



Every child is born a potential genius.

R. Buckminster Fuller

### PESTICIDES

## Last Call for Lindane

Lindane is losing much of any luster it once had. The pesticide, once widely used to kill lice and a variety of pests that attack agricultural products, livestock, and trees, has slowly been eliminated from many applications since the mid-1970s. As long ago as the early 1980s, three U.S. organizations petitioned the U.S. Food and Drug Administration (FDA) to ban lindane following an FDA doctor's advisory that the pesticide caused seizures in children and test animals. In two of the latest actions, the European Commission ruled in December 2000 that member states must withdraw all authorizations for plant protection products containing lindane, and California approved legislation in September 2000 that banned lindane-based products used to treat lice and scabies. Many groups lobbied heavily to have lindane added to the list of 12 persistent organic pollutants banned by the Stockholm Convention signed in May 2001. (It could still be added to a codicil to be developed once the convention comes into force.)

Lindane, known technically by synonyms such as gamma benzene hexachloride and gamma-hexachlorocyclohexane, has been in use for about 50 years. Researchers have found that the long-lasting chemical can cause liver, kidney, neurologic, and immune system damage; birth defects; cancer; and death. It may also be an endocrine disrupter.

However, the FDA considers lindane an acceptable pesticide for killing lice and treating scabies when used according to the labeled instructions. Several companies still sell lindane-based lotions and shampoos. Numerous other pesticides, such as malathion, permethrin, and pyrethrins, also are used in products that target lice and scabies. To help reduce all pesticide exposures, alternative methods to detect and possibly remove lice, such as wet combing, are gaining favor in some circles.

For broader indoor and outdoor uses such as wood fumigation and agricultural pest control, the U.S. Environmental Protection Agency is in the midst of evaluating lindane as part of its reregistration process for this and many other pesticides. At present, lindane is approved only for seed treatments to fight pests such as wireworms and white grubs that attack crops such as cantaloupes, lentils, and wheat.

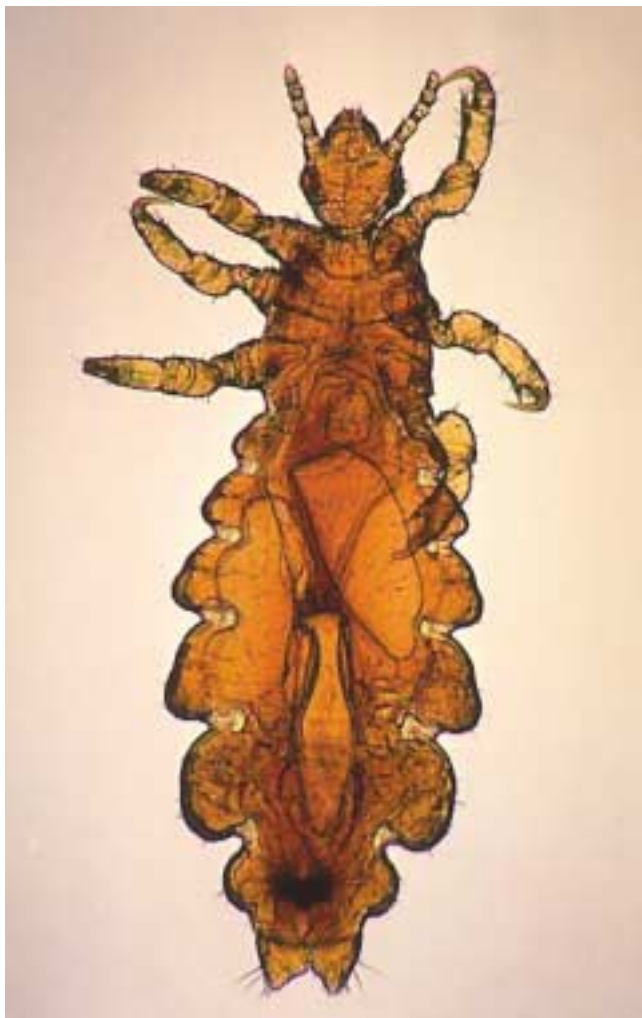
Such plant-protection uses are no longer valid in the 15 European Union countries. On 20 December 2000, the European Commission—primarily concerned with the safety of operators exposed to the pesticide and the adverse impacts the chemical has on the environment—banned lindane for those purposes, allowing 18 months for users and

producers to phase out existing stocks. But lindane may still be used for nonagricultural purposes such as household pesticides.

The ban follows actions taken by several member countries and a 1999 Austrian risk assessment that concluded the chemical is a possible carcinogen with no safe exposure level. In 2000 lindane was also found by the French Institute for the Environment in a number of French waterways that are used as drinking water sources. European environmental activists support the announcement, though Helen Lynn, health coordinator for the London-based Women's Environmental Network, stated in a 13 July 2000 Friends of the Earth press release that "whilst we welcome today's decision, we are disappointed that the public will still be exposed to this dangerous chemical in the home."

Water degradation and the ensuing impacts on human health and the environment were the primary drivers behind California's ban, scheduled to go into effect 1 January 2002. Research in the Los Angeles basin in 1999 revealed that, when lindane shampoos were rinsed down the drain, the pesticide readily contaminated the effluent and eventually the downstream waterways. Cutting down on lindane use through educational campaigns conducted prior to approval of the ban reduced contamination by an average of 50%, says Ann Heil, senior engineer for the Sanitation Districts of Los Angeles County. The continued use of lindane as a seed treatment shouldn't have much impact on water contamination, she adds.

However, lindane pervades the food supply. In the Total Diet Study, an FDA project published in September 2000, lindane was found in dozens of foods, such as evaporated milk, ground beef, pork chops, chicken, lima beans, peanuts, popcorn, and breads. The levels of contamination aren't sufficient to cause health problems, FDA officials say. But little information exists on the interactions lindane may be having with the dozen or more other chemical contaminants typically associated with food production—for instance, benzene and chlorpyrifos—that are often found in tandem with lindane. —Bob Weinhold



**Louse on the loose?** Lindane, a chemical traditionally used to kill lice and other pests, has been banned by the European Commission and the state of California due to health concerns, particularly for children.

Dennis D. Juraneck/Centers for Disease Control and Prevention

## ENVIRONMENTAL EDUCATION

## Green Lessons Boost Grades

Using the environment as a context for learning changes student outlook and results in better academic performance across grades K–12 compared with traditional schooling, according to *Environment-Based Education: Creating High Performance Schools and Students*, a report issued in September 2000 by the National Environmental Education



& Training Foundation (NEETF). Environment-based education uses the environment as a thematic focus for interdisciplinary, hands-on learning. Students in environment-based programs not only raise their reading and math scores but also perform better in science and social studies and are better able to transfer knowledge from familiar to unfamiliar contexts, according to the report. Classroom discipline problems also decline.

The report examined a diverse group of schools and grade levels in Texas, North Carolina, Wisconsin, Minnesota, Kentucky, and Florida. It includes case studies at five individual schools with environment-based programs, a model school program, and the statewide Kentucky public school system. “The fact that environment-based education boosted achievement regardless of geographic location and socioeconomic status is most significant,” says Mary Smith, director of environmental education with the National Audubon Society.

According to the report, students’ natural interest in the environment motivates them to learn and understand the complexities of their world, which translates into higher test

scores. For example, the report describes the case of Isaac Dickson Elementary School in Asheville, North Carolina, where fourth-grade students saw a 31% boost in math achievement after just one year of environment-based learning as measured by state achievement tests.

Teachers also observed increased student motivation and improved classroom behavior after introducing environment-based programs. In fact, known troublemakers often find an interest in academics through the hands-on opportunities the environment offers as a classroom, the report says. “Teacher after teacher in Kentucky reported that students previously performing at low academic levels ‘came alive’ when introduced to an environment-based curriculum,” says the report.

The NEETF report follows the seminal 1998 State Education and Environment Roundtable report *Closing the Achievement Gap: Using the Environment as an Integrating Context for Education*, which examined 40 schools in 12 states and detailed the success of environment-based programs in motivating student interest and improving academic achievement. “The new report provides more evidence the first study wasn’t a fluke,” says Andy Finch, senior director of NEETF’s Education and the Environment Program.

The two studies attempt to take the case studies further by linking anecdotal evidence with test scores, Smith says. But there are limits to this approach as well. Whether test scores truly quantify academic achievement remains controversial. In addition, comparing data among states is difficult because achievement measures are increasingly state-specific, says report author Joanne Lozar Glenn.

The NEETF report recommends creating an Office of Ombudsman for the Environment to establish links among the Department of Education, the Environmental Protection Agency, the National Science Foundation, and other federal agencies concerned with U.S. education. The report also suggests conducting demonstration projects in order to improve community outreach programs and attract greater community involvement. It further recommends expanding cooperative educational ventures with resources such as public and private parks, marine sanctuaries, and nature centers. —Julie Wakefield

## A Better Grade of School Bus

The California Air Resources Board has launched a \$50 million initiative to reduce the harmful emissions produced by the state’s 24,000 school buses. Each school day, the buses emit 13 tons of nitrogen oxides and almost half a ton of particulate matter. As part of the initiative, 375 of the state’s oldest, most polluting buses will be replaced by cleaner diesel or alternative fuel buses. A portion of the funds will help build new fueling



facilities and defray the added costs of low-sulfur diesel fuel. Another \$12.5 million will be spent to retrofit the remaining diesel buses with filter traps to

reduce particulate emissions by at least 85%.

The new and retrofitted buses will be in place by the 2002–2003 school year.

## Sensing Lead in the Environment

A lead-detecting sensor developed at the University of Illinois at Urbana-Champaign is less expensive and less complicated than current methods and can be used to obtain real-time, on-site data. The sensor employs small pieces of DNA that were discovered through an *in vitro* selection process to be sensitive to lead. Researchers manipulated the single-strand DNA to create a special site at which the metal ion would bond. A fluorescent tag has been added to the DNA to boost the sensor’s detection abilities.

The sensor can be used for environmental and industrial monitoring as well as for clinical toxicology applications. Researchers believe that the principles used to develop this sensor can be applied to obtain DNA biosensors for other metals such as mercury, cadmium, calcium, and potassium.

## Screening Chinese Children for Lead

On 6 January 2001 China started the first phase of an enormous children’s lead screening program in Shenyang, the capital of the northeastern province of Liaoning. All of the city’s children under age seven, as well as pregnant women, will have medical examinations to determine if and how they have been affected by lead poisoning. Study participants will also receive lessons on how to protect themselves from lead exposure.

The project, which will also be carried out in seven other provinces, is expected to test 8–10 million children, who are increasingly at risk for lead exposure as China’s economy grows and with it transportation and industrial pollution levels. According to the Xinhua News Service, an earlier study conducted in the northern city of Taiyuan found that 64% of the 10,000 children tested had lead concentrations much higher than acceptable limits.



## AIR POLLUTION

## Dirty Air Stunts Lung Growth

Long-term exposure to air pollutants such as nitrogen dioxide and particulate matter can cause reduced lung growth in children, and the effects are more pronounced in areas where air pollution is highest, according to findings from the Children's Health Study, a 10-year longitudinal study at the University of Southern California in Los Angeles.

Started in 1993, the Children's Health Study is following the respiratory development of over 3,000 fourth-, seventh-, and tenth-graders from 12 communities throughout California with different levels and types of air pollution. Each year the students undergo lung function tests at school. The researchers also measure levels of ozone, nitrogen dioxide, particulate matter smaller than 10 microns in diameter, and acid vapors at each test site (gasoline and diesel engine emissions are the major source for all four pollutants). Data collected during the first four years of the study were reported in the October 2000 issue of the *American Journal of Respiratory and Critical Care Medicine* by lead author W. James Gauderman, an assistant professor

of preventive medicine at the university, and his colleagues.

Exposure to nitrogen dioxide, particulate matter, and acid vapors has been found to have the greatest association with impaired lung growth, with ozone having a statistically insignificant effect. Compared to students living in the least polluted communities, children living in the most polluted communities have shown a reduction in two measures of lung function: a cumulative 3.4% reduction in FEV<sub>1</sub> (forced expiratory volume) and a 5.0% reduction in MMEF (maximal mid-expiratory flow). The FEV<sub>1</sub>, or amount of air expelled in the first second of blowing, measures how well the large and medium-sized airways in the lung are functioning, explains Gauderman, whereas the MMEF measures

small airway function. Although children with reduced lung growth probably experience no outward symptoms of lung problems, they may be at increased risk as adults for chronic respiratory problems such as asthma and emphysema, says Gauderman. The longitudinal effect found in the first cohort has now been replicated in a second cohort, with identical results.

Children who spend the most time outdoors experience the greatest effect of air pollution on their lung function. Generally, advises Gauderman, children should minimize outdoor playing on high-pollution days. Reports on regional air pollutant levels are often available through TV weather channels and local meteorology offices.

"No one else has followed a cohort of schoolchildren of this age for this long a time," says pulmonologist David Bates of the University of British Columbia in Vancouver. He says the study's findings are "a major contribution" in understanding the long-term consequences of air pollution on children's lungs. Moreover, in 120 of the children who moved out of the study area and were tracked separately, lung function growth was greater in those who moved to cleaner environments compared to those who moved to more polluted areas. This is a "striking confirmation of the longitudinal study," Bates adds. —Carol Potera



**Smog stunts lungs.** Results of a long-term study show that air pollutants decrease lung growth in children and may lead to increased risk for respiratory disease as adults.

## MOLECULAR BIOLOGY

## Uncovering the Viral Mechanics of Croup

Researchers say they have solved the crystal structure of a key protein that allows the paramyxoviruses—the major cause of croup and other diseases—to attach to cells, which in turn permits the viruses to invade cells and cause respiratory illness. The new research, published in the November 2000 issue of *Nature Structural Biology*, may provide a basis for developing drugs to fight these diseases.

Members of the paramyxovirus family include the parainfluenza viruses (which cause respiratory infections), the mumps virus, and the Newcastle disease virus (which affects birds). "Most people who are infected with parainfluenza get symptoms similar to a bad cold," says Susan Crennell, the postdoctoral student at the University of Bath in England who used X-ray crystallographic techniques to identify the protein. "In very young children, this can develop into life-threatening respiratory disease including pneumonia." She adds, "Paramyxoviruses can be very dangerous to people—especially children—with compromised immune function."

The multifunctional paramyxovirus protein hemagglutinin-neuraminidase (HN) is critical to the invasion process that creates illness, Crennell says. HN, a protein on the surface of the virus, binds to cells, permitting a cascade of molecular events that results in the virus fusing to the target cell and then incorporating itself into the cell. Once inside the cell, the virus then has established a base of operations from which it can infect other cells.

Crennell says the project was made difficult because HN is a flexible protein that changes shape with different periods of the cell's life cycle. Before HN binds to the cell, it has a different shape than after it attaches. Once HN has bound to the target, the structure of the cell prevents a mediator—a drug, for example—from interfering with HN's work setting the infectious stage of development into motion. Crennell says the key to preventing HN from working is to know its shape prior to binding so it can be attacked before initiating the events that lead to fusion.

The study was performed using a form of the Newcastle disease virus. Crennell says that particular virus was used because scientists found they could get a crystalline structure of the Newcastle HN protein, something that has so far evaded researchers using the viruses that cause human disease. "The HN protein on this virus we believe is very close to that found on the human virus," says Crennell. With the crystal form available, Crennell exposed the structure to X rays. Computers analyzed the subtle changes in the signals produced by the X rays in order to show the shape of the protein.

Crennell says the structure provides the basis for the structure-based design of inhibitors for a range of paramyxovirus-induced diseases. Other researchers, including principal investigator Garry Taylor of the University of St. Andrews in Fife, Scotland, are just beginning to use the crystal structure of HN to design drugs that can prevent binding and keep the virus from causing illness.

"We have no vaccines or effective drugs to stop viruses like parainfluenza," says Fran Rubin, program officer for respiratory diseases at the National Institute of Allergy and Infectious Diseases, which partially funded Crennell's study. "This study opens new possibilities for drug development." She adds, "This report is the most exciting discovery in the field in quite some time." —Ed Susman





## Cancer Mortality Maps & Graphs

Scientists since the time of the ancient Greeks have noted the phenomenon of disease clusters, in which diseases occur in greater-than-expected numbers over a short time in a small area. In the 1850s, pioneering epidemiologist John Snow was one of the first physicians to construct maps solely for the purpose of studying a disease (in his case, cholera). His work was important not only for discovering how cholera is transmitted but also for showing the correlation between geography and disease. Over the past few decades, the use of maps as epidemiologic tools has greatly expanded with the development of computer mapping technologies and the use of the Internet.

In April 2001, the National Cancer Institute (NCI) launched its Cancer Mortality Maps & Graphs Web site, located at <http://www.nci.nih.gov/atlasplus/>. The site brings online the Atlas of Cancer Mortality in the United States, 1950–94, one of a series of atlases produced by the institute since 1975 showing geographic patterns of disease mortality through color-coded maps. These reference works provide epidemiologists and public health scientists a unique resource for studying disease patterns on both spatial



and temporal levels. The new Web site will be updated with additional cancer data as they become available.

Using atlas data, factors contributing to high rates of certain types of cancer have been identified. One example is the finding that elevated death rates from lung cancer in several southeastern U.S. coastal communities were linked to exposure of shipyard workers to asbestos during World War II. Another is that variations in cigarette smoking greatly influence the patterns of certain tobacco-related cancers, such as lung, larynx, esophagus, and oral cavity cancers.

The central core of the site is the atlas itself, accessible through the Atlas of Cancer Mortality in the United States: 1950–94 (Book) link. The atlas provides maps, text, tables, and figures for more than 40 cancers for the time periods 1950–1969 and 1970–1994. Clicking on the Mortality Maps and Rates by Cancer link leads to in-depth overviews of specific types of cancer, including conventional, complementary, and alternative treatment options; clinical trial information; and links to resources and support groups.

Visitors may also choose the Customize Mortality Maps option under each cancer type to create mortality charts and graphs based on any combination of parameters such as cancer type, geographic unit, time period, age group, race, and sex. These charts and graphs can be accessed by the visually impaired through text files that can be converted to speech with a screen reader. Back on the home page, the Customize Mortality Maps and Interactive Mortality Charts and Graphs links provide direct routes to these mapping options.

NCI officials hope this resource will be used not only by researchers and the general public to gain greater insight into patterns of cancer deaths but also by policy makers for allocating resources based on disease rates, availability of health care, and other demographic factors. The Centers for Disease Control and Prevention is using the Web site as a model for an injury mortality Web site it is developing, while several schools, including the Harvard School of Public Health and George Washington University, are using the site as a classroom teaching tool. The NCI plans to expand the site to include noncancer mortality mapping and graphing as well as other variables including environmental, occupational, and economic data. **—Erin E. Dooley**

## Diazinon Use Exterminated

In December 2000 the U.S. EPA banned indoor use of diazinon, a pesticide sold under various trade names (including Ortho, Spectracide, and Real-Kill) that is widely used for commercial and household insect control. The 1996 Food Quality Protection Act requires the agency to restrict or ban a pesticide if it poses a specific threat to children's health. A May 1999 EPA draft study on diazinon concluded that the pesticide may pose greater health risks than previously thought. The chemical, which can cause nausea, headaches, diarrhea, and weakness when inhaled, is one of the leading causes of insecticide poisoning in the United States, according to the EPA. Outdoor applications of diazinon will be phased out over a four-year period.



## EPA Acts for Kids

On 15 December 2000 the EPA announced it would for the first time require power plants to reduce mercury emissions, saying that these emissions pose significant human health hazards, especially to children and fetuses. The agency said it will propose regulations by 2003 and issue final rules by 2004.

Additional EPA efforts to protect children's health were announced in January 2001. On January 4, the agency set new standards for acceptable levels of environmental lead. Presently, nearly 1 million U.S. children have dangerously elevated blood lead concentrations. Under the new standards, lead is considered a hazard if there is more than 40  $\mu\text{g}/\text{ft}^2$  on floors, more than 250  $\mu\text{g}/\text{ft}^2$  on interior windowsills, and more than 400 ppm in bare soil in children's play areas.

On January 5, the agency established the Voluntary Children's Chemical Evaluation Program. This program calls for better evaluation of the risks to children from chemicals that they could be exposed to on a daily basis. Under this program, the EPA is asking manufacturers to voluntarily provide key testing data on 23 specific chemicals (including acetone, benzene, and toluene) that were selected because studies had found them in human tissue samples.

## Enviro-Friendly Farm Funding

The USDA has granted The Rodale Institute funds for research on how to increase the profitability and efficiency of family farms through organic and regenerative agriculture methods, which have the added benefit of promoting environmental health. A portion of the \$800,000 grant, which will target farms in the U.S. Mid-Atlantic region, will be used to study methods such as no-till farming and nutrient loading through compost programs. Plus, farmers will be educated on how they can put the research findings into practice. Money will also be allocated to educate extension agents in organic practices and to develop alternative marketing strategies for use by small farmers to increase their profits.

