The discovery which comes as a puzzle and surprise usually marks a fresh epoch and opens a new chapter in science.
Sir Oliver Joseph Lodge, English physicist (1851–1940)

PERSISTENT ORGANIC POLLUTANTS

Melting Glaciers Release Frozen Toxicants

The melting of glacial ice that formed in the middle of the twentieth century may be a source of a cocktail of persistent, bioaccumulative toxic substances that can threaten human health and the environment, according to a study by Christian Bogdal, a postdoctoral research fellow at the Swiss Federal Institute of Technology, Zürich, and colleagues in the 1 November 2009 issue of *Environmental Science & Technology*. Their findings, along with those of a handful of other studies, suggest the release of toxics once bound within glaciers may be a little-recognized consequence of ongoing climate change.

The Swiss team analyzed sediment samples taken from Lake Oberaar, a glacier-fed lake in central Switzerland. They measured sediment levels of several pollutants that would have entered the lake over the period 1953–2006 and compared the measurements with those from three lower-altitude Swiss lakes that aren't glacier fed. The substances analyzed included 17 dioxins and furans, 18 polychlorinated biphenyls (PCBs), 10 synthetic musk compounds, DDT and two of its transformation products (DDE and DDD), 4 additional organochlorine pesticides (hexachlorobenzene, hexachlorocyclohexane, dieldrin, and heptachlor epoxide) and their transformation products, and polychlorinated naphthalenes.

The Lake Oberaar and lower-altitude samples reflected a generally consistent pattern of increased influx of the compounds into the lakes from the 1950s through a peak in the 1960s–1970s, followed by a decrease to relatively low levels in the 1980s and 1990s. The exception was musk compounds, whose sediment influx was fairly steady from the 1950s to the mid-1990s. These patterns parallel the widespread increase in production and use of these substances from the 1950s through the 1970s, and the subsequent decline (except in the case of musk compounds) as concerns about toxic effects often resulted in restrictions or bans on use. These patterns also mesh with the premise that the primary source of the sediment toxics to that point was deposition of airborne pollutants generated in urban, industrial, and agricultural areas.

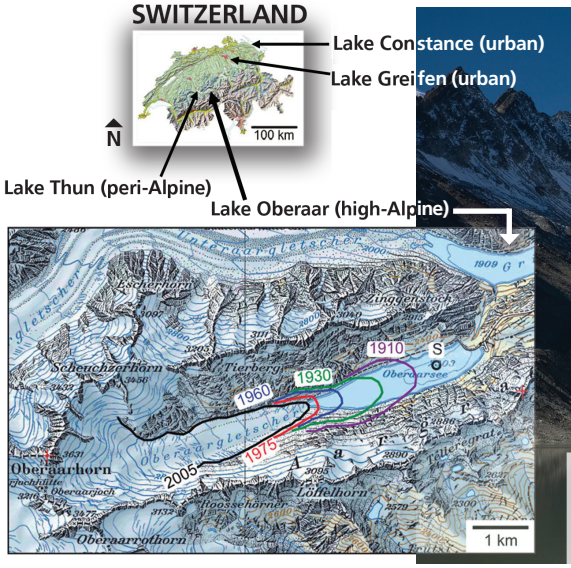
Beginning in the late 1990s, however, the influx of all the compounds into Lake Oberaar—but not the lower-altitude lakes—increased moderately to sharply. In some cases, the new peak influxes were 2–5 times higher than the 1960s–1970s peaks. These increases coincide with a total reduction in Alpine glacier volume of about 12% between 1999 and 2008, according to a report by Daniel Farinotti and colleagues in the August 2009 issue of *Global and Planetary Change*. About one-quarter of that reduction occurred following the unusually hot summer of 2003.

Bogdal and colleagues hypothesize that the sources of the later contaminant influxes they observed likely were not distant, because production and use of these chemicals had decreased substantially. Instead, they conclude the glacial meltwater was the source. Studies they are conducting at Lake Oberaar and elsewhere support this hypothesis, says Bogdal.

The evidence to date suggests the release of these and other persistent toxics, such as lead and mercury, may be a concern for many glaciated settings. Among areas of potential concern, say Bogdal and other experts in this field, are locations in the Arctic region, Antarctica, the Alps, the Himalayas, and the Caucasus, Andes, Rocky, Cascade, and Sierra Nevada mountain ranges. "Melting of glaciers is releasing a huge amount of water containing dangerous contaminants used in the past," says Roberta Bettinetti, an assistant professor of freshwater ecology at Italy's University of Insubria. "Now these pollutants can contaminate great basins even at low altitudes where water is used for drinking and fishing purposes."

In the October 2008 issue of *Chemosphere*, Bettinetti and colleagues reported on their study of the toxic effects of melting glaciers on biota of two southern Alpine lakes. They found that the amount of DDT and its metabolites released by melting glacial ice increased the concentrations in lake mussels and fish above the threshold considered safe for human consumption. Silvana Galassi, a professor of ecology at the University of Milan and coauthor of that report, recommends implementation of monitoring to identify areas where mitigation, such as limiting fish consumption or avoiding disturbance of sediments, may be warranted.

Bob Weinhold, MA, has covered environmental health issues for numerous outlets since 1996. He is a member of the Society of Environmental Journalists.



The retreat of the Oberaar Glacier is not a new phenomenon, but Bogdal and colleagues point out that ice formed in periods of higher pollution can result in "important" releases of contaminants upon melting.
Figure, left: Bogdal C et al. 2009. Environ Sci Technol 43(21):8173–8177.

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HAZARDOUS WASTE

GAO Grades Hanford Cleanup

In 1989 the Berlin Wall came down. The same year, the U.S. Department of Energy (DOE) began a large-scale initiative to clean up the radioactive waste from creating plutonium for nuclear weapons at its Hanford Site in Washington. While the world has changed dramatically since the Wall came down, change has come more slowly to the Hanford Site. "Over the past 20 years, DOE has tried developing various approaches for treating and disposing of these wastes, at varying costs and with little success," wrote the authors of a September 2009 Government Accountability Office (GAO) report titled *Nuclear Waste: Uncertainties and Questions about Costs and Risks Persist with DOE's Tank Waste Cleanup Strategy at Hanford*.

Some 56 million gallons of radioactive waste from Hanford now sits at a storage site upriver from 200,000 people. The waste is stored in 177 underground tanks. Generally speaking, 98% of the radioactivity in the waste comes from strontium-90 and cesium-137, which have half-lives of about 30 years. The other radioactive components have half-lives stretching into the millions of years. There are also "large volumes of hazardous chemical waste . . . [that] can remain dangerous for thousands of years," according to the report.

The DOE effort is governed by the Tri-Party Agreement, which describes the roles, responsibilities, and authority of the U.S. Environmental Protection Agency, the DOE, and the state of Washington. The agreement also establishes a plan to remove 99% of the waste from the tanks and sets milestones for completing certain tasks.

When the cleanup effort began, "it was not appreciated how hard it was going to be," says Micah Lowenthal, a National Research Council staff member who worked on that group's 2005 report *Risk and Decisions about Disposition of Transuranic and High-Level Radioactive Waste*. He points out, however, that some progress has in fact been made at the Hanford Site.

"They have spent billions of dollars on the tank wastes, and people might wish it were spent more efficiently, but it is not as though we haven't gotten anything for our money," he says. For instance, 149 of the 177 tanks are single-walled tanks, and 67 of these are known or suspected to have leaked. Lowenthal says the DOE has transferred the free liquids from all the single-walled tanks to the double-walled tanks.

Underground storage tanks being built at the Hanford Site circa 1947.

www.hanford.gov

Furthermore, he says, the DOE has taken steps to deal with other environmental and safety emergencies on the site and stabilize the situation. "Now," he says, "the agency is working on the long-term problem of retrieving, processing, and preparing the waste for disposal."

The GAO report details a number of technical concerns about the Hanford cleanup effort, which involves analyzing the composition of the waste, retrieving it from the storage tanks, separating it into appropriate waste streams, vitrifying it (immobilizing it in glass), and placing it into stainless steel containers, which will be stored in a permanent repository. Each of these steps faces uncertainties. For instance, the system to collect and analyze the waste may not operate as quickly and efficiently as intended, substantially slowing the whole waste treatment process. Also, the system to transport waste from the tanks to a new waste treatment plant may clog and inadequately filter out certain parts of the waste. The report says DOE efforts to test this system using simulated waste "may not uncover all potential problems."

The new plant is slated to start operating in 2019, but questions remain as to whether it will work as envisioned. Each step in the waste treatment process has to handle the chemical form of the waste it is fed. And the waste is very complex, says Gene Aloise, GAO director of natural resources and environment and lead author of the September report, who adds, "It's unlike anything else in the world."

And that complexity may translate into higher cleanup costs than anticipated. Cleanup could be complete as soon as 2042, but the GAO estimates the projected budget of $77 billion may balloon to $86–100 billion if the effort extends to 2054. "The cost has a lot of factors in it," says Lowenthal. "In addition to the fact that they're expected to do this unprecedented effort, they're expected to do it with a level of worker safety . . . that is also unprecedented."

The DOE is working to solve the problems identified by the GAO, says Erik Olds, director of communications of the department's Office of River Protection, which manages tank waste cleanup at the Hanford Site. "We expect by either the end of this calendar year or early next year to have completed and closed all of those issues . . . that the GAO referenced in its report," he says.

Although he talks optimistically, Olds acknowledges the DOE record at Hanford does not lend itself to optimism. "There is a history at the site of plans that were made for the treatment of tank waste that were never implemented for a variety of different reasons. One is that there were questions about the performance of the form, a grout, in which the waste would be immobilized," he says. He adds that the capability of treating waste has evolved over the years and that the new waste treatment plant is over half built.

The report references a forthcoming environmental impact statement (EIS) that will be used as the basis for several decisions about Hanford's cleanup, among them the final condition of the underground tanks, the final treatment and disposal of the wastes in those tanks, and whether waste from other DOE sites will be allowed to be stored there. According to the report, "the [EIS] provides an opportunity to use available risk assessment guidelines to consider scenarios the department has not considered to date—in particular, the possibility of removing varied quantities of waste from the tanks." The DOE issued the draft EIS on 30 October 2009 in cooperation with the Washington State Department of Ecology. It will be open for public comment until 19 March 2010.

Harvey Black of Madison, Wisconsin, has written for *EHP* since 1994 as well as for *Environmental Science & Technology*, *ChemMatters*, and the *Milwaukee Journal Sentinel*.

CHILDREN'S HEALTH

Less Pollution, Less Earache?

Children exposed to secondhand cigarette smoke suffer more ear infections. Irritating toxicants in cigarette smoke, such as carbon monoxide (CO) and sulfur dioxide (SO_2), also are constituents of vehicular emissions, so it's not surprising that children exposed to high levels of traffic pollution also have more ear infections, as shown by studies published in the September 2006 *EHP* and the May 2007 *European Respiratory Journal*. In the newest twist on the air pollution/ear infection connection, researchers have linked improvement in U.S. air quality over a decade with a reduction in the prevalence of pediatric ear infections.

Otolaryngologists Nina Shapiro of the University of California, Los Angeles, and Neil Bhattacharyya of Harvard University obtained data for 126,060 children, mean age 8.6 years, collected as part of the National Health Interview Survey between 1997 and 2006. Shapiro and Bhattacharyya identified cases of frequent otitis media (defined in the survey as three or more ear infections in the previous 12 months), respiratory allergy, and seizures. Seizures were included as a control condition believed to be unrelated to air pollution. Data on concentrations of CO, SO_2, nitrogen dioxide (NO_2), and particulate matter (PM) for the same 10-year period came from the U.S. Environmental Protection Agency (EPA). Elevated levels of all four pollutants are strongly associated with deficits in respiratory health.

During the study period, air quality steadily improved, and the incidence of recurrent ear infections fell, but the incidence of allergy or seizures did not change. SO_2 and NO_2 were more strongly associated with frequent otitis media than were CO and PM. The researchers reported the results at the American Academy of Otolarynology—Head and Neck Surgery Foundation national meeting in October 2009. Bhattacharyya elaborates, in figures not presented at the meeting, that in 1997 there were about 5.8 million cases of children with frequent otitis media, whereas by 2006, the number of frequent otitis media cases had fallen to 4.1 million.

These preliminary results suggest it may be possible to "track the effects of environmental pollution on one disease, in this case ear infections, and see if children benefit from a greener Earth," says Udayan Shah, co-director of fellow and resident education in pediatric otolaryngology at Nemours–Al DuPont Hospital for Children in Wilmington, Delaware. The findings, while intriguing, will need to be confirmed in studies of individual children.

Exactly how air pollutants might contribute to otitis media remains unknown. However, all four toxicants are known to cause inflammation that restricts the movement of respiratory cilia that clear toxicants. "The lining of the middle ear is similar to the respiratory tract mucosa," notes Shapiro, suggesting that similar mechanisms may be involved. In a study published in the April 1989 (part 1) issue of the *Annals of Otology, Rhinology, and Laryngology*, Y. Ohashi and colleagues found that SO_2 depressed cilia function in guinea pigs' ears.

The Clean Air Act revisions of 1990 strengthened the EPA's enforcement of stringent regulations aimed at improving air quality to benefit the nation's health, with the added benefit of reducing medical costs. In the February 2004 issue of *EHP*, Eva Y. Wong and colleagues estimated that reductions in air pollution by 2010 as a result of the Clean Air Act could save up to $2 billion in children's respiratory health costs alone. If the current findings bear out, the savings could be substantial for otitis media costs, which may exceed $5 billion annually, according to a report in the June 2000 issue of *Pediatrics*.

In future projects, Shapiro and Bhattacharyya will explore how changes in average annual temperature relate to respiratory illnesses in adults and children. In the first study of this type, Bhattacharyya found a statistically significant association between increased prevalence of sinusitis and increased annual temperatures between 1998 and 2006, as described in the October 2009 issue of *The Laryngoscope*.

Carol Potera, based in Montana, has written for *EHP* since 1996. She also writes for *Microbe*, *Genetic Engineering News*, and the *American Journal of Nursing*.

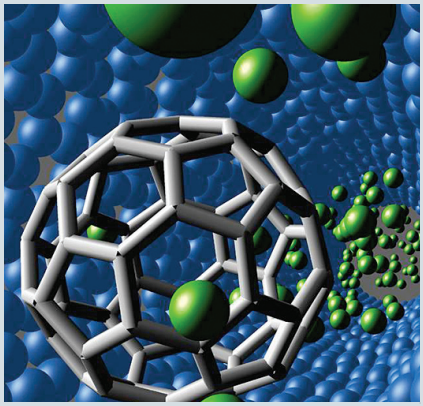
The Beat | by Erin E. Dooley

Young and Restless

In work published online 3 Nov 2009 in the *Journal of Epidemiology and Community Health*, sons of women who reported smoking heavily in pregnancy were nearly twice as likely as sons of nonsmokers to exhibit restlessness and distractibility at age 3 years. Despite limitations—potential underreporting of smoking in pregnancy, dependence on parental reports of behavior, and unmeasured maternal characteristics that could influence child behavior—the study supports earlier animal findings that cigarette smoke exposure *in utero* affected neurologic development in fetuses. Jayne Hutchinson and colleagues write that studies in this cohort using teacher assessments of behavior at older ages may yield valuable insights.

Nanotech Summit Highlights Business Needs

Research Triangle Park, North Carolina, played host to the Research Triangle Environmental Health Collaborative's second annual summit in October 2009. The summit focused on environmentally responsible development of nanotechnology, including critical environmental health issues faced by businesses in the development and manufacturing of nanomaterials. A guidance document with recommendations for business and policy makers will be forthcoming.



Acetaminophen May Spur Asthma

A review in the Nov 2009 issue of *Chest* indicates acetaminophen use may be associated with as much as a 75% increased risk of developing asthma and wheeze in adults and a 60% increase in children. Senior author J. Mark FitzGerald and colleagues are attempting to help explain why asthma rates have risen over the past 30 years. Over this same period physicians began advising patients to use acetaminophen rather than aspirin

Left to right: © CRG Studios/Blend Images LLC; ORNL

RESEARCH ISSUES AND INITIATIVES

NIEHS Funds Human BPA Research

With $14 million in stimulus funds from the American Recovery and Reinvestment Act, the NIEHS is bolstering a coordinated effort to produce data on bisphenol A (BPA) that will help refine our understanding of whether the general population's current exposures to the chemical pose a health risk. Used in producing plastics, BPA can leach into food and beverages from everyday items such as food storage containers, water bottles, and baby bottles.

The NIEHS has used the stimulus monies to fund 10 two-year studies on the potential contribution of low-dose BPA to problems such as obesity, diabetes, reproductive disorders, asthma, sexually dimorphic behaviors, cardiovascular diseases, and prostate, breast, and uterine cancer. Those grants augment ongoing work on BPA by researchers in the NIEHS Intramural Division and at the National Toxicology Program (NTP).

Many animal studies suggest exposure to low doses of BPA during critical periods of fetal development may result in adverse reproductive, behavioral, and carcinogenic changes over the long term. However, fewer studies have examined whether or how the effects seen in animals translate to humans. In 2008 the U.S. Food and Drug Administration (FDA) declared BPA safe, with an updated ruling pending at press time. But regardless of what the FDA decides at this point, scientists involved in BPA research agree more human data are needed for the compound.

"Policy makers and regulatory agencies such as the FDA are constantly looking at new data, and we're hoping that the data we will provide in the next two years will have a significant impact in helping them [continue to assess] the health effects of this chemical," says Jerry Heindel, a health scientist administrator at the NIEHS.

Coordinating the new effort with research already under way will yield a more comprehensive understanding of BPA while also maximizing resources, says Linda S. Birnbaum, director of the NIEHS and the NTP. "We saw the stimulus package award as a real opportunity to bring together the ongoing NIEHS work, the NTP work, and these new projects to clearly answer the question of how much of a problem BPA may or may not be," Birnbaum says. In total, including the stimulus funds, the institute will invest approximately $30 million over two years on BPA-related research.

Many of the awardees met with institute scientists involved in ongoing BPA research in October 2009. "Having the key players talking to one another as they begin new research efforts will stimulate collaboration, create opportunities to share resources, and encourage researchers to develop reliable and reproducible methods that will allow for a comprehensive assessment of the human health effects of BPA," Heindel explained in an NIEHS press release.

The group will continue to meet periodically and share data and tissue samples. For example, one of the new grantees, B. Paige Lawrence, an associate professor at the University of Rochester School of Medicine, is studying whether BPA influences immune-mediated diseases, but some of the data from her study may also provide clues to the chemical's potential role in cancers. "The same types of cells and pathways that fight viral infections also detect and destroy tumor cells," she says.

The new effort is crucial to getting results from human studies quickly, says grantee Kim Harley, an epidemiologist at the University of California, Berkeley, who will study BPA levels and health outcomes in a birth cohort of 300 children followed through age 12. "We haven't focused on BPA before," she says, "but we have this valuable cohort as well as urine samples stored, so with this grant we can measure BPA levels and start to see the effects in children all the way to puberty."

Angela Spivey writes from North Carolina about science, medicine, and higher education. She has written for *EHP* since 2001 and is a member of the National Association of Science Writers.

because of aspirin's link to Reye syndrome. This life-threatening disorder can affect people of all ages, although it is perhaps most notorious for affecting children. Further prospective studies are required to better understand the acetaminophen–asthma connection, and the authors do not recommend abandoning acetaminophen as a treatment for flu symptoms in children.

Sensor for Pesticides in Foods

In the 1 Nov 2009 issue of *Analytical Chemistry*, Zakir Hossain and colleagues describe a new biosensor they have developed that works more quickly and cheaply than conventional methods to detect small amounts of organophosphate and carbamate pesticides in foods and beverages. Conventional methods can take hours to reveal such contaminants, but the new bioactive paper sensor provides results in minutes. The researchers note their method could be especially useful in developing countries, which often lack access to electricity and expensive testing equipment.

The Temperature of Conversion

A new study reveals that most land use changes in the United States lead to local and regional increases in surface temperature, with the greatest increases occurring with urbanization and conversion to bare soil. But Souleymane Fall and colleagues also report that conversion of land to agricultural uses resulted in cooler temperatures even if the land was previously forested, perhaps because of increased evaporation. These findings add to a growing body of knowledge that highlights the necessity of incorporating land use changes into climate change models. The paper appeared online 24 Aug 2009 ahead of print in the *International Journal of Climatology*.

Phones and Bones

In a study of 150 male cell phone users, Tolga Atay and colleagues found that wearing a belt-mounted phone was associated with decreased bone density in the pelvic iliac wing closest to the phone—perhaps, they suggest, due to exposure to electromagnetic fields (EMFs). Although the reduction in bone density was not statistically significant, the authors note the men in their study were relatively young (21–57 years old). If the reductions resulted from exposure to EMFs from the phones, the effect could grow with continued use. (Conversely, very weak EMFs have been used successfully to stimulate healing in broken bones.) The report appeared in the Sep 2009 issue of *The Journal of Craniofacial Surgery*.

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