offices at EPA. As a result of special funding from Congress, efforts to reduce exposure levels for both these indoor air contaminants are well advanced.

The future will undoubtedly bring other indoor pollutants into the spotlight as scientific knowledge and public awareness of the various aspects of this multi-faceted problem continue to grow. □

*(Brown is a Writer/Editor in the EPA Office of Public Affairs.)*

Non-smokers are exposed in some buildings to large quantities of environmental tobacco smoke, known as ETS.

## Indoor Air Highlights

There are many different sources of indoor air pollution, and many different ways of dealing with the problems they pose. In general, however, the primary mechanisms for improving indoor air quality entail eliminating, reducing, or sealing sources of pollution.

When a home or other building has a low rate of ventilation to start with, the use of a mechanical heat recovery ventilation system (also called an air-to-air heat exchanger) can be quite effective in reducing the concentration of multiple pollutants without substantially increasing energy costs.

Air cleaners such as high-efficiency particulate filters, negative ion generators, and electrostatic precipitators—used separately or in series—can be effective in reducing particulates. Care should be taken, however, to select air cleaners which will provide adequate air flow and can be easily maintained. Many devices do not do an adequate job of removing particles, and only a few systems have been demonstrated effective against gaseous pollutants.

**Environmental Tobacco Smoke**

*Sources*: Cigarettes, cigars, pipes.

*Effects*: Numerous—because of the wide variety of harmful chemicals in the smoke—including eye, throat, and lung irritation; increased long-term risks of lung cancer, emphysema, and cardiovascular disease by "passive smokers."

*Steps You Can Take*: Quit/prohibit smoking or limit indoor smoking to one area that is directly vented to the outdoors.

NOTE: Tobacco smoke also contains volatile organic compounds (including benzene and formaldehyde); combustion gases; and particulates. For details about these indoor air pollutants, see below.

**Combustion Sources**

*Pollutants/Sources:* Carbon monoxide, nitrogen dioxide, and particulates from gas stoves, kerosene heaters, woodstoves, malfunctioning furnaces, car exhausts (via building ventilation systems, loading docks, and garages adjoining residences and offices).

*Effects:* Carbon monoxide: Headache, dizziness, nausea, and death at very high concentration. Nitrogen dioxide: Throat, lung, and eye irritation. Particulates: Eye, nose, and throat irritation, bronchitis, emphysema, lung cancer, heart disease.

*Steps You Can Take:* Install an exhaust fan vented to the outdoors above your gas range. Increase ventilation to the local area where woodstoves and kerosene heaters are used. Follow manufacturers' directions and use proper fuel in space heaters.

**Materials and Furnishings**

*Sources:* Asbestos in insulation, ceiling surfaces, etc.; formaldehyde in plywood and particleboard (also present in tobacco smoke); other volatile organic compounds in a wide range of building materials including caulking and adhesives.

*Effects:* Asbestos: Lung, chest, and abdominal cancer, plus scarring of the lungs. Formaldehyde: Breathing difficulty, eye and skin irritation, nausea, dizziness. Volatile organic compounds: Breathing difficulty, eye and skin irritation, nausea, dizziness, increased risk of serious lung disease.

*Steps You Can Take: Asbestos:* Call EPA's TSCA (Toxic Substances Control Act) hotline at 1-202-554-1404. You'll be sent a free packet including an asbestos fact sheet, a booklet, and report offering "Guidance for Controlling Asbestos-Containing Materials in Buildings." It is important to remember a few basic principles: Do not remove or disturb asbestos-containing material that is in good condition. When such materials are frayed or in poor condition, call in a professionally trained contractor to handle the problem. *Formaldehyde:* Purchase materials labelled "low-emitting formaldehyde." Coat pressed-wood surfaces to reduce emission of formaldehyde. Follow manufacturers' directions and ventilate before and after use of materials containing volatile organic compounds.

**Biological Contaminants**

*Sources:* Air conditioning systems, humidifiers, cooling towers, household pets.

*Effects:* Pneumonia-like respiratory infections, allergic reactions.

*Steps You Can Take:* To avoid harboring and distributing biological microorganisms, clean air-conditioning systems and empty humidifier water trays frequently. Keep surfaces clean and dusted.

**Human Activities**

*Sources:* Hazardous substances in pesticides, paints, solvents, cleaning agents, polishes, air fresheners, toilet deodorants, copying machines, hot water, textiles, the dry-cleaning process.

*Effects:* Breathing difficulty, eye and skin irritation, nausea, dizziness, increased risk of serious lung disease.

*Steps You Can Take:* In the home, use integrated pest management techniques instead of chemical pesticides. Use consumer products according to the manufacturers' directions and ventilate during and after use. Remove unused spray cans, paints, etc. Store remaining cans in garage or room vented to outside. Use a fan vented to the outdoors when you take showers to reduce exposure to organics released from hot water.

**Ambient (Outdoor) Environment**

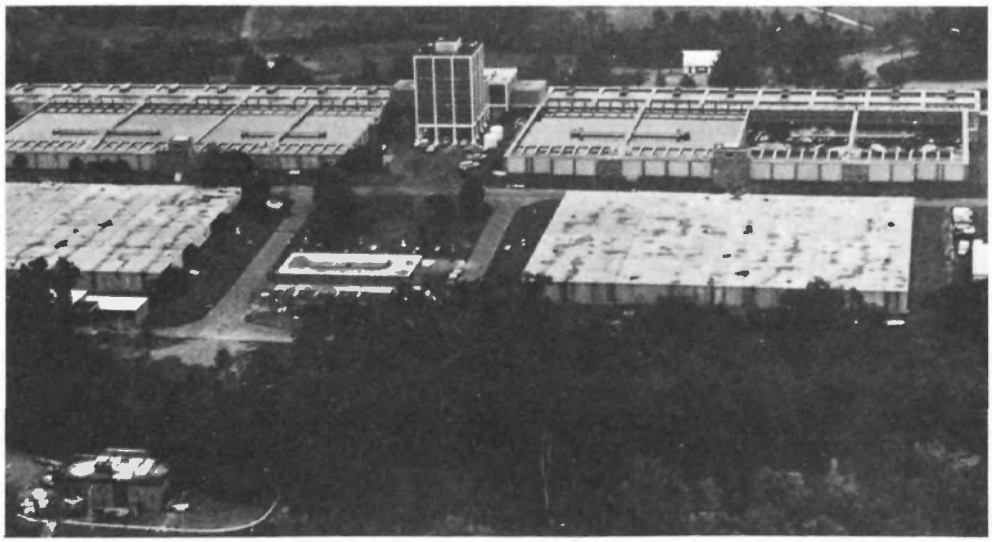
*Sources:* Contaminants such as radon and termiticides that originate outdoors in the soil but collect, penetrate cracks in structures, and concentrate indoors.

*Effects:* Increased risk of cancer.

*Steps You Can Take:* Have your home inspected and modified, if necessary, by a qualified contractor. *Radon:* Test your home for radon. EPA conducts a Radon Measurement Proficiency Program. This voluntary program allows laboratories and businesses engaged in radon detection to demonstrate their capabilities. The names of firms participating in this program can be obtained from your state radiation program or from your EPA regional office. *Termiticides:* Testing for pesticides is expensive and is recommended only if you suspect that high levels may be present. To locate a commercial laboratory qualified to test your indoor air for traces of termiticides, call the National Pesticide Telecommunications Network (NPTN) at 1-800-858-7378. You may also want to contact EPA's Public Information Center for additional information about radon and termiticides: 1-202-475-7751.

# Water Treatment to Combat Illness

by Dave Ryan



Washington Suburban Sanitary Commission

Aerial view of drinking water filtration plant near Washington, D.C. Most United States surface water supply systems are disinfected, but many are not filtered.

Our drinking water...we never think twice about it. When we fill our glasses from the tap or drink water from a glass set before us in a restaurant, we drink with assurance that the water is safe and there is no cause for concern. And that's the way it should be.

But while it's true that we do have some of the safest drinking water in the world, it may come as a surprise to learn there are over 10,000 cases of waterborne illness a year in this country, costing us hundreds of millions a year in medical costs and job-time loss.

Some 3,000 supply systems using water sources from the surface of the earth still do not filter their water—about one-third of all treatment works using surface water. These unfiltered systems serve over 21 million Americans and include such major cities as New York, Boston, San Francisco, and Seattle. Some of these systems stringently protect their surface water and have very clean source waters. Others are more questionable.

Therefore, EPA has just proposed new rules for determining when filtration should be required and, if required, what criteria should be used for determining its effectiveness. This marks the final chapter in a remarkably successful public health effort that should further minimize water-caused intestinal diseases in the United States.

The proposal requires states to evaluate the 3,000 surface water systems to see if they need to install filtration. EPA expects that up to 75 percent of these utilities will either have to start filtering their water, or switch to an alternative source of water. (This may involve using ground water or purchasing water from another supply system.)

Besides the requirement for filtration, which is basically the process of removing particles of solid matter from water, usually by passing the latter through sand or other porous material, the proposal requires water systems to disinfect and to meet criteria which assure effective control of pathogenic (disease-causing) organisms.

Disinfection is a chemical or physical process that kills pathogens in water. Disinfection methods include the use of chemicals such as chlorine or ozone. (Ironically, though ozone may contribute to air pollution, it's an effective chemical for killing germs in water.)

About 97 percent of U.S. surface water supply systems already disinfect. (Most facilities use chlorination.) EPA expects that under the proposal, very few systems will have to begin disinfecting for the first time, but some might have to upgrade already-existing disinfection processes.

It's important to note that filtration and disinfection must be used together for maximum protection of public health. Neither process is fully effective by itself. Filtration eliminates large-sized microorganisms, which may be resistant to disinfection, and solid particles that can interfere with chlorination. Chlorine can kill microorganisms which filtration may not remove.

Filtration is nothing new. Even the ancients had some understanding of rudimentary water treatment; historical records show that they improved water quality by storage and by boiling and filtering.

A Sanskrit manuscript from 2000 B.C. gives evidence that people in India used boiling, pots of porous clay, and wick siphons to filter cloudy water. (A wick siphon is a cord or strand of loosely woven, twisted, or braided fibers that water is sucked through for cleansing.) *The Sus'ruta Samhita*, a body of Indian medical lore also dating from 2000 B.C., declares: "Impure water should be purified by being boiled over a fire, or being heated in the sun, or by dipping a heated iron into it, or it may be purified by filtration through sand and coarse gravel and then allowed to cool."

Similar techniques were used by the Egyptians as early as 1500 B.C. In the fourth century before Christ, Hippocrates, the Greek "Father of Medicine," advocated the boiling and straining of rainwater before drinking. In the oriental world the ancient Chinese cleared up water with alum, an aluminum salt commonly used today for chemical pretreatment prior to filtration.

Water supply engineering among the ancients reached its apogee under the Romans, who transported fresh water over long distances by aqueducts, but was largely neglected in the Middle Ages.

In 1742, while visiting Paris, a Frenchman named Joseph Amy drank water from the Seine River that had stood in jugs made from baked clay. He suffered no ill effects. Returning to Paris

years later, he drank Seine water that had been stored in copper containers. This time, however, he got symptoms of poisoning and suffered a long illness. He concluded that it was not Seine water, but the green or bluish deposits of copper carbonate on the drinking vessels that made strangers in Paris sick. He replaced the copper container with a wooden boxlike contraption for purifying water. Because of his pioneering work, Amy was granted by France the first water filter patent ever issued anywhere. He also published the first book on filters ever to appear in the world, and founded the first filter factory.

Early in the 19th century, people became increasingly concerned about the pollution of water supplies. They started recognizing that specific diseases could be transmitted by water, and realized the need for bacteriological examination of water. The honors for much of the pioneer work in mass filtration go to England and Scotland. The first filter used to treat water supplied to a whole town was completed by John Gibb at Paisley, Scotland, in 1804; but, unlike today, water had to be carted to consumers' homes. A mere three years later, however, filtered water was being piped directly to consumers in Glasgow. The companies that built these two systems constructed a half dozen filter plants within the next 20 years, but, surprisingly, none was a success.

Water filtration started on a truly large scale in 1829, when James Simpson, an engineer of the Chelsea and Lambeth water companies of London, introduced a "slow" sand process. In this type of filtration, basically the same process still being used today, solid matter is removed from water by passing it through porous material such as sand. A filter normally consists of a bed of sand or crushed coal (from 20 to 40 inches thick), supported on a bed of gravel or some coarse porous material, and contained in a basin with various operating accessories.

The two basic filtration processess in use today are "slow" sand and "rapid" sand. They are basically similar. The difference between the two is, as the names imply, how fast the water passes through.

"Slow" sand is a much simpler process, where you don't have to pretreat the water with chemicals before filtration. However, it can only be used in waters with small amounts of particles. With "rapid" sand, you have to pretreat before filtration; the level of pretreatment depends on how dirty the source water is.

***EPA estimates that the cost of a single* Giardia *outbreak can range from $23 million to $55 million dollars.***

Also with "rapid," you don't need as much land area for the treatment works, so it's more appropriate for cities. "Slow" needs more space for treatment, so it's better for rural areas. Not surprisingly, considering we're an urban nation, 90 percent of all U.S. systems are "rapid" sand.

In the 1850s in London, what has come to be called the Broad Street Pump Incident gave credibility to the notion of linkage between contaminated drinking water and disease outbreak. In this case, considered by some to be the birth of epidemiology, people living near a local brewery were getting cholera at an alarming rate, while those working in the brewery seemed immune to the disease.

A local physician, Dr. John Snow, noticed that those working in the brewery were using their own water supply rather than drinking from the pump used by citizens living around the brewery. Snow believed the pump was being contaminated by human waste. He decided on a very practical application of his theory of a working connection between environmental factors and health effects: he simply removed the pump handle. As a result, cholera in the neighborhood was eradicated. In 1855, the filtration of all river-source water supplies of London was made compulsory.

The wisdom of mass filtration was further confirmed in 1892 when Dr. Robert Koch traced a cholera epidemic in Hamburg, Germany, to its unfiltered raw water supply. He did this by observing that a town called Altona on the opposite bank of the Elbe River from Hamburg, used the same river water but filtered it, and therefore had no disease.

Filters were not introduced in the United States until about 1870 and were of the "slow" sand type; the first "rapid" sand filtration plant was built in 1902 at Little Falls, NJ, and is still in use today.

Disinfection, or germ-killing, has been practiced for millennia, with people using heat, copper, silver, chlorine, ozone, and ultraviolet rays to kill microorganisms. For instance, boiling has been employed since the beginning of civilization to disinfect. Aristotle is said to have advised Alexander the Great: "Do not let your men drink out of stagnant pools. Athenians, city-born, know no better. And when you carry water on the desert marches it should first be boiled to prevent its getting sour."

However, nothing in the field of water disinfection came into use as rapidly and as widely as chlorination.

Chlorine was first used in a crude way to disinfect water supplies in England in 1897. Then, in 1909, liquid chlorine was developed for disinfection. Subsequent development of equipment for its automatic application has made this procedure standard practice in most modern treatment processes, and has drastically reduced waterborne disease throughout the world.

Chlorine now is normally applied both before and after filtration. Pre-chlorination controls the growth of algae, reduces biological growth in filters, and contributes to improved filter efficiency. Post-chlorination appreciably reduces the number of most types of bacteria and viruses entering the distribution system.

In this century, the ability of disinfection and filtration to remove bacteria from drinking water was demonstrated by the virtual elimination of waterborne typhoid fever and cholera in the United States. For example, the typhoid fever death rate in Pittsburgh dropped precipitously in 1907 when a waste treatment plant went into operation. In addition, these cleansing processes have brought under control such debilitating diseases as amoebic dysentery, shigellosis, and salmonellosis.

In less developed nations, disinfection and filtration are not widely practiced, and diarrhea resulting from waterborne microorganisms in both drinking and bathing water remains one of the biggest causes of death for infants and small children. It has been estimated that 25,000 such deaths occur each day in these countries.

"Throughout this century, remarkable strides have been made in the United States in protecting people from dangerous waterborne pathogens," comments Lawrence J. Jensen, EPA's Assistant Administrator for Water, "but we still see outbreaks of giardiasis and virus-caused illnesses. These cases occur in situations where inadequate

treatment is in place or a problem has occurred in the distribution system."

In a dramatic move to minimize these drinking water problems in America, EPA last October began writing a new chapter in the history of water quality by announcing a proposal to further reduce the risk of waterborne illness. Specifically, the regulations consist of two separate proposals that expand regulatory control over microbiological contaminants.

One proposal consists of surface-water treatment criteria. These apply strictly to public treatment systems that draw water from sources that are exposed to the atmosphere. The proposal requires all surface-water systems to provide disinfection; they will also be required to filter unless they can meet specific conditions.

The filtration requirement will require greater adjustments than the disinfection requirement. At present, about 97 percent of all surface-water systems already disinfect; only about two-thirds filter. The proposed rules contain criteria for states to use in determining which water systems will have to install filtration, or upgrade existing filtration facilities.

The rule calls for increased protection against waterborne sources of disease such as *Giardia*, viruses, heterotrophic bacteria, turbidity, and *Legionella* bacteria.

*Giardia* are protozoa in human and animal waste that cause giardiasis, also known in popular parlance as "Backpacker's Disease." Giardiasis usually involves diarrhea, nausea, and dehydration that can be severe and last for months. There have been over 20,000 water-related cases reported in the last 20 years. EPA's new rules require 99.9 percent removal or inactivation of *Giardia* cysts. ("Inactivation" means making the virus unable to function.)

Viruses are sub-microscopic organisms that cause infection. Common waterborne diseases caused by viruses include hepatitis and gastroenteritis. The new rules require water systems to achieve 99.99 percent removal/inactivation of intestinal viruses.

Turbidity is a measure of the cloudiness or clarity of the water, and can indicate the presence of harmful microorganisms. Heterotrophic bacteria are indicators of water quality and can include disease-causing bacteria. *Legionella* bacteria can cause Legionnaire's Disease.

The other rule relates to coliform bacteria, and pertains both to surface- and ground-water systems. Coliform bacteria often come from human and animal waste, but are also common in the environment. Generally coliforms are not harmful themselves, but their presence indicates that water may be contaminated with disease-causing organisms.

Both the surface water and coliform proposals require all water systems to be operated by qualified operators, as determined by the state. In addition, operators of local water systems must report to their state government every month on their progress in meeting the federal rules.

As a result of these proposals, and later disinfection requirements for ground water, EPA expects cases of waterborne disease to drop by many thousands every year.

Nationally, the surface-water treatment rules are expected to cost water systems currently without filtration about $1.6 billion in capital costs and $225 million in annual costs. Systems that already have filtration but need to upgrade it to meet the new federal requirements are expected to pay about $333 million in capital costs and $95 million annually. These national costs translate into monthly water bill increases of about $4.00 for citizens served by large water systems (greater than 10,000 people served), and about $17 to $32 for consumers served by small systems (less than 500 served).

But these costs must be seen in light of the proposal's economic benefits. Based on a study of a 1983 *Giardia* incident near Wilkes-Barre, PA, EPA estimates that the cost of a single *Giardia* outbreak, for a system serving over 10,000 people, can range from $23 million to $55 million. These estimates are probably low since they don't include costs for litigation and for intangibles such as pain and suffering.

In conclusion, EPA sees the filtration and disinfection proposal as the beginning of an important new chapter in the history of water purification that will culminate when all Americans can drink from any public water supply with confidence in its safety. □

*(Ryan is a press officer in the EPA Office of Public Affairs.)*

Washington Suburban Sanitary Commission

Drinking water is checked by a chemist at a Washington Suburban Sanitary Commission laboratory in Laurel, Maryland. Two methods used in preparing drinking water are filtration, which removes particles of solid matter, and disinfection, a chemical or physical process to kill pathogens in water.

# Ten Years Later: Clean Soil Covers Maine Waste Site

by Greg Supernovich

What a difference a decade makes. Ten years ago local officials discovered a small hazardous waste site in Gray, Maine, that EPA later listed as one of the worst toxic sites in the United States.

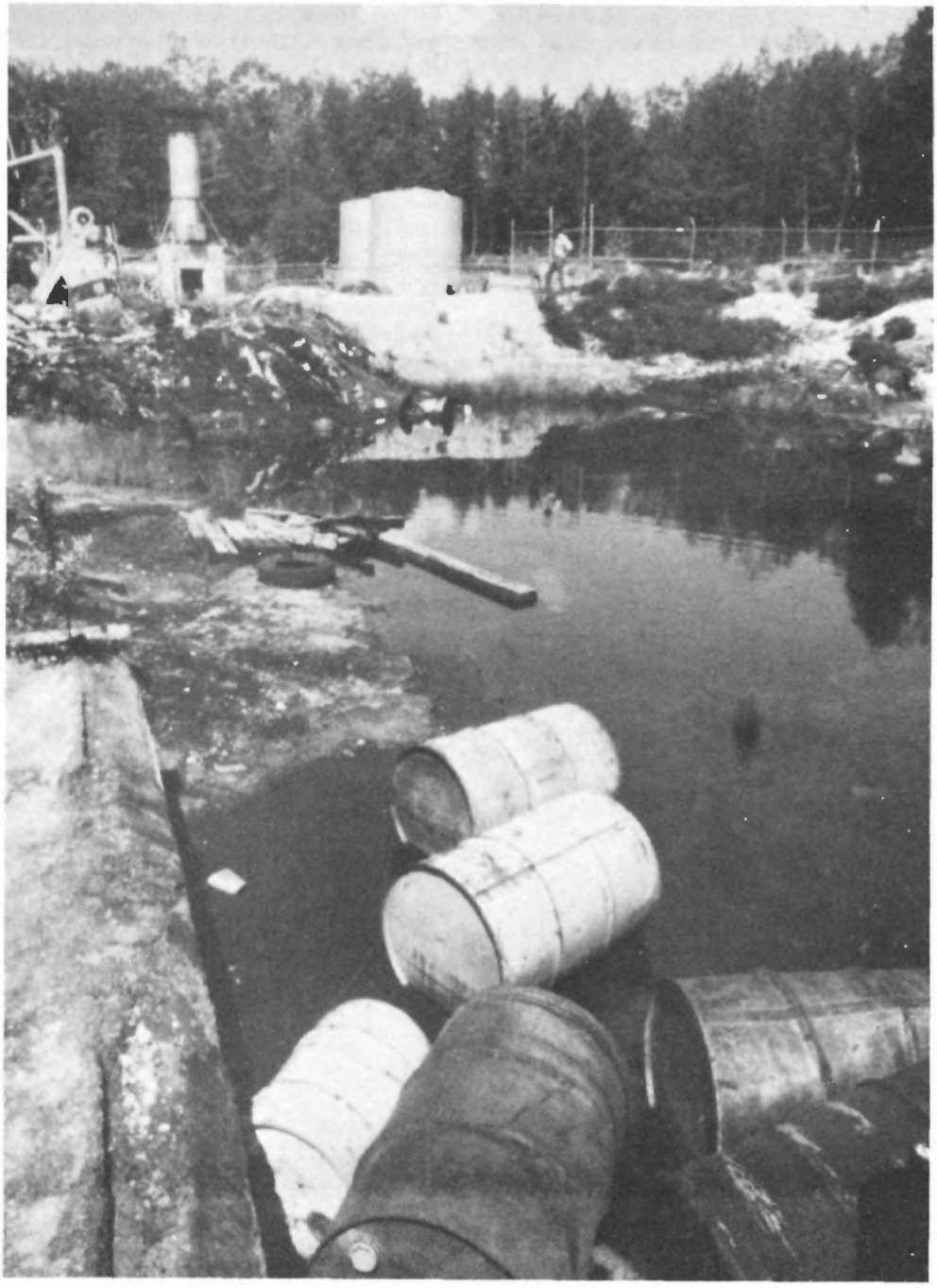
Today the McKin Superfund site is hailed as one of the most successful cleanups in New England and the nation. During a recent media event at the site, town, state, and federal officials, political leaders, and citizens gathered to celebrate.

Everyone remembered the site as it was 10 years ago: an old gravel pit, an unlined lagoon filled with liquid wastes and oily debris, a makeshift incinerator, more than 20 large storage tanks (some of them leaking) sitting on the ground, hundreds of 55-gallon drums, and unburied sludge. They also recalled a decade of studies, frustrations, fears, hopes, and cleanup efforts. Most of all, they celebrated what, working together, they had achieved. They had drained the lagoon, removed the drums and tanks, and dismantled the incinerator. They had used an innovative soil technology on-site to dig up and treat approximately 12,000 cubic yards of contaminated soil—roughly enough soil

Maine Department of Environmental Protection

After. By September 1987, a freshly planted meadow grew where the dump site had been. Next comes the cleanup of contaminated ground water. A utility pole remains on site to provide power for the ground-water remediation system.

Before. Gray, Maine, residents had long been concerned about the McKin Site. When this picture was taken in September 1982, there were 20 empty storage tanks, an unlined lagoon filled with oily debris and liquid wastes, plus these drums.



Maine Department of Environmental Protection

to cover a football field 10 feet deep. Now they stood on a freshly planted meadow once covered by toxic wastes. And they knew that the cleanup of the contaminated ground water would soon begin.

"Citizens were able to participate," said Cathy Hinds, a former resident of the semi-rural neighborhood that surrounds the McKin site. "We had scientists review the cleanup. A lot of changes were made. We had something to celebrate. When you've been involved so long—no matter how small the victory—you need to celebrate to recharge yourself."

"We have a piece of land that can be returned to beneficial use. We have clean soil in which children can safely play, and wildlife can feed. It is once again in the form it was before mankind messed it up," said Michael Deland, EPA's Administrator in Region 1.

Anyone seeing the McKin Superfund site for the first time in 1987 would find it difficult to imagine the toxic brew of wastes that once existed at the site, or the human tragedy that is part of its history. In 1977, officials first became aware that Richard Dingwell's small waste collection business had indiscriminately and randomly stored, burned, and dumped hundreds of thousands of gallons of hazardous waste oils, chemicals, and sludge on the seven-acre site.

Nearby neighbors complained of headaches, loss of balance, dizziness, difficulty concentrating, rashes after showering, and a burning sensation in the eyes. These symptoms led them to seek the initial water tests that eventually prompted officials to inspect the McKin hazardous waste site. The inspection showed that the wastes had contaminated massive areas of sand and gravel and had tainted 16 private drinking water wells, which officials capped.

Residents of Gray, a town of 5,000 people approximately 12 miles from Portland, were shocked. The town temporarily halted construction of new homes within a two-mile radius of the site. State officials groped for the money, the expertise, and the authority to clean up the site.

Hazardous waste was an unknown danger in 1977. Maine had no laws governing it. The United States had not yet enacted a national Superfund program to clena up toxic wastes. And engineers had not developed the technology to solve the hazardous waste problem.

Meanwhile, people like Cathy Hinds and her family had been drinking and bathing in water containing toxic poisons. They had been breathing toxic vapors. Some children had been playing in toxic soils. The residents feared that their exposure to the wastes would harm their health and might even kill them and their children.

It was a typically cold Maine winter 10 years ago when Hinds and her neighbor drove daily to the town office of Gray to fill empty milk jugs with water from an outside spigot. Their own private wells had been polluted by contaminants from the McKin site.

As the two women filled their bottles, the near-freezing water from the faucet spilled onto their hands. They hurried

back to the car with their water and warmed their cold hands over the defroster. They looked at each other and cried. The task seemed overwhelmingly difficult. They had no energy left for simple chores. They were consumed with the fear that their children were going to die from having drunk contaminated well water for several years. Later that winter the town began trucking in emergency water supplies to McKin residents. Subsequently the town installed a new water main to the area.

Hinds' family had moved near the McKin site in 1975. Soon after she and her family began suffering severe headaches, temporary blindness, rashes, respiratory problems, and even paralysis. "My daughter would sit on a chair at the table and lose her balance and fall off the chair. She'd walk into a wall like she was drunk. I was afraid my children were going to die. I didn't know if these things would get better or not. We went to doctors and they didn't know what was wrong," she said. In 1977, Hinds suffered a miscarriage. In 1978, her prematurely born, two-day-old son died.

According to Hinds, about eight families including her own who lived near the McKin site filed a lawsuit in the late 1970s against approximately a dozen companies allegedly responsible for the McKin contamination. The lawsuit was settled out of court in 1984. But she noted she could not reveal the nature of the settlement because nondisclosure was part of the agreement.

Currently, the Environmental Health Unit of Maine's Department of Environmental Protection (DEP) is analyzing potential links between the contaminated well water and health problems of 128 McKin neighbors, compared to a "control group" of 260 residents from other parts of Gray. Researchers collected data for analysis by questioning participants about a specific list of health problems, then confirming whether reported problems appeared in the respondents' medical records.

Steve Serian, EPA's remedial project manager for the site, said the health of the McKin neighbors was foremost in his mind. "It was tragic that local residents drank and bathed in the contaminated water and didn't even know it. The human side really affected me. It gave me the added motivation to carry out EPA's mission. I wanted the job done right, and openly and fairly," he said.

EPA

Contaminated soil was treated in the on-site aeration plant. David Webster, EPA environmental scientist, inspected progress regularly. The "smoke" is just steam which was generated on cold days.

Yet there were certainly times that citizens were unhappy with the government's performance at McKin.

"At the public hearings, the people expressed a high emotional level after dealing with government without tangible results. They would say, 'All you do is study, study, study. When will you bring out a spade and clean up?' It was frustrating for me too," said Hank Aho, the site project manager at McKin for the DEP.

But Aho also understood that there weren't any government mechanisms in place to deal with hazardous waste in the late 1970s. And he knew that McKin was one of the first waste sites to be examined. Therefore a thorough study was a necessary prerequisite to any action.

The McKin site had been used as a collection and transfer station for waste oil and other industrial wastes, handling between 100,000 and 200,000 gallons annually from 1972 to 1977. Several areas within the site were contaminated with oily debris, cleaning and degreasing solvents, and other chemicals. In some places, the contaminants seeped into the earth 40 feet to ground water.

The cleanup at the McKin site was a gradual, step-by-step process. In 1979, the DEP removed more than 30,000 gallons of liquid waste from the storage tanks. In 1980, the U.S. Congress passed Superfund. In 1982, EPA ranked McKin as one of the worst sites in the nation

on its national priorities list. In 1983, EPA and DEP supervised the removal of the storage tanks, 10,000 gallons of waste liquids, and 68 drums of sludge. "Taking the first tank off—that was a good moment. The wheels had begun to turn. We were out of the planning and study process, and we were actually doing something," Aho said. Officials completed soil treatment in 1987.

One of the most successful projects at McKin was the soil treatment. Under EPA and DEP supervision, Canonie Environmental Services Corporation of Indiana dug up and treated more than 12,000 cubic yards of contaminated soil. Workers handling the soil wore breathing masks and protective overalls. The company used bulldozers and a boring tool attached to a crane to excavate the soil. It employed a technology to treat the soil known as soil aeration, a process that involves some of the same equipment found in portable asphalt batch plants.

The temporary aeration plant was installed right on the McKin site. Workers placed the contaminated soil onto an enclosed conveyor belt leading into the large aeration plant. The soil entered the dryer unit of the plant, where it was heated to 300 degrees Fahrenheit. It was mixed and aerated to allow the volatile contaminants to evaporate. The gases were then driven off and treated in a series of air pollution control devices.

After lab analysis verified that the contaminated soil had been adequately treated, it was returned to the McKin site. The soils removed by the boring tool were stabilized with cement and then reburied. The cement prevented the soil from collapsing when adjacent soil was excavated. The soil project took a year to complete.

"Our search for technology paid off. We found a way to clean up the soil on-site without having to truck it someplace else, thereby creating a potential problem for somebody else," Deland said.

Many new technologies, including soil aeration, soil incineration, and vacuum extraction are now available to treat contaminated soil at Superfund sites. When Congress reauthorized Superfund at a level of $8.5 billion last year, it asked EPA to find more permanent on-site remedies that do not threaten human health or the environment. As Deland pointed out, "now that we have demonstrated that the cleanup can be done, future cleanups will be easier because we're beginning to master the intricacies of an enormously complex problem and are steadfastly developing new technologies."

Serian said overseeing the soil aeration project at McKin was a monumental task sometimes comparable to riding a roller coaster. "The potentially responsible parties needed a quick turnaround to minimize costs. We needed to approve actions based on public health criteria, treatment effectiveness, and quality assurance. We made decisions daily," he said.

***Anyone seeing the McKin Superfund site for the first time in 1987 would find it difficult to imagine the toxic brew of wastes that once existed at the site.***

Patty D'Andrea, EPA coordinator for Superfund Community Relations, said the most crucial job for her in the McKin site cleanup was to encourage EPA to keep the public informed, and to urge citizens and town, state, and federal officials to work together.

"You can never give people too much information. The more information you give them, the more they feel comfortable. If you keep them in the dark, they get suspicious," she said.

D'Andrea said people were initially afraid of the air emissions during soil aeration. However, EPA allayed those fears by monitoring emissions in people's driveways. To address other areas of public concern, EPA set up a hotline at Gray's Town Hall with weekly updates on action at McKin, set up an observation tower at the site for the public, held public meetings, provided fact sheets, and kept the media informed.

The McKin site has left lasting scars and has caused dramatic changes for Cathy Hinds. She has become actively involved in toxics issues and is now the New England organizer for the National Campaign Against Toxic Hazards. She said the hazardous waste problem has resulted in a strong citizens' movement that is winning victories because citizens are persistent and putting pressure on elected officials.

"One of the most successful moments at McKin was when we found out that when citizens joined together they could get a response from officials. We used the press to make the site more inaccessible to kids. It felt good because we cared and banded together and were able to make something happen," Hinds said.

The human cost at the McKin site may never be measurable. The financial cost is. Thus far the cleanup has cost $6 million. Under a consent decree, the parties potentially responsible for the contamination of the site will pay this bill. They also provided engineering skills that contributed to the cleanup. Ground-water cleanup at McKin will begin by spring 1988. The settling parties will also reimburse the government for the cost of the operation and will operate the ground water remediation system until public health levels have been achieved.

Meanwhile, Gray officials have spent $350,000 to extend a water main to the McKin area, worked numerous hours coping with the problem, and have lost, at least temporarily, the use of one of their aquifers.

"Prevention is far cheaper than cleanup. If we are to prevent the need for future Superfunds, we must make two major societal changes. We must learn how to more efficiently destroy hazardous waste so we don't simply move it from one site to another. And we must dramatically reduce the volume of hazardous waste that we as a nation produce," Deland said.

The McKin site has changed the way Gray conducts its business. The town has passed zoning restrictions to protect aquifers, issued hazardous waste licenses, and implemented a recycling program for used oil. Town manager Janis McGrath said, "In the 1970s people didn't realize what they were doing at McKin. Now people in Gray realize you can't dump things into the ground and expect problems to just go away."

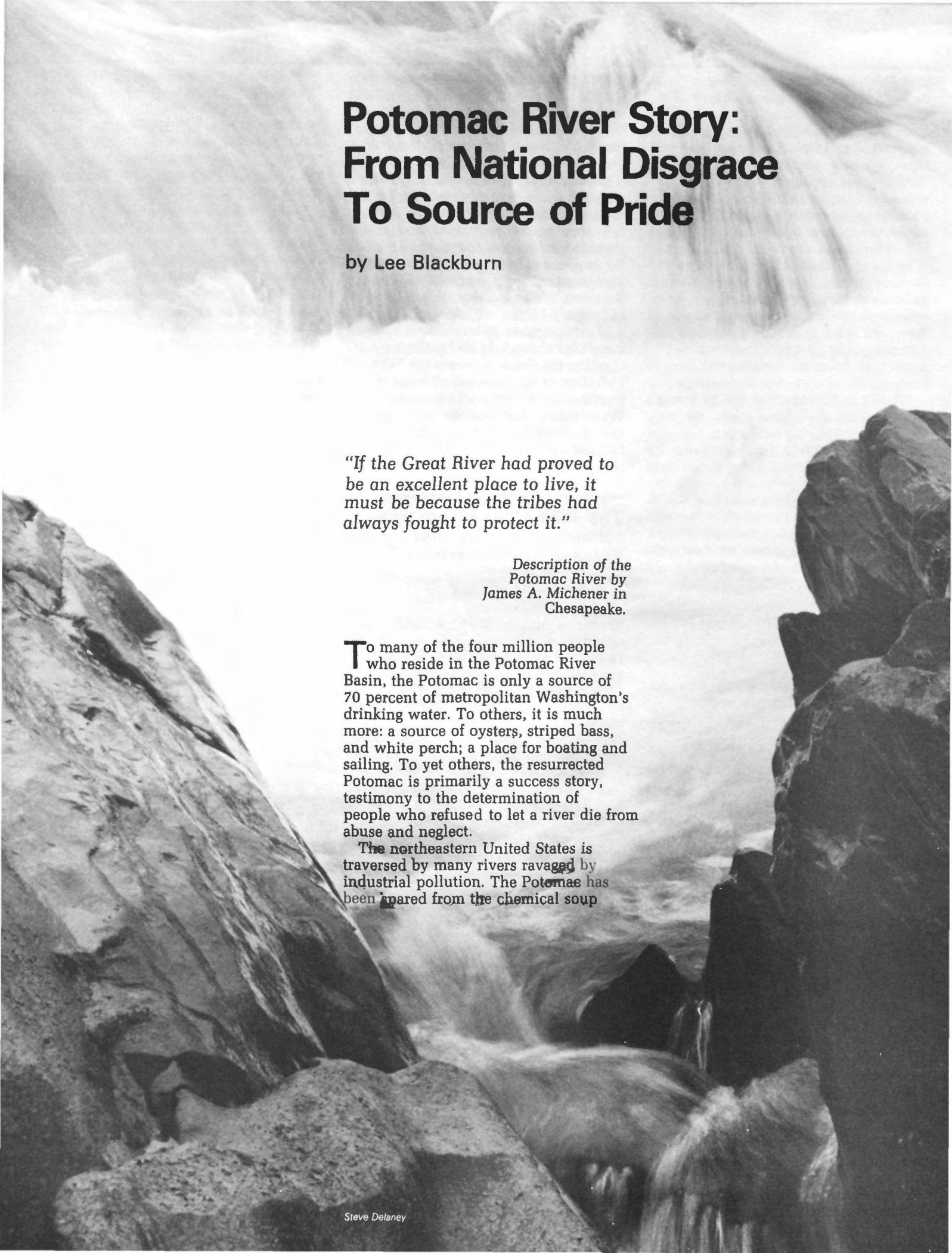
The McKin site is just one of thousands of cleanups expected to occur across the nation. But the people who cleaned up McKin will never forget this particular site. They fought to protect public health and the environment, and they succeeded.

"It was an exhilarating moment to see the site closed up, graded, loamed, and seeded. I was able to stand out there in my suit and Sunday shoes at the recent media event on what was once a hazardous waste site. All of us—local and state officials and the public—had come together to celebrate that the site was cleaned up," Serian said. □

*(Supernovich is a Writer/Editor in the EPA Region 1 Office of Public Affairs.)*

# Potomac River Story: From National Disgrace To Source of Pride

by Lee Blackburn



*"If the Great River had proved to be an excellent place to live, it must be because the tribes had always fought to protect it."*

*Description of the Potomac River by James A. Michener in* Chesapeake.

To many of the four million people who reside in the Potomac River Basin, the Potomac is only a source of 70 percent of metropolitan Washington's drinking water. To others, it is much more: a source of oysters, striped bass, and white perch; a place for boating and sailing. To yet others, the resurrected Potomac is primarily a success story, testimony to the determination of people who refused to let a river die from abuse and neglect.

The northeastern United States is traversed by many rivers ravaged by industrial pollution. The Potomac has been spared from the chemical soup

Steve Delaney

that has plagued many streams. Nonetheless, it has been endangered by man.

As the Potomac winds through mountains and farms, it is generally rural. When it reaches metropolitan Washington, millions of gallons of wastewater and run-off pour into it. More than a century's worth of untreated wastewater and run-off nearly killed this great river.

In the late 1950s, U.S. Public Health Service officials described the Potomac as "malodorous...with gas bubbles from sewage sludge over wide expanses of the river." Fish kills were commonplace. In 1965, President Lyndon B. Johnson declared the Potomac River a "national disgrace."

Were it not for the concern of federal, state, and local officials, who have parlayed over $1 billion into a successful effort to reduce discharge levels, the river would today be an open sewer.

To understand how a river like the Potomac could have come so close to death, and require such intense efforts to revive it, it is important to look at the history of man's involvement in the river's life.

In the 15th and 16th centuries, the Potomac River was home to many Indian tribes who fished for bass and perch and dove for oysters and crabs. The establishment of our national capital created a vast population center along the Potomac's banks and tributaries. By the latter half of the 19th century, urban sprawl characterized the capital area. At the turn of the century, the District and its suburbs teemed with people, and the waste they generated began to cause major disposal problems.

Little concern was given to the river. Sewage collection trenches grew into networks. Eventually, raw sewage emptied into the river. The 20th century saw pipes replacing trenches, but the end result was the same: the Potomac was an open cesspool. In the 1930s, sewage treatment operations were begun in many areas of the District, Maryland, and Virginia, but Potomac water quality grew worse.

To reverse the damage to this vital waterway, the Interstate Commission on the Potomac River Basin (ICPRB) was formed in 1940. Later, in the 1960s, the U.S. Department of the Interior's Federal Water Quality Administration (one of EPA's predecessors) and the states in the Basin began closer monitoring of the Potomac's problem. Their purpose was to find proper ways to control these problems and, where possible, eliminate them. Combined cooperation of all levels of government was crucial to the success of the Potomac cleanup.

In June 1967, the District of Columbia adopted water quality standards for its interstate waters. The standards took into account planned water uses, quality standards to protect them, and a plan for implementation and enforcement. The standards were approved by Secretary of the Interior Walter J. Hickel in January 1969.

When progress in implementing the standards slowed, Hickel pulled together the Conference on the Matter of Pollution of the Interstate Waters of the Potomac River and its Tributaries in the Washington Metropolitan Area (also called "Potomac Enforcement Conference") in April 1969.

***The 1983 algae bloom aside, all indications are that the Potomac is recovering nicely.***

Representing the water pollution control agencies of Maryland, Virginia, and the District of Columbia, the ICPRB, and the Federal Water Quality Administration, the Conference made recommendations to enhance water quality in the Potomac Basin.

Perhaps the most significant recommendation called for design and construction of advanced wastewater treatment plants. The District took the lead and proceeded to implement its plans for construction of a major facility at Blue Plains. On October 7, 1970, a Memorandum of Understanding was completed, clearing the way for the Blue Plains project to get underway. The Memorandum was directly responsible for the initiation of many other major wastewater treatment projects in the Potomac Basin.

Since municipal wastewater, rather than industrial or nonpoint source pollution, was primarily responsible for the Potomac's woes, improved treatment of wastewater was the key to the river's return to health. The District of Columbia metropolitan area, where 75 percent of the Potomac Basin's population lives, contributes 80 percent of the wastewater discharged, treated and untreated, into the Potomac.

Owned and operated by the District of Columbia and municipalities in Montgomery and Prince Georges Counties in Maryland, and Fairfax County in Virginia, Blue Plains is the largest municipal wastewater treatment facility in America. It is also one of the most technically advanced and effective.

The Clean Water Act of 1972 set effluent discharge standards, permitting requirements, and provided hundreds of millions of dollars' worth of federal aid for projects like Blue Plains. The $500 million in combined federal, state, and local funding is staggering, but the success of the Blue Plains project, more than anything else, is responsible for the return to health of the Potomac Basin.

By the 1980s, water quality in the Potomac had improved markedly. It seemed as if the Potomac's problems were over for good until 1983, with the occurrence of a massive, 20-mile-long bloom of *microsystis aeruginosa* algae. Massive, sudden algae blooms threaten marine life because algae robs the water of essential oxygen. In the past, it was believed that such blooms were caused by nutrients in municipal wastewater discharge. This time, however, official measurements indicated that effluent control programs were working. In 1983, nutrients were entering the river at the lowest rate since measurements began, certainly at too low a level to account for the algae bloom.

How could the observed high levels of phosphorus be accounted for? EPA concluded that the phosphorus was the result of a phenomenon originating in the sediment on the river's bottom. Numerous hypotheses were developed. The one that seemed most plausible relied on a new theory which held that algal absorption of carbon dioxide raised the water's pH to a point where phosphorus was released from the sediments and became an additional food supply for growing algae.

It was decided that the Potomac Eutrophication Model computer program (developed to estimate the effects on river aging of algae growth and dissolved oxygen from both point and nonpoint sources) could be

modified to examine the possibility of preventing future algae blooms by enhancing alkalinity. A study was begun, which is still in progress.

The 1983 algae bloom aside, all indications are that the Potomac is recovering nicely. In 1983, submerged aquatic vegetation returned to the Potomac, after several decades' absence. Aquatic vegetation thrives in clean water environments, and provides food, shelter, and a natural habitat for a variety of aquatic life.

According to the ICPRB, commercial and sport fishing has made a storybook comeback. ICPRB representatives interviewed fishing guides along the river, who described the great increase in fish populations. Guide Ken Wilson said, "Fishermen are surprised at the cleanliness of the river. The biggest expansion is in bass fishing. The South Branch is famous for large-mouth bass."

There has been an increase in other recreational activities along the Potomac's banks. Yearly festivals celebrate the river's abundance. Each year, the District of Columbia sponsors Riverfest; Alexandria also shows off its waterfront with a special festival. The Chesapeake and Ohio National Historical Park, America's second largest, welcomes thousands of visitors each year to special events like C & O Canal Days in August.

Riverfront communities have always felt a pride of ownership toward their waterways, because they are sources of water and life. That is no less true among the Potomac's neighbors today. Not only is the Potomac a source of pride; it is also a source of hope for the continued return to health of the Chesapeake Bay. The Potomac feeds the Bay, where waters have often been less than palatable.The problems that have plagued the area's rivers are magnified many times in the Bay.

The Chesapeake is still troubled, in spite of the Potomac cleanup. The Potomac success will be difficult to replicate in the Bay, but it is a start. Cutting off the sources of the Chesapeake's woes is a vital requirement for a return of the Bay to the conditions seen by the native Americans who plied its waters. Putting an end to the problems of municipal wastewater discharge is simply a matter of constructing modern, efficient treatment facilities and ensuring their maintenance and proper operation.

Nonpoint source pollution must also be controlled and that will be more difficult. The effects of nature and thousands of years of agricultural practice are not easy to counteract. There must continue to be efforts to encourage modern land management practices and alternatives to chemical fertilizers and insecticides throughout the Potomac Basin.

The magnitude of what has been done for the Potomac cannot be underplayed; it was, historically, one of the biggest contributors of Bay pollution. But similar success stories are being played out along many other tributaries. They too must continue. □

*(Blackburn is public affairs specialist, EPA Region 3, Office of Public Affairs. Senny Ponomarenko, intern and senior journalism major, Temple University, assisted with research.)*

Interstate Commission on the Potomac River Basin

A raft race on the Potomac below the Memorial Bridge, Washington, D.C.

# Particulates: Science Advances, Standards Change

by Henry Thomas

Earlier this year, EPA announced changes to its ambient air standards for particulate matter that have far-reaching implications. Particulate matter may pollute ambient air in the form of dust, soot, smoke, and other visible and invisible particles emitted by factories, power plants, construction activity, and other sources. Particulate matter also includes natural windblown dust and the particles formed in the atmosphere as the result of the transformation of gases such as sulfur dioxide and volatile organics.

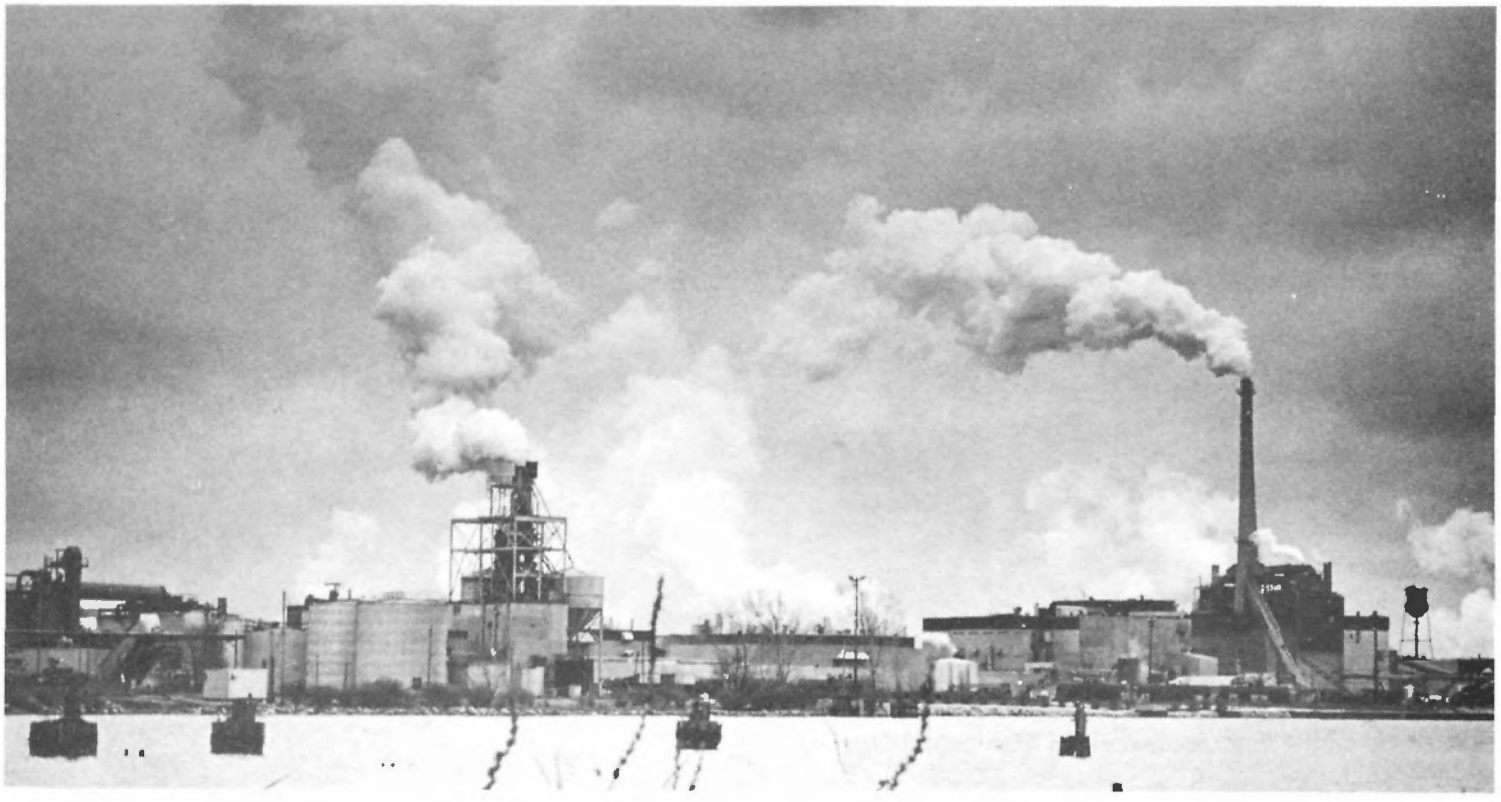
In the 1950s and 60s, many areas of this country suffered from high concentrations of particulate matter. In some urban areas, suspended particulate matter was a very visible problem. In addition, numerous studies had shown that these airborne particles were damaging to human health. The major health effects associated with high exposure to particulate matter include changes in lung function and increased respiratory symptoms, aggravation of existing respiratory and cardiovascular disease, alterations in the body's defense systems against foreign materials, damage to lung tissue, cancer, and, in extreme cases, premature death.

One of the very first actions which EPA took as a new Agency was to set national ambient air quality standards (NAAQS) for particulate matter: the Total Suspended Particulate Matter (TSP) standards established in 1971. In the years that followed, attaining the TSP standards was a major priority for the Agency's air program staff. EPA and state regulations resulted in major reductions of TSP. Between 1970 and 1984, inventoried emissions fell by 60 percent. With so much measurable success in the TSP program, why did the Agency recently find it necessary to rethink its national standards for particulate matter? The answer to this question illustrates the dynamic nature of challenges faced by a modern regulatory agency.

When it set the TSP standards in 1971, the technology used for measuring ambient particulate matter levels was something called the "high volume," or "hi-vol," sampler. The hi-vol sampler effectively measured all particles ranging in size up to 25 to 45 micrometers (um). (A micrometer is one millionth of a meter or 1/25,000 of an inch. By way of comparison, common bacteria are about 1-2 um in length, while human hair is 100-200 um thick.)

To meet the TSP standards set by EPA, state and federal controls were placed on a wide variety of industrial sources. In those early days, sources in many areas had been operating with little or no control. The focus of the early control programs was generally on basic industries, and the results were often dramatic. For example, particulate matter emissions from the iron and steel industry fell by some 85 percent from

Many air pollution sources are likely to come under new particulate matter standards recently issued by EPA. The picture below is of a paper mill—one source category being considered for such review.



Mike Brisson

1970 to 1985, and the emissions from coal-fired power plants dropped by almost 75 percent. These very dramatic emissions reductions led to marked improvements in air quality as well. The composite average of TSP levels measured at some 1,400 sites decreased by almost 25 percent from 1976 to 1985. At many sites the improvement was even more pronounced.

As a result of the combined efforts of EPA and the states, wide areas of the country now enjoy air quality levels better than those set out in the original TSP standards. Even in the approximately 97 counties which did not meet the health-based primary TSP standards earlier this year, air quality levels had registered considerable gains. All of this has meant a reduction in the health risks incurred by millions of Americans.

Nevertheless, in today's society, regulatory programs must be constantly reevaluated, in light of progress made in science and technology, to ensure that the goals which society wants to achieve are realized. The fundamental goal of the TSP program was to protect the public health and welfare from particulate matter pollution. The original 1971 NAAQS for TSP were based on data analyzed in a 1969 "criteria document," which summarized and assessed the data then available on the health and welfare effects of particulate matter. Much of this data came from epidemiological studies dating back to the 1950s. Scientific research and study, of course, did not stop when the standards were set. During the period when EPA and the states were making such progress at reducing particulate matter emissions, progress of a different sort was being made in our understanding of the health and welfare effects of those emissions.

In particular, the relationship between particle size and health effects was an area where the Agency's understanding progressed significantly since 1971. The original standards treated all particles the same, regardless of their size or chemical composition. Given the monitoring capability and information available in the early 1970s, this represented a sound public health policy, and indeed the implementation of the TSP standards reduced health risks. More recent work on particles, however, has enabled a more refined approach. Some experts called for the use of chemical-specific indicators of particulate matter (e.g., sulfates), while others suggested that size-specific indicators ought to be used. The arguments for a size-specific indicator rested on studies showing that the smaller particles penetrated more deeply into the human respiratory tract and were therefore more likely to pose a health risk. In fact, occupational standards had for some time recognized the importance of particle size.

In addition, since the early 1970s, new epidemiological studies had been initiated, and the data used in some of the older studies had been reanalyzed. In 1976, as a result of an internal Agency review and the recommendations of the Agency's Science Advisory Board, EPA decided to revise the existing health and welfare criteria document prepared in 1969 by EPA's predecessor in air pollution control, the Department of Health, Education, and Welfare. Since some important research was still in progress and since other pollutants were then deemed a higher priority, the review process was scheduled to begin in 1979. Once it began, the review involved a fundamental reappraisal of the particulate matter NAAQS. In the process, EPA provided numerous opportunities for review and comment by the scientific community, industry, and the general public.

Although there was general agreement that a particle size indicator ought to be used in place of the TSP indicator, agreement on the specific size cut to be used, and on almost all other aspects of the NAAQS, came slowly. Agency staff, the public, and the policymakers had to come to grips with a scientific data base that was inconclusive on some key questions. In many cases the data provided no evidence of a clearly defined threshold, but suggested instead the possibility of a continuum. Many of the epidemiological studies used measures of particulate matter that did not correspond to any of the particle size indicators being considered. Compounding these problems was the fact that the chemical makeup of ambient particulate matter in the United States today is not the same as it was when the studies were done (the difference being due to the change in the mix of sources from the 1950s to the present).

***PM10 will focus control efforts on the smaller particles which can reach the thoracic or lower regions of the respiratory tract.***

In sum, the new NAAQS for particulate matter was one of the most difficult decisions which the Agency has confronted. In his March 1984 proposal to revise the standards, the Administrator chose to propose ranges rather than specific values. This was done to illustrate and highlight the difficulties in selecting the present standard. Following the proposal, the Agency decided in 1985 to further update its criteria document in order to take account of certain new studies that had emerged since the criteria document was finished in 1982.

On July 1, 1987, EPA announced its final decisions regarding the particulate matter NAAQS. The old TSP indicator was replaced by a new indicator that includes only those particles that are 10 um or smaller. The new indicator for airborne particulate matter has been dubbed "PM10." PM10 will focus control efforts on the smaller particles which can reach the thoracic or lower regions of the respiratory tract—the particles which are likely to be responsible for most of the adverse health effects. The new 24-hour primary (or health-based) standard limits PM10 to 150 micrograms per cubic meter ($ug/m^3$) of air. In addition, a new long-term primary standard limits annual averages of PM10 to 50 $ug/m^3$. New secondary (or welfare-based) standards were set equal to the primary standards and are meant to protect the public from adverse soiling and nuisance effects.

These new standards will necessarily lead to a thorough reappraisal of current air quality and particulate matter control strategies. Even while the standards were still under review, the states and EPA began developing a new PM10 monitoring network. In addition, the Agency developed statistical methods for using TSP data to gauge the probability of violating the PM10 NAAQS. The measured data and probability estimates were used to help design an implementation policy that allows states some flexibility in addressing their problems. Only areas with measured violations, or a high probability of violation, are required to begin immediate regulatory actions. Other areas have been asked to "commit" to a course of appropriate regulatory action once sufficient ambient data have been collected, and a problem has been demonstrated. This

phased approach was adopted to protect the public health in truly polluted areas, while at the same time allowing sufficient time to design more reasoned strategies in areas with borderline problems.

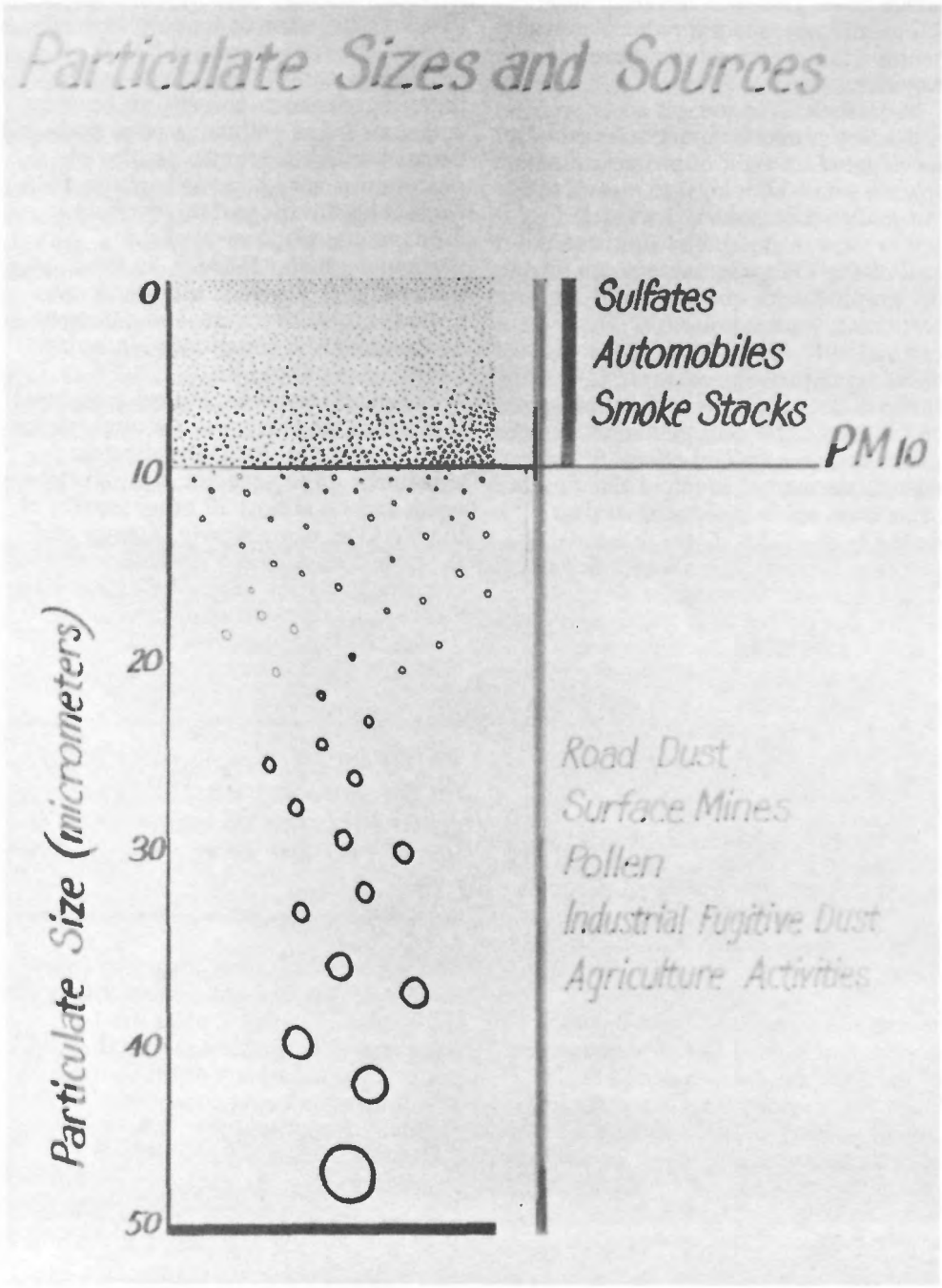
Although the new standards will represent a significant challenge to the states and EPA to implement, their meaning to the many thousands of sources which emit particulate matter is not yet clear. The new standards limit the amount of small particles in the ambient air, but all sources tend to emit both small and large particles in varying proportions. It is unlikely, therefore, that any of the controls now in place for the TSP NAAQS could be removed without adversely affecting attainment of the new PM10 NAAQS. The question of which sources will be required to institute further control measures will depend on the ambient PM10 levels around the source, the proportion of smaller particles in the source's emissions, and how much each source contributes to a violation of the NAAQS. These are factors that the states and EPA are beginning to look at right now. Preliminary studies have indicated that as many as 250 industries may be affected by the new NAAQS and that control costs may reach $640 million per year. Many industries, such as iron and steel, cement, mining, and utilities—which were already controlling to meet the TSP standards—may have to control further to attain the PM10 standard.

Additionally, some "new" source categories may be added to the control strategies in some sreas. Controlled burning in some national forests and in some agricultural areas, for example, adds significantly to local PM10 levels. The use of woodstoves in some communities has led to PM10 levels in excess of the NAAQS. Sources such as these will pose new problems to the air pollution control community. In the past, control of particulate matter was largely a matter of specifying emission rates and control devices, but open burning in national forests will obviously require a more innovative approach. Dealing with thousands of homeowners heating their homes with woodstoves will be a different matter from meeting with a plant engineer at a steel facility. These are the kinds of challenges which lie ahead.

The story of the revision to the particulate matter standards illustrates the challenges faced by EPA today. The TSP standards, which were put in place in 1971, led to major reductions in particulate matter emissions, improvements in air quality, and reductions in public health risks. However, while these improvements were being made, our understanding of the composition of particulate matter and its impact on public health and welfare was increased through scientific research. Thus, despite the successes of the TSP program, sound public policy concerns required that it be revised. In July 1987, the Agency made major changes to the NAAQS and is in the process of making other changes to its implementation program. To truly protect the nation's health and welfare, EPA must always be ready to change its program when science shows that such change is needed. □

*(Thomas is an Environmental Protection Specialist, Ambient Standards Branch, EPA Office of Air Quality Planning and Standards, at Research Triangle Park, North Carolina.)*

Relationships between particle size and health effects are considered differently now than they were in 1971 when EPA's original Total Suspended Particulate Matter (TSP) standard was established.



# Report Details Status of Nation's Surface Waters

by Alice Mayio

How clean are America's rivers, lakes, and estuaries? Are they safe for swimming and fishing? If not, what's being done to clean them up and to protect them from future degradation?

These are some of the questions answered in EPA's biennial report to Congress, which summarizes what the states and territories reported on the quality of their rivers, lakes, estuaries, and ground waters in 1986.

While finding significant improvement in water quality over the past 15 years, the report also reveals that persistent pollution problems remain. Pollution from nonpoint or diffuse sources—e.g., runoff from agricultural fields, construction sites, and city streets—appears to be an increasing concern. Other major concerns reported by the states include toxic substances control; ground-water protection; wetland loss; acid rain; and limited money for pollution control.

Nevertheless, the report contains positive signs: the nation's ability to treat its wastewater has increased substantially, thanks to expenditures by EPA, the states, and localities for construction and upgrading of sewage treatment facilities; and the states are developing and implementing a variety of ground-water protection activities. Highlights of EPA's water quality assessment follow.

One common measure of water quality is the degree to which rivers, lakes, and estuaries are clean enough to be used in the ways for which they've been officially designated, e.g., for activities such as fishing, boating, and drinking. The report finds that about three-quarters of the nation's assessed waters are usable for their state-designated purposes.

Where water qualtiy is impaired and waters cannot be used for recreation, fishing, or drinking, the causes most commonly reported by the states include fecal coliform bacteria (indicators of disease-causing organisms); excess nutrients such as phosphorus and nitrogen; turbidity; oxygen-demanding substances; and toxic pollutants.

For the first time, the states have indicated that nonpoint sources of pollution may be the leading contributors to water degradation. Nutrients from fertilizer runnoff, animal wastes, and inadequate septic systems were seen as the leading pollutants of nonpoint origin in lakes.

At the same time, point sources of pollution—that is, factories and sewage treatment facilities that discharge wastes to waterways through a pipe, conduit, or other easily identifiable point—remain as significant problems in many waters, especially estuaries and streams.

Twenty-two states found that 8,500 miles of rivers and streams were affected by elevated levels of toxics (above health or environmental protection standards); 16 states reported elevated levels of toxics in 362,000 lake acres; and six states reported that 190 square miles of estuaries were affected by toxics. Industrial dischargers and agricultural runnoff were reported as the leading sources of these toxics.

The states impose advisories or bans on fishing when toxics are found in fish tissue at elevated levels. These levels include limits set by the U.S. Food and Drug Administration; 24 states reported imposing 286 fishing advisories, and 15 states reported 108 fishing bans affecting portions of their waters. Elevated levels of PCBs, mercury, and chlordane were most often cited as the reason for the advisories and bans. These findings are incomplete, since not all states provided information on fishing restrictions, and methods of reporting vary among states.

More than half of the U.S. population draws drinking water from ground-water supplies. Mississippi, Florida, Hawaii, Nevada, and the Northern Marianna Islands depend on ground-water sources for at least 90 percent of their drinking water needs. In these states and many of the nation's rural areas, alternative sources of water may not be physically, legally, or economically available.

Monitoring of ground-water conditions by the states revealed that failing septic tank systems, leaking underground storage tanks, and agricultural activities such as fertilizer applications are leading sources of ground-water pollution.

The report included specific examples of pollution control efforts that clearly benefited the nation's surface waters. For example:

- Vermont reported that sewage treatment plant construction and upgrading improved the quality of the Dog, Winooski, and Connecticut rivers and Lake Memphremagog.
- North Dakota reported a dramatic reduction in levels of oxygen-demanding substances in the Red River since industrial controls were imposed.
- Kentucky's Reformatory Lake, once impaired for recreational fishing due to low dissolved oxygen levels and high levels of nutrients, improved when better methods of livestock management were instituted.
- In the Great Lakes, phosphorus control programs such as phosphate detergent bans successfully reduced levels of this nutrient and improved the condition of nearshore waters. Although contamination of fish tissue and sediments by toxic substances continued to be a problem in many areas of the Great Lakes, some declines were noted in fish tissue, especially for DDT and mercury.

Other examples can be found in almost every other state.

New EPA and state initiatives in pollution control include incorporation of toxicity testing requirements into discharge permits; development of regulations for the use and disposal of sewage sludge; and programs to pretreat industrial discharges to municipal sewage treatment facilities. Another new initiative was the issuance of a 1986 strategy to identify the best way to manage nonpoint sources and to identify waters affected by nonpoint source pollution. The report also discusses a new, long-term EPA plan to protect estuarine and coastal waters.

In February 1987, Congress revised the Clean Water Act and gave EPA and the states a number of new pollution control responsibilities.

With such enhanced water pollution control efforts in mind, EPA feels the nation is getting closer to the day when future reports will say yes, the waters of the United States are clean. □

*(Mayio is an Environmental Specialist, Monitoring and Data Support Division, EPA's Office of Water.)*

# Timber and Tourists: Idaho Confronts Logging Issues

by David Wann

The slide showed a sunny, sandy beach on the banks of an apparently pristine Idaho stream. But looks can be deceiving. "This," said biologist Don Anderson to the class of elementary school sudents, "is a stream that is dying from too much sediment. Nonpoint source pollutants such as sediment, nitrogen, phosphorus, organic matter, and metals can have major impacts on rivers and streams. In Idaho, we get a lot of sediment from logging activities. This sediment can be especially harmful, not for the aquatic death it causes, but rather the life it prevents. When sediment builds up in our streams and rivers, the fish can't reproduce, insect life doesn't thrive, and the whole ecosystem suffers."

A fisheries biologist (the locals call him a "fish cop") with the Idaho Fish and Game Department, Anderson is one of many state and local specialists working with EPA to remedy nonpoint source problems. In Idaho, those problems stem in large part from the effects of timber harvesting and associated road building.

Past water quality management programs, such as Section 208 of the Clean Water Act, provided for pollution abatement plans and led to the regulation of forest practices in some states. Since the late 1970s, however, it has become apparent that these programs have not been adequate to protect beneficial uses such as fisheries. As a result, many states are currently reevaluating the impacts of forest practices on fish habitat.

Idaho is a national focal point for this trend because of its attempts to develop a viable strategy for implementing both water quality standards and "antidegradation" requirements for nonpoint sources of pollution. Anderson, a fifth-generation Idahoan, has observed first-hand the effects that sediment can have on watershed quality and productivity. His district is located in the Payette National Forest in central Idaho, where logging activities have caused the primary sediment impact. In fact, one of the country's more disturbing sedimentation "blow-outs" occurred there in 1965. The South Fork of the Salmon River at one time produced 50,000 adult chinook salmon per year—or more than half the salmon population of the entire Columbia River drainage system. In 1965, massive mudslides caused by a major "rain on snow event" washed out roads built on unstable soils and slopes. (About three-quarters of sediment impacts result from road construction, a large percentage of it in the first year.)

According to congressional testimony, "Along 25 miles of the South Fork, the soil seemed to dissolve and run like wet concrete. The forest opened to reveal swatches of naked bedrock as dislodged trees flowed away." In some stretches of the 25-mile section, the sediment accumulated to a depth of 12 feet. Anderson recalled the creek being "a gold-covered ribbon with a ripple of water running over it—no rocks, no holes, and certainly, no salmon habitat." An estimated $100 million was lost in salmon and steelhead trout fisheries, and as few as 300 salmon now remain in that stretch of the river.

Logging affects fisheries habitat in several ways. When erosion and runoff are heavy, sediments settle into the cobbled spaces ("interstices") in the streambed. Oxygen can't get into the spawning nests, and the offspring can become physically entombed in their own birthplaces. Those that do survive must cope with reduced hiding cover as well as a reduced food supply of insects and other invertebrates. The interstices also provide cover from turbulence so that energy is not expended unnecessarily, and, in early spring, cover from hurtling chunks of ice. By removing shade, logging can also raise the temperature of the stream beyond fish tolerance.

The whole ecosystem, in fact, can be diminished by clearcutting practices which leave too little deadwood, since many micoorganisms, insects, and mammals rely on forest debris. The South Fork blowout and similar occurrences—as well as the perceived need to maintain some pristine land—have resulted in Idaho becoming a national focus for the issue of nonpoint-source pollution from silvicultural (logging) activities. Conservation groups across the nation are intently watching the progress in the state; in effect, it has become a test case for environmental action on non-point source pollution.

Yet the issue is slippery, both scientifically and politically. It has been difficult to pinpoint the best methods to quantify the impacts of a pollution source that is generally not a single event, but rather a slow, insidious development. There is no such thing as a "sediment meter," and furthermore, sediment itself is not a criteria pollutant in state water quality standards, although many states have turbidity standards.

But how are scientists to distinguish naturally occurring sediment from human-caused impacts? How can the public be made aware of the severity of the problem, especially in a traditional logging state? How to best enforce and strengthen federal and state regulations which must be generic in scope, while nonpoint sources themselves are very site-specific?

The Clean Water Act Amendments of 1987 require states to identify nonpoint sources of pollution and set forth actions to control these sources. Thus, the states work in conjunction with EPA, the U.S. Forest Service, the Bureau of Land Management, and the timber

David Wann

A timber harvest which did not leave a buffer strip between the stream and cutting. When erosion and runoffs are heavy, logging sediments settle into streambeds' cobbled spaces or "interstices." This provides less oxygen for fish spawning nests, plus fewer hiding places for fingerlings and little protection for them from turbulence and ice chunks.

industry to ensure that Best Management Practices (BMPs) are implemented during logging and road building to protect beneficial uses and, in general, protect water quality in accordance with congressional and EPA "antidegradation" requirements.

The National Environmental Policy Act (NEPA) has been particularly valuable in upholding an ecosystem approach to land management. Three recent litigations, based largely on NEPA, have clarified the Forest Service's mandate to address and mitigate the cumulative impacts of logging activities. Environmental groups (especially the so-called "Group of Ten") have made their intentions clear to EPA to pursue a legal course of action if state water quality standards are not met, beneficial uses are not protected, and BMPs not adequately implemented.

BMPs include both structural and non-structural controls: devices that drain water more efficiently from logged areas; sturdy bridges reinforced with boulders on the streambank; careful reseeding of logging roads after their use; buffer strips of uncut trees and understory vegetation between logged areas and streams; alternate methods of harvesting (such as helicopters or skyhooks when feasible); careful planning and engineering of road construction to avoid fragile soils and land types.

However, Don Martin, nonpoint source coordinator with EPA's Idaho Operations Office in Region 10, believes that BMPs have sometimes tended to be a distracting focal point rather than the means of genuinely protecting beneficial uses. Rather than rely solely on BMPs, he advocates a "feedback loop" consisting of vigilant monitoring of the ecosystem itself to make sure that the goal of environmental quality is actually being met.

One of the major players in the logging/sedimentation issue is the U.S. Forest Service, which manages about 190 million acres of national forest. The National Forest Management Act of 1976 (NFMA), sometimes referred to as "the largest and longest-running natural resource planning effort undertaken anywhere in the world," is designed to lay out projected uses and impacts for the national forests for the next 50 years.

While there has been increasing attention paid by the Forest Service to the importance of fisheries in the national forests, Martin points out that the 100-plus management plans thus far received in draft or final form have generally emphasized increased timber cutting and road construction. "Nationwide, sport fishing is a $20 billion dollar industry, and here in

***The middle ground is represented by people who believe that there is a way to have both logging and environmental conservation.***

Idaho we have some of the country's best fisheries," he says. "There are times when it makes more sense to leave the trees standing to protect those fisheries."

According to a recent Wilderness Society report, *Forests of the Future*, 73 of the 123 national forests are currently losing money on their timber operations: "Taxpayer losses will exceed $2 billion over the next decade as the Forest Service pushes logging onto ever more steep, erosive, and remote forestland." Concerning the Idaho forests in particular, the report says, "All 12 forests in Idaho—with the exception of the Challis—sustained annual losses on their timber programs from 1979 through 1984."

Martin has been working directly with the Forest Service as well as the other players in the Idaho forest planning issue, including the state, BLM, environmental and industry groups, and Indian tribes.

"We're learning to listen to each other," he says. "And we're coming to consensus on the types of techniques that will make it far easier for us to quantify sediment impacts. For example, analysis of streambed composition and biological indicators such as numbers of insect larvae per square foot are proving to be good, workable tools." Some of the techniques now used permit biologists to make direct correlations between sediment and fish habitat quality. An example is the nitrogen-cooled probe that lifts small, frozen cross-sections right out of the streambed to permit careful analysis of the sediment's impact on salmon "redds"—or spawning nests.

Martin, whose background includes 10 years of field work in nonpoint source pollution, feels that raising public awareness is an important first step in the process of finding solutions. "It takes a lot less sediment to impact fisheries than most people realize," he says.

In an undisturbed, mature forest, .5 tons of sediment erode per acre per year. In carefully managed logging activities, 1-15 tons per year can erode, while in intensely and carelessly logged areas, sediment runoff can exceed 100 tons per year.

"By carefully studying fish ecology as well as the physical and biological properties of these watersheds," Martin explains, "we've realized that good BMPs have got to be enforced or we're going to lose a virtually irreplaceable resource. People need to realize, too, that drinking water supplies are being impacted by sediment. Some towns have been forced to go to alternate sources of water because it became too expensive to filter the sediment from the water."

Local residents seem somewhat divided on the issue. Some drive cars with bumper stickers that say "Wilderness: Land of No Uses" and refer to BMPs as "Biologically Malignant Pillage." This sector pushes for upgrading the infrastructure in the state to attract industries other than logging. One of the more outspoken residents of McCall, Idaho, said, "You've got to beat the timber industry over the head, with fish, to make them realize that recreation is Idaho's best option for the future."

To the Native American population, the fisheries represent something more than recreation. Having once relied on bountiful supplies of "anadromous" (ocean-migrating) fish, they have a cultural and economic need for the "tshawytscha" (chinook salmon), and have become very active in the issue. Like the other major players, they have hired fisheries experts to help make Native American participation more effective.

Other residents are more in line with the traditional thinking about logging—reminding environmentalists that the industry employs 11,000 people in the state, and provides a tangible commodity that can be diced up and shipped off for profit.

The middle ground is represented by people who believe that there is a way to have both logging and environmental conservation. One of these is lumber mill owner/operator Bob Hitchcock, who runs a state-of-the-art mill near McCall. The mill is designed to use different dimensions of lumber, which makes the operation less reliant on cutting old growth. In some cases, the high-grade ponderosa pine is located so far up on steep slopes that cutting it would likely result in environmental impacts.

Hitchcock's mill uses laser scanning technology to get the most lumber out of a given log. It also employs ultra-narrow saw blades to waste as little as possible, and what little waste there is gets converted into electricity via cogeneration and sold to Idaho Power Company. "We can co-exist without destroying each other," says Hitchcock, referring to the ongoing dialog with environmental agencies and groups.

Underlying the whole issue, however, is the larger issue of risk assessment. Essentially, we need to decide what level of environmental degradation we are willing to accept for the sake of one industry and its products.

Essayist Wendell Berry exhorts us to "love the board before it becomes a table, love the tree that yields the board, and love the forest before it gives up the tree."

Bearing in mind all the tangible and intangible benefits contained in them, and the statutes that are designed to protect them, the essential question remains, "How much do we love our forests?" □

*(Wann is a Writer/Editor with EPA's Region 8.)*

# Pacific Pollution: Trouble in Paradise

by Norman Lovelace

EPA's environmental responsibilities extend into the Pacific Ocean well beyond our 50th state. To the west and south of Hawaii are hundreds of islands where EPA has an active and direct role. Most people do not realize that there are now six separate and distinct island jurisdictions, in addition to the State of Hawaii, that are part of EPA's Region 9. These island jurisdictions consist of the three U.S. territories of Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI), as well as the emerging sovereign nations of the Federated States of Micronesia (FSM), the Republic of Palau (ROP), and the Republic of the Marshall Islands (RMI).

Each of these island areas has a distinct history, culture, and leadership structure. They differ from each other, and they differ significantly from the mainland states in subtle and profound ways.

The political relationship of these areas with the United States is as varied as their history and culture. Two of them are U.S. territories, one is a commonwealth, two of them have become freely associated with the United States, and one of them is in the process of arriving at a final status. Each status has its particular meaning in the parlance of international recognition, sovereignty, self-government, and in other important ways; but the status does not change the environmental and public health tasks that remain to be done.

EPA's Pacific responsibilities present the agency and our island counterparts with a varied menu of environmental and public health challenges. These challenges range from those associated with sound environmental management of rapid, modern-day development and life to those of providing basic sanitation and drinking water facilities to individual families. It is important to

appreciate the geopolitical factors that influence the area and the way we conduct our business. The areas in which EPA has responsibility currently consist of over 2,000 islands with an approximate total land mass of 1,000 square miles. These islands are scattered over an expanse of the Pacific Ocean that exceeds the area of the contiguous United States. Approximately 310,000 people call these islands their home.

The CNMI, Guam, FSM, RMI, and ROP are in the Western Pacific Ocean in an area called Micronesia, which is slightly north of the equator and west of the international dateline. The ROP is the westernmost point, roughly 7,000 miles west-southwest of San Francisco. American Samoa is in the South Pacific Ocean and is considered part of the Polynesian island group. American Samoa is roughly 4,200 miles southwest of San Francisco. As a partial consequence of the geography, many of the influences in these areas do not come from the U.S. mainland; they come from the Asian countries and other countries within the Pacific Basin. In addition, the geography, travel limitations, and communication systems make doing our "regular business" a bit different. The task of making a phone call to many areas can be a trying experience, and it can take over 24 hours of constant travel to go from San Francisco to the ROP (plus an extra day because of the international dateline). Taken together, all of these factors make the Pacific a truly exciting and challenging place for EPA.

All of the Pacific is varied in history, political evolution, and culture. Those familiar with the Pacific theater of World War II will recognize the island areas of Peleliu, Truk Lagoon, Guam, Saipan, and others as sites of major battles during the war. American Samoa was once a coaling station for trading ships in the South Pacific. And, of course, there is a rich history of culture and migration that is unique to these islands and not yet fully understood by students of the area. The complex history and tradition of the islands greatly influence the present day and make each a unique experience.

Guam and American Samoa have been U.S. territories since the late 1890s. They each now have well-established forms of democratic government. Guam's first popularly elected governor was elected in 1970; American Samoa's in 1978. Each territory also has an elected legislative body, a judiciary system, and an elected non-voting representative to the U.S. House of Representatives. Guam and American Samoa are each unincorporated territories. They are recognized as U.S. possessions and are under U.S. control. All of EPA's programs apply to Guam and American Samoa.

More recently, a major area of the Pacific, the Trust Territory of the Pacific Islands (TTPI), has been undergoing a dramatic political transformation. Originally established in 1947 as a United States-administered strategic trusteeship by the United Nations, the TTPI was composed of the CNMI, RMI, FSM, and ROP. Two of the principal goals of the trusteeship are for the United States to foster self-government and self-determination for the area's peoples. These goals are now being realized as each area selects and finalizes a new political status.

In 1976, the United States approved the covenant to establish the Commonwealth of the Northern Mariana Islands and the area was administratively separated from the TTPI, although it was still covered by the trusteeship. In 1986, the United States terminated the trusteeship with respect to the CNMI and commonwealth status became formally effective. As a commonwealth, the CNMI owes allegiance to the United States, but exercises greater self-government and sovereignty than a U.S. territory. EPA programs will continue to apply to the CNMI.

***Although the Pacific's face is changing quickly, there is still the opportunity to "do it right the first time."***

Also in the mid to late 1970s, the RMI, FSM, and ROP each formed governments and began separate negotiations with the United States on future political status. The RMI and FSM have elected to become freely associated with the United States. Under this arrangement they are recognized as self-governing, sovereign nations. The United States, however, will retain certain strategic and international relations interests in the areas. The details of the arrangement have been negotiated betweeen the United States and the RMI and FSM. In 1986, the trusteeship was terminated for the RMI and FSM and their new status became effective. Some EPA programs will continue to apply until 1989 as part of a three-year transition period.

The ROP has also indicated that it wishes to become freely associated with the United States under the same general parameters as the RMI and FSM. The formal approval process for this new relationship is still underway.

All of the islands are undergoing dramatic changes that create a diversity of environmental challenges. Beneath the serene, tropical beauty of the islands, there are turbulent currents of economic development and social change. The world is looking to the Pacific as a new economic frontier, and the areas where EPA has responsibility have not been left out. The islands face the dual problems of managing rapid modern-day development in an environmentally responsible manner while meeting the basic public health needs of their people.

In some areas, life is relatively unchanged from what it was 100 years ago. In others, luxury resort hotels, shopping centers, tract homes, and traffic jams have taken the place of palm trees over the last 10 years. The face of the Pacific is rapidly changing and added pressures are being placed on the environment:

- More drinking water is needed and the limited supplies of fresh water must be carefully managed and protected.
- More solid and hazardous wastes are being generated which must be safely collected and disposed of.
- More wastewater is generated that must be treated and properly disposed of.
- More construction is occurring that must be carefully managed to reduce damage to rivers and reefs.
- More power will be generated and the existing pristine quality of the air must be preserved.
- More oil and hazardous materials are being transported, thereby increasing the danger of spills.

In addition to problems that are rapidly emerging, the islands must also cope with a backlog of existing ones. Many people living in population centers as well as small villages do not have safe and dependable supplies of drinking water or adequate waste disposal facilities. Basic infrastructure (water, power, wastewater) in the population centers is often inadequate for today's demands, let alone those of

the future. On top of this, most island governments are very young and still in the process of establishing their policies and institutions to protect the environment and public health.

Although the Pacific's face is changing quickly, there is still the opportunity to "do it right the first time." For the most part, the environmental challenges and opportunities connected with economic growth and activity are those of preventing problems rather than correcting existing ones. The limited land and fresh-water resources of the islands demand that these challenges be met. For example, a ground-water polluting industry will not only pollute *an* aquifer: it could pollute *the* aquifer. The next closest source of potable ground-water could be on another island 200 miles away! So the task of comprehensive and sound environmental management is critical for island environments.

Does EPA have a role in these tropical paradises? Yes, EPA has several roles and responsibilities. Aside from the formal responsibilities assigned to EPA by Congress, we have an equally important obligation to understand the real problems and needs of the islands and to find ways to address them. Our most fundamental obligation is to form partnerships with our island counterparts and work together to solve and/or prevent environmental and public health problems.

Meeting these obligations takes many forms, some of which do not readily fit into the mold that has been cast for EPA in its dealings with the 50 states. An example of this is the recently completed "Micronesian Water Supply Initiative." This initiative was a multi-agency project that included participation and assistance from the U.S. Department of Interior, the University of Hawaii, the University of Guam, private consultants, and the island governments. Through the initiative the RMI, FSM, and ROP are being provided with technical, programmatic, and instructional materials to improve the status of water supplies, including individual household supplies. The initiative even included development of a 12-year school curriculum for environmental health education.

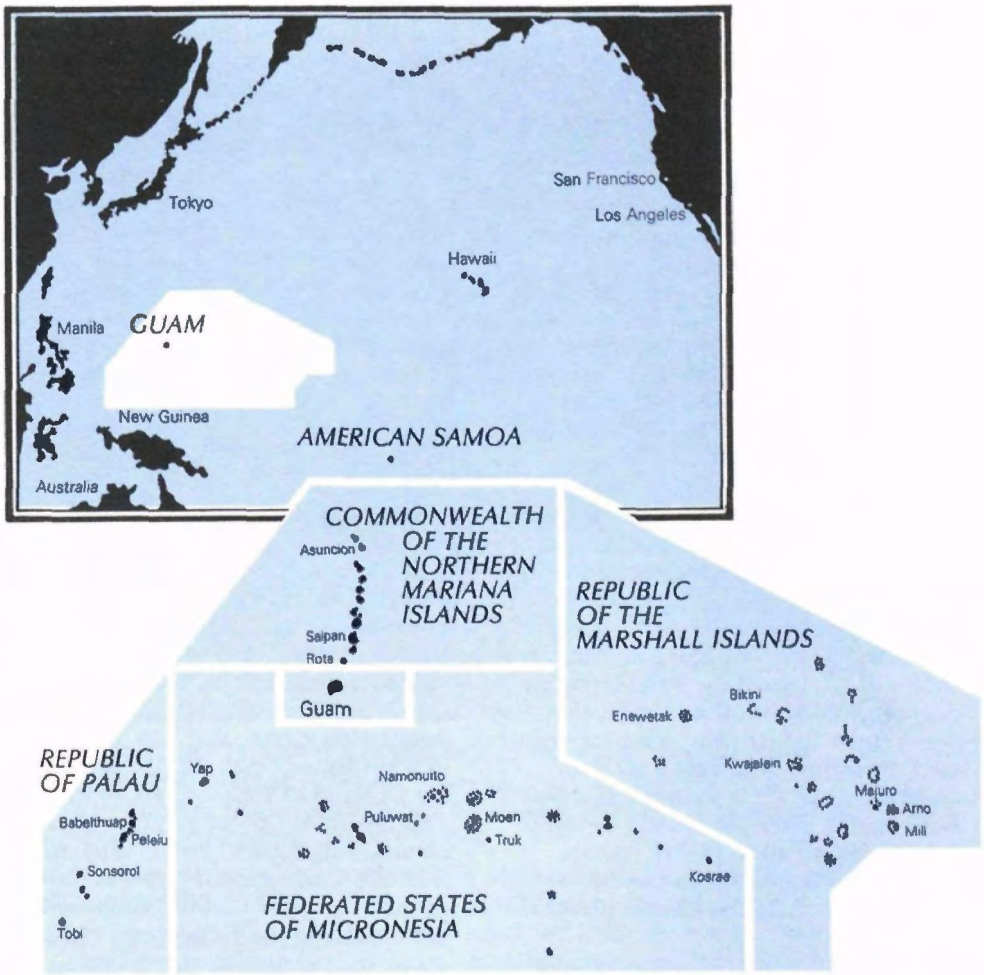
Other examples of appropriate assistance are the "Rural Sanitation Projects" that are underway in the RMI, FSM, and ROP. These projects are designed to provide basic sanitary facilities to households that are located on remote islands or outside major population centers. The origin of these projects and EPA's participation in them is a vivid and tragic illustration of the basic public health needs that exist in many areas: the Truk Islands experienced a major outbreak of cholera in 1982 and 1983 that claimed over 3,000 victims and took over 20 lives.

In addition to the many differences that arise because of geography, culture, and political status as well as public health needs, the U.S. Congress has made special allowances for the islands that directly affect the way in which EPA administers programs. In general, EPA must look at these islands in a different way than we look at California or New York.

In Region 9, an Office of Pacific Island and Native American Programs has been formed to oversee and manage EPA involvement in the islands, and to provide for appropriate program delivery. Also, within the community of federal agencies and departments, a special Oceania Regional Response Team has been formed. This team will assist in responding to oil and hazardous materials spills as well as in preparing emergency contingency plans.

The future looks good for the island counterparts. EPA must continue to be a strong voice for the environment and a resource for the island communities. □

*(Lovelace is Chief, Office of Pacific Island and Native American Programs, EPA Region 9.)*




EPA's Region 9 has responsibilities for Pacific island areas with 310,000 people. The islands are scattered over an area larger than the 48 contiguous states.

# Tracking Environmental Diseases with Epidemiology

by Robert Griffin

Epidemiology is the study of the behavior of disease in populations. As a separate discipline, it first arose from the urgent need to make scientific sense of the frightening and seemingly capricious attacks of infectious illnesses such as cholera and typhoid. Scientists found, however, that the techniques developed to study infectious diseases also could be applied to chronic diseases—for example, diabetes, heart disease, and certain other conditions including alcoholism and mental illness. Now, these same techniques are proving useful in studying the association of disease with environmental problems as well. Some cancers, for example, have been linked to exposure to chemical pollution. Environmental epidemiology, however, usually presents much greater difficulty for investigators than does the study of infectious disease.

According to Dr. Chad Hemick, a medical epidemiologist with the Centers for Disease Control (CDC) in Atlanta, most diseases caused by environmental problems are of a chronic nature.

"Infectious diseases usually have short incubation periods and victims of acute illness can often point to recently ingested foods, or other factors that may prove to be the culprit," Hemick points out. "Everyone who eats a tainted cheese will know it within a few hours! But chronic diseases usually develop from a combination of risk factors, unlike infections, which can be attributed to a single, clearly identifiable organism."

"Concerns about the environment aren't necessarily based upon getting an acute illness—at least in the short run," Hemick says. "Diseases caused by factors in the environment may develop over long periods of time, and they may show up only as a greater-than-expected number of cancers, or frequent incidence of other chronic disease within a population." In any epidemiological study, one of the most basic steps is to identify the common circumstances, or "risk factors," associated with victims of the disease. (See box.) Working backward from the risk factors, epidemiologists can deduce the cause and even suggest preventive measures.

Sometimes an examination of health statistics will alert officials to the possibility of an environmental health problem. Unusual "clusters" of chronic disease victims may be cause for suspicion. Sometimes the existence of an environmental problem will be first suspected by concerned citizens or practicing phyicians, whose evidence is merely anecdotal, or based on "hunch." In either case, the environmental origin of a disease problem can be proved only by a rigorous epidemiologic study.

But, even in cases where statistics reveal a geographic clustering of disease that could be of environmental origin, it is sometimes difficult to prove the case. Long latency periods in development of chronic diseases, the fact that people move from place to place, and the difficulty in identifying all risk factors to which they have been exposed over a lifetime, serve to complicate the environmental epidemiologist's work. There are, however, exceptions: the occurrence of illnesses such as mercury poisoning or mesothelioma (a cancer which is associated with asbestos exposure) immediately suggest the existence of an occupational or environmental hazard.

Epidemiologic studies may be either prospective or retrospective, and both are applied to health problems that are known or suspected to be caused by factors in the environment.

In a prospective study, a "cohort," or population group, that has been exposed to a suspected "risk factor" is followed for a period of time—often many years. The health of this population group is carefully monitored and compared with that of a non-exposed population, or "control group." Health problems that are unique to the first group, or that occur in statistically significant numbers, may be attributed to the risk factor(s). An example of a long-term prospective study is the continuing follow-up on survivors of the atom bomb blast at Hiroshima.

In a retrospective study, epidemiologists begin with a known disease condition. The challenge is to deduce the set of circumstances shared by all those with the disease, and determine which of these may be properly identified as risk factors.

Environmental epidemiologists point out that their work can have immense psychological value. A thorough investigation sometimes will disprove the existence of a suspected environmental problem. For example, citizens in South Carolina who lived near a nuclear plant became alarmed at reports suggesting they were at greater risk of developing *polychthemia vera*, a relatively rare blood disorder. They suspected that its occurrence among their neighbors was due to their proximity to the plant. A careful epidemiological study, however, revealed that the blood disease was no more frequent in South Carolina than elsewhere.

***Environmental epidemiologists point out that their work can have immense psychological value.***

EPA is involved in a number of epidemiology programs. According to Gunther Craun, with EPA's Health Effects Research Laboratory in Cincinnati, the Agency offers assistance to the Centers for Disease Control in investigating outbreaks of suspected waterborne disease. More importantly, through a cooperative agreement with the University of Pittsburgh, EPA supports a Center for Environmental Epidemiology. "The Center was established in 1979 especially to address the nation's long-term research needs in the areas of human mortality and morbidity from exposure to environmental contaminants," Craun observes. "It performs epidemiologic studies, and works to improve epidemiological study methods, including statistical and analytical techniques. The Center staff also assesses environmental exposures in support of epidemiologic investigations, and assists EPA in identifying areas where the science of epidemiology can support the agency's mission."

Examples of the Center's work include such projects as assessing the

exposure to volatile chemicals from contaminated water, developing mathematical models to permit extrapolation of environmental exposures back in time, and developing computer software to perform risk assessment of occupational groups exposed to arsenic.

It is unlikely that the science of epidemiology can ever identify environmental problems with the same precision and confidence it has shown with infectious disease. This is partly due to our imperfect knowledge of the environment and its complex interaction with the human organism. But epidemiology remains an indispensable tool in the continuing effort to extend our knowledge of the environment and protect human life and health. □

*(Griffin is a Washington-based science writer.)*

## Field Work

Among the methods employed by the epidemiologists, none has been more fruitful than "field work." An 1854 cholera epidemic in London provides a classic example of the value of field work and reveals the logic employed by epidemiologists.

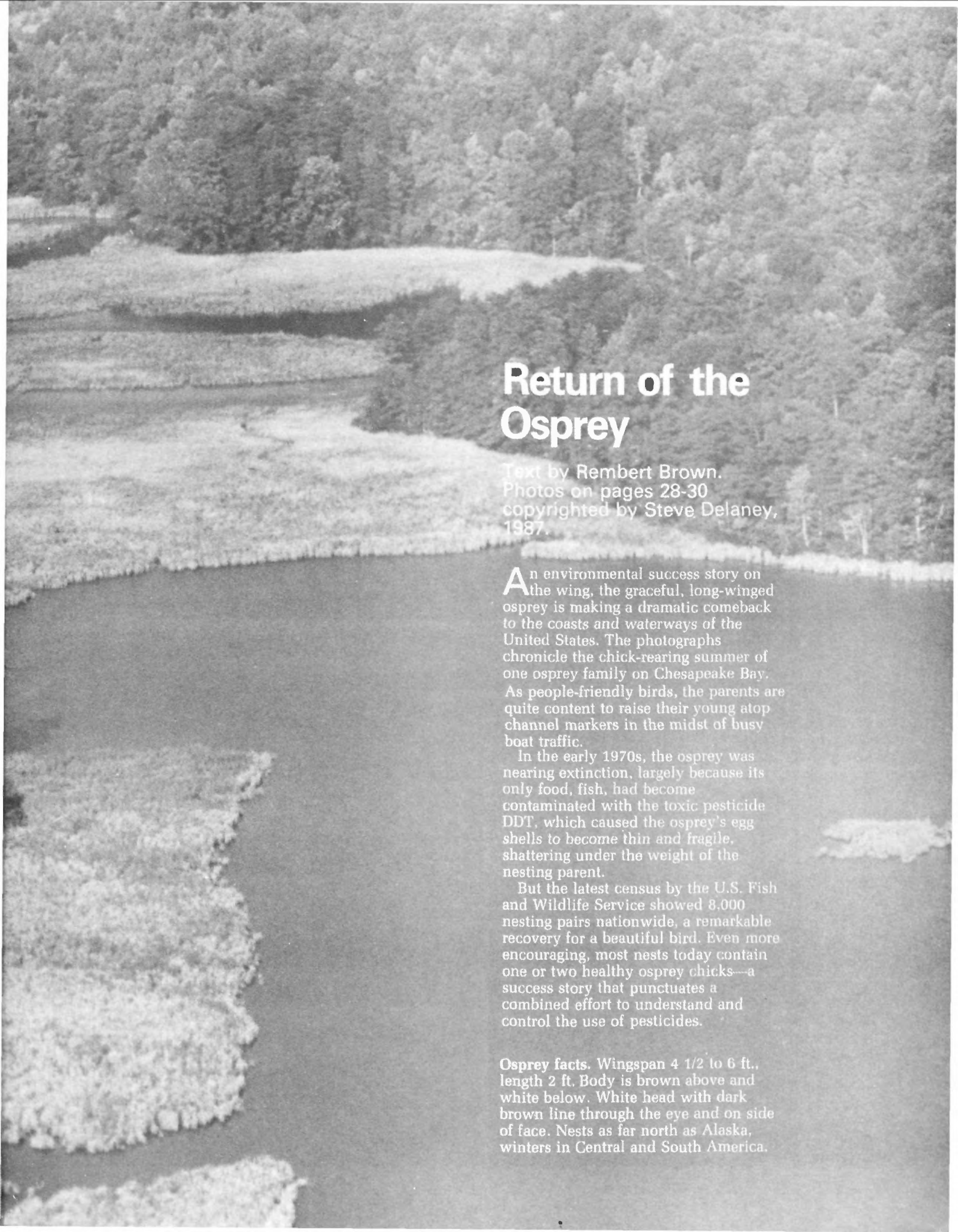
The 1854 outbreak appeared sharply localized, with the residents of one particular section of the city suffering the greatest incidence of disease and the greatest number of deaths. A health investigator, John Snow, seized upon the idea of plotting the locations of cholera deaths on a map of the city. It quickly became apparent that not only were the greatest number of cholera deaths occurring in St. James' Parish, but they were clustered about the Broad Street Pump. Snow discovered that certain cholera victims who lived outside the parish were in the habit of drawing their water from the Broad Street Pump. He also determined that parish residents who had their own wells, and who did not use the Broad Street Pump, were virtually free of disease. Acting upon this evidence, Snow had the pump handle removed.

As this example shows, a crucial task of the epidemiologist involves identification of risk factors. Modern statistical methods provide a powerful tool in this process. Several statistical relationships have proven especially valuable in epidemiologic studies:

- The **mortality rate** is the number of deaths occurring in a given year per 1,000 or 100,000 total mid-year population.
- The **morbidity rate** is the number of cases of a disease per 100,000 population existing at a particular time, or cases occurring in a defined period of time.
- Disease **incidence** per 100,000 individuals is the number of new cases occurring during a given time period multiplied by 100,000 and divided by the mid-year population. Incidence is a measure of the risk of developing a disease in a given time period.
- Disease **prevalence** is the number of existing cases at a specified moment, or during a specified time period, divided by the total population.
- The **fatality** ratio is an indicator of disease severity, and is defined as the number of deaths expressed as a percentage of the number of cases.

National Library of Medicine

Identification of risk factors is a crucial task of the epidemiologist, and modern statistical methods provide powerful tools. When cholera was rampant in Europe, field work was just beginning. In this engraving by J. Roze, nursing nuns in Paris attend the sick.



# Return of the Osprey

Text by Rembert Brown.
Photos on pages 28-30
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1987.

An environmental success story on the wing, the graceful, long-winged osprey is making a dramatic comeback to the coasts and waterways of the United States. The photographs chronicle the chick-rearing summer of one osprey family on Chesapeake Bay. As people-friendly birds, the parents are quite content to raise their young atop channel markers in the midst of busy boat traffic.

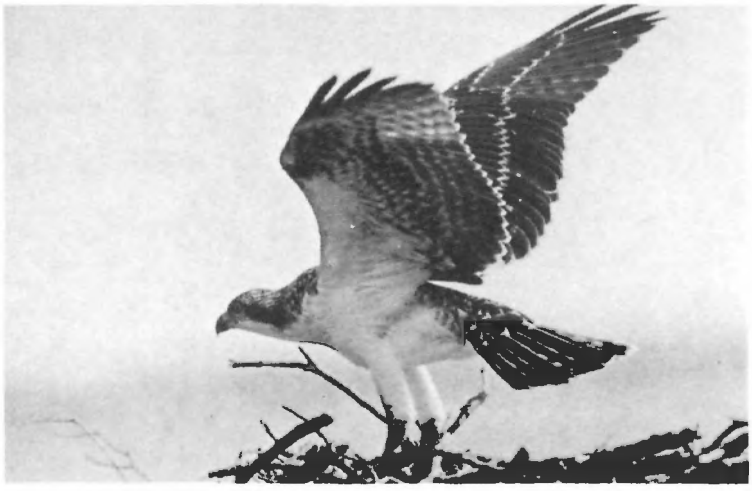
In the early 1970s, the osprey was nearing extinction, largely because its only food, fish, had become contaminated with the toxic pesticide DDT, which caused the osprey's egg shells to become thin and fragile, shattering under the weight of the nesting parent.

But the latest census by the U.S. Fish and Wildlife Service showed 8,000 nesting pairs nationwide, a remarkable recovery for a beautiful bird. Even more encouraging, most nests today contain one or two healthy osprey chicks—a success story that punctuates a combined effort to understand and control the use of pesticides.

**Osprey facts.** Wingspan 4 1/2 to 6 ft., length 2 ft. Body is brown above and white below. White head with dark brown line through the eye and on side of face. Nests as far north as Alaska, winters in Central and South America.

Previous page: Tributary waters of the Chesapeake Bay are home to the osprey family pictured.

Right, mother and baby wait for the father to bring more fish. Below, baby ospreys grow rapidly. Bottom, after the father eats the fish head, mother and baby share the rest. Bottom right, it's flight time. This photo was taken on the baby's first flight day.



# Appointments

**Dr. Ken Sexton**, a veteran environmental scientist and leader in the air pollution field, is the new Director of the Office of Health Research in the Office of Research and Development. Dr. Sexton started his professional career as an Air Force Computer Systems Operations Officer in 1972. From 1975 to 1979, he was first a Research Assistant and then an Environmental Engineering Faculty Member at Washington State University. In 1979, he joined the Acurex Corporation in California as an Energy and Environmental Division engineer, returning to academia a year later for a three-year stint at the Harvard University School of Public Health, where he earned his doctorate in Environmental Health Sciences.

Sexton became Director of the California Department of Health Services Indoor Air Quality Program in 1983, then was appointed Director of Scientific Review and Evaluation at the Health Effects Institute in Cambridge, Massachusetts, in 1985. He joined EPA recently.

In addition to Masters degrees from Texas Tech and Washington State, he has a Bachelor of Science degree in Life Sciences from the Air Force Academy. He is chairman of the Air Pollution Control Association Committee on Air Quality Policy, Regulations, and Strategy, and has been active in a number of California and national advisory and working groups in the field of air quality control. □

# Letter to the Editor

Dear Editor:

A recent *EPA Journal* (Sept. '87) carried an article on perspective on the global environment by Albert Fry. While I welcome Mr. Fry's point of view in the *Journal* and applaud parts of his article, some sections, it should be pointed out, are clearly erroneous.

It was good to see that industry supports continued economic growth that is compatible with a healthy environment. It is admirable that multi-national corporations are using their influence in an effort to persuade trade associations and individual businesses to comply with the environmental guidelines they adopted. Mr. Fry's comment that pollution control often pays for itself is important to stress.

However, his statement that "environmental rhetoric and confrontation make headlines but seldom clean up pollution" simply cannot be supported. EPA's judicious use of confrontation (enforcement activities, such as lawsuits) accompanied as they often are by "rhetoric" (e.g., press releases quoting EPA officials) produce headlines that are very effective in reminding the rest of the regulated community that violating the law is not cost-free. The result is a cleaner environment.

His argument that uniform environmental standards should be rejected in favor of local standards, since the benefits depend on the local environment and since they would not be "economically efficient," was rejected in this country years ago. We saw that the states were not effectively controlling the problem; pollution did not respect state boundaries; and the deleterious effects on the environment were seen to be economically counterproductive. In the United States the national government had the political will to address the problem, whereas states that were competing against each other to attract industry did not. National environmental standards, the end result, have been universally applauded as a success since they require all parties to compete on a level playing field.

The international community faces the same problem and needs global environmental standards. The catch is enforcement. In the absence of effective enforcement by the United Nations, the developed countries can help by refusing to import products from countries that do not comply, or more selectively by refusing to import products from those individual plants that do not play by the same rules the world requires. If we are to prevent more Chernobyls, Rhine River disasters, and ozone depletion, we must establish such global laws and enforcement tools.

Charles Garlow, Attorney, U.S. EPA
Office of Enforcement and Compliance Monitoring--Air Enforcement

*In the interest of presenting a range of opinion on various issues, EPA Journal occasionally publishes letters to the editor. As with other articles in the Journal, letters express the opinions of the authors, and do not necessarily reflect EPA policy. Although each letter cannot be acknowledged, the Journal invites readers to send letters, and appreciates the time and effort that goes into them. Letters become the property of EPA Journal and will not be returned. Letters are published at the discretion of the Journal, which reserves the right to edit them for clarity or brevity.*

## AIR

### Stronger CFC Regulations Proposed

New domestic regulations restricting production and consumption of ozone-depleting chlorofluorocarbons (CFCs) have been proposed by EPA Administrator Lee M. Thomas. Imposed under Section 157 of the Clean Air Act, the rules would constitute this country's implementation of the "Montreal Protocol on Substances that Deplete the Ozone Layer," which was signed by the United States and 23 other countries in September 1987.

### SO2 Standards Finalized

EPA on December 1 issued its new source performance standards for sulfur dioxide (SO2) emissions from new, modified, or reconstructed coal- and oil-fired steam-generating units of greater than 100-million Btu per hour heat-input capacity. Facilities using conventional technologies must reduce SO2 emissions by 90 percent and meet an emission limit of 0.6 lb. SO2/million Btu if they burn coal, or 0.8 lb./million Btu if they use oil. Facilities using new or emerging technologies must reduce emissions by at least 50 percent and meet emission limits of 0.6 lb./million if coal-fired and 0.4 lb./million Btu if oil-fired. There are special requirements for units being used at less than 30 percent of capacity, units using very low-sulfur oils, and those in non-continental areas.

### Visibility Protection Plans Disapproved

The EPA Administrator on November 10 signed a final rule disapproving state implementation plans (SIPs) of 29 states and incorporating federal plans to meet visibility requirements. The states involved failed to comply with EPA regulations calling for protection of mandatory Class I areas such as national parks and wilderness areas from visibility impairment caused by "plume blight" traced to a single source or small groups of sources.

### Truck Emissions Standard Delayed

Responding to a November District of Columbia Court of Appeals decision, EPA has deferred nitrogen oxide (NOx) exhaust and emissions standards for all three-ton or larger gasoline- and diesel-powered trucks until the 1990 model year.

The decision allows manufacturers to continue certifying heavy trucks under the existing 10.7 grams NOx per brake horsepower per hour standard (g/BHP-hr.) through the 1989 model year. In 1990, the standard will be 6.0 g/BHP-hr. The light truck standard is now 2.3 g/BHP-hr; it will also be tougher in 1990.

## ENFORCEMENT

### Bid-Rigging Repayment

Officials of Chattanooga, Tennessee, have agreed to pay EPA $600,000 of the $3.7 million the city has recovered from contractors who participated in illegal bid-rigging for sewer construction jointly funded by EPA and the city. Although EPA has recovered money from bid-riggers on EPA-funded sewer projects before this, Chattanooga is the first municipality to take the initiative in recovering illegal profits involved in such joint efforts.

## HAZARDOUS WASTES

### Regulations Extended to "Miscellaneous" Facilities

New permitting rules issued by EPA November 30 bring "miscellaneous" hazardous waste facilities—treatment, storage, and disposal facilities that don't fall within traditional definitions—under Agency regulation. The regulations will apply to such hazardous waste facilities as those used for open burning, open detonation of explosive wastes, some thermal treatment units, and some underground disposal geologic repositories like salt formations, mines, and caves.

## PESTICIDES

### New Limits On Alachlor

EPA has placed a number of restrictions on use of the pesticide alachlor, following a special review that began in 1985, when concerns were raised about the chemical's potential to cause cancer. These restrictions are primarily intended to reduce risks to persons involved in the alachlor application process.

EPA will soon propose a Maximum Contaminant Level for alachlor in public drinking water. However, a determination on the risk to ground water has been deferred pending completion of an EPA-required nationwide monitoring study by the registrant, due in 1989.

EPA has concluded that alachlor residues on treated crops do not pose unreasonable risks to consumers.

### Permits For Field Testing Biotech Frostban Extended

EPA has granted the request of Advanced Genetic Sciences (AGS) Inc., of Oakland, California, to expand the experimental use permits issued in November 1985 (and reissued in February 1987) allowing AGS to test two strains of ice-nucleating bacteria that have been genetically altered to be non-ice-nucleating. The new permits allow AGS to conduct additional testing at Brentwood, California, site of spring 1987 tests.

## WATER

### Chesapeake Bay, Great Lakes Pacts Signed

The 1987 Chesapeake Bay Agreement—a blueprint for Bay restoration efforts for the next decade—was signed in Baltimore on December 15. Signators included EPA Administrator Lee M. Thomas, Governors Gerald L. Baliles, Virginia; William Donald Schaefer, Maryland; and Robert P. Casey, Pennsylvania; District of Columbia Mayor Marion Barry, Jr.; and Chesapeake Bay Commission Chairman Kenneth J. Cole.

In mid-November, EPA Administrator Thomas and Canada's Minister of the Environment, Tom McMillan, signed amendments to the Great Lakes Water Quality Agreement. The latest amendments reflect recent advances in science and technology and are designed to assure prompt implementation.

### First National Estuary Program Announced

Albemarle-Pamlico Sounds in North Carolina, the nation's second largest estuary complex, have been designated as EPA's first National Estuarine Management Program under the Clean Water Act. The announcement was made by Lawrence Jensen, Assistant Administrator for Water, at a meeting at Elizabeth City, North Carolina, and reflects cooperative efforts by North Carolina and EPA to include all estuary users in developing the plan. The management program includes a five-year environmental study which will culminate in a comprehensive conservation and management plan in 1992. EPA has already given $1.1 million to the Albemarle-Pamlico program, and the state of North Carolina has contributed $.5 million. □

Mike Brisson

On the northeast shoreline of Green Bay, Wisconsin.

Back Cover: Winter in New England. Photo by DeWitt Jones, Woodfin Camp, Inc.