Department of Environmental Health

ENVIRONMENTAL HEALTH News

School of Public Health and Community Medicine ▪ University of Washington ▪ Winter 1999

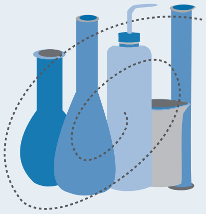
TOXICOLOGY AND YOU

At what point in your day should you stop drinking coffee if you want to sleep well later on?

Does drinking alcohol during pregnancy result in a low IQ child?

Given the health hazards it poses, has lead been taken out of gasoline all over the world?

Photo: Fred Felleman



INSIDE THIS ISSUE

Toxicologists concern themselves with questions in arenas like these (see answers on our back cover); they work to help us understand and deal with the thousands and thousands of chemicals that are part of modern life. Their discipline has been formally defined as "the study of the adverse effects of chemicals on living organisms, and the assessment of the probability of their occurrence" (Society of Toxicology).

Last December 3, toxicology was the subject of a day-long continuing education course offered by the Department of Environmental Health through its Northwest Center for Occupational Health and Safety. The instructors were Dr. Steven Gilbert, Affiliate Associate Professor of the department, and Dr. Rafael Ponce, technical director of CRESP, a department program concerned with hazardous waste cleanup at nuclear weapons sites.

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Dr. Gilbert noted that toxicology is an old science that is closely linked to medicine. Toxicology's medical counterpart is pharmacology, the study of the beneficial and adverse effects of drugs. The adverse effects–"side effects"–are the aspects that must be balanced against benefits. For example, drugs taken to control or cure cancer are often very toxic, and it is only the amount administered that separates helpful effects from those that could cause death. Paracelsus (1493-1541) summed this up in his famous quote: "The right dose differentiates a poison from a remedy." As *EH News* has reported, even an element as poisonous as arsenic may be necessary to human health in trace amounts (although, if it is, scientists don't know why).

Dr. Gilbert remarked that he likes to modify Paracelsus' familiar quotation to focus on personal response: "*The sensitivity of the individual* differentiates a poison from a remedy." He added: "The fundamental principle of toxicology is the *individual* dose-response curve." To illustrate human variability, readers of this issue of *EHN* will learn how workers at the Hanford Nuclear Reservation react very differently to occupational exposure to beryllium, a substance that can severely challenge the immune system.

The ability of a toxic agent to get into a specific organ of the body often dictates effect. Lead exchanges for calcium and accumulates in the bones, while many pesticides are stored in fat cells. Storage sites for mercury are the kidneys and the central nervous system, as readers will discover from our article on mercury and a visit to the dentist. Drs. David Eaton and William O. Robertson have written (see Reading List, page 11): "Historically, the heavy metals–most notably lead, mercury, and arsenic–presaged the advent of occupational and environmental toxicology. Centuries before Christ, outbreaks of poisonings were recorded based on interpretation of simple epidemiologic observations."

Does the body have a reserve capacity to defend itself against some toxic agents, at least up to a certain point? Yes. Genetic variability is one kind of defense. Metabolism –the body's ability to change a substance into more basic chemical parts–is another. Through metabolism, a toxicant may be reduced to elements that are either harmless or more readily excreted, a process called detoxification. The liver is the most important organ for this process.

Some people have a genetically determined sensitivity to chemicals that leads to various health problems, including cancer. Dr. Ponce explained that cancer is a group of diseases characterized by uncontrolled cell growth. Chemical carcinogenesis involves different stages, the first of which, *initiation*, involves the binding of a chemical to DNA. While most DNA damage is either minor, lethal to the cell, or repaired by special DNA enzymes, some DNA changes may not be repaired. Changed, precancerous cells may remain in a quiescent state (the "latency period") for many years, or be destroyed by antibodies. However, if immune reaction fails or new substances called *promoters* are introduced, cells may proliferate, become tumors, and metastasize to different parts of the body.

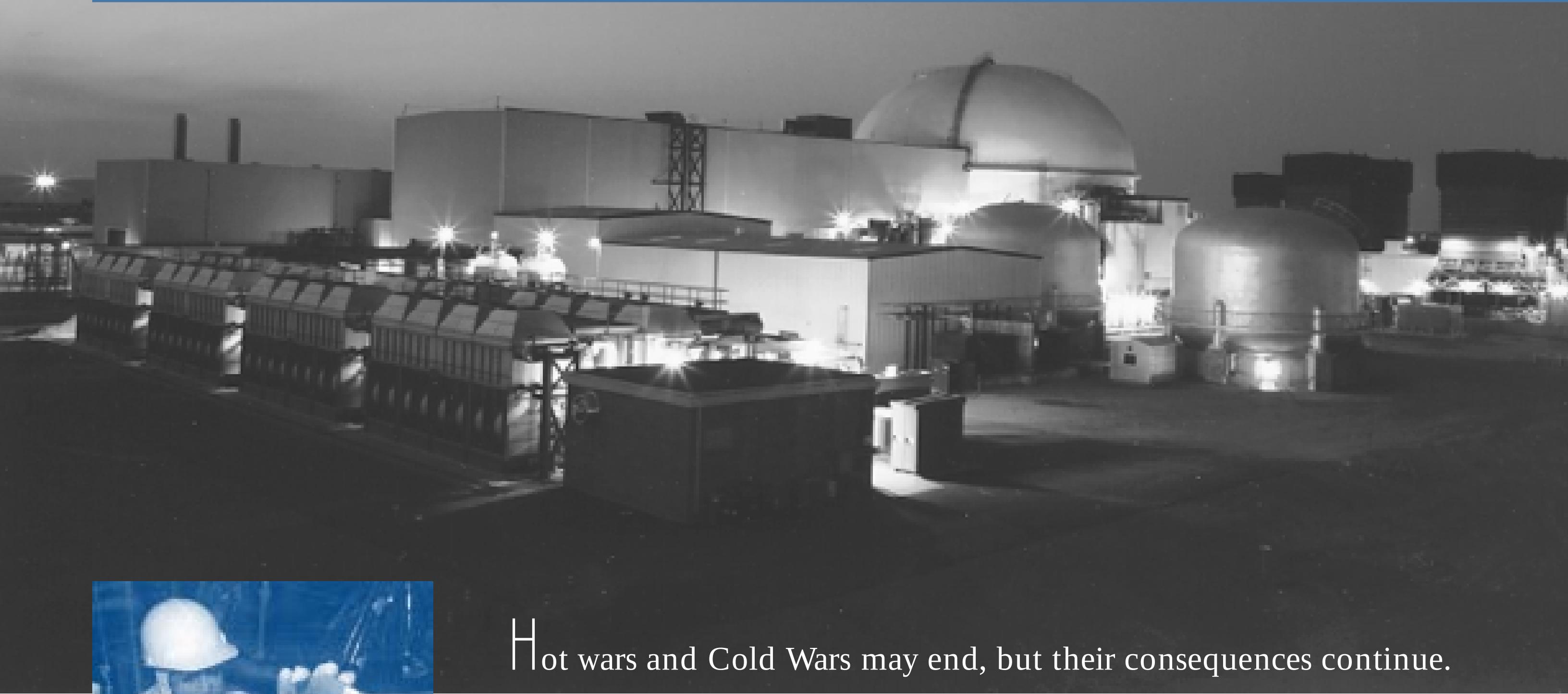
Chemicals cause other problems, including immunologic impairment, neurobehavioral effects, kidney/liver disfunction, reproductive failure, and birth defects. A developing fetus is extremely sensitive to toxicants, particularly during the first trimester of pregnancy. As embryonic development continues, methylmercury, lead, and alcohol are examples of substances that can seriously harm the developing nervous system, to birth and beyond. A new issue in toxicology is whether man-made chemicals can mimic natural chemicals, such as hormones, to cause body abnormalities and other problems.

In our daily round, we are not exposed to one toxicant at a time. At Hanford, some workers have been occupationally exposed to very complicated poisonous mixtures. Ordinary indoor air pollution may simultaneously involve tobacco and wood smoke, molds, carpet glue, mothballs, cleaning products, bug sprays, flea collars, and many other substances. Sometimes one substance can cause the body to respond more strongly to another. We know, for example, that environmental tobacco smoke greatly increases the risk of cancer from asbestos exposure.

In the occupational setting, industrial hygienists employ both mechanical devices and human biomonitoring to measure and evaluate potential hazards. Dr. Michael Morgan, a faculty member in the Department of Environmental Health, explains aspects of biomonitoring in a final article in our discussion of toxicology.

—PC

HANFORD WORKERS AND BERYLLIUM



Photos: Hanford file

Until Dr. Takaro's research team came along, it was thought that any exposure at Hanford was too low to produce health problems.

Hot wars and Cold Wars may end, but their consequences continue.

One more example? The discovery, by the Department of Environmental Health's Dr. Timothy Takaro, of worker risk from beryllium used at the Hanford Nuclear Reservation in Eastern Washington. Beryllium was used to seal fuel rods for the reactors that produced plutonium for nuclear weapons, as well as for other purposes.

Beryllium is a strong, lightweight metallic element used not only in connection with weaponry, but also in the aerospace industry and, increasingly, in consumer goods ranging from golf clubs to bike frames. It is also used in making dental crowns. (In 1932 beryllium enabled Sir James Chadwick to discover the neutron when he bombarded beryllium with alpha particles.)

Beryllium becomes a problem when its particles are delivered to the lungs. For reasons that are not yet fully understood, the lung mounts a strong immune reaction to the particles. According to Dr. Takaro, significant beryllium exposure was thought to have been eliminated by the 1950s through engineering redesign of manufacturing processes. And indeed, acute berylliosis, caused by breathing in particles at high levels, is no longer a problem. However, chronic beryllium disease (CBD) is a different case. Until Dr. Takaro's research team came along, it was thought that any exposure at Hanford was too low to produce health problems. But the disease can have a long latency period (as long as 25 years) and is sometimes confused with sarcoidosis, another pulmonary ailment. (The usual symptoms of chronic beryllium disease are shortness of breath and coughing.) Before the finding of a clear case of CBD at Hanford, some workers were misdiagnosed.

In an interview with *Environmental Health News*, Dr. Takaro stressed that, since occupational disease is often difficult to discern, the correct diagnosis of the first case is extremely important—scientists call it the "sentinel event." From there, the challenge is to figure out whether other people have been put at risk and to determine how they were exposed. CBD is not a disease to be taken lightly. In unusual cases, it can kill in as little as two to three years if not accurately diagnosed and treated. Although some people do not respond to treatment, with the help of steroids and other immunosuppressant treatments patients can live for many decades. For others, the disease simply goes dormant.

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Only a few former or current workers at Hanford have so far been diagnosed with chronic beryllium disease. But a great many have yet to be given a blood test that reveals the sensitization to beryllium which initiates the disease process. According to some studies, half of the people who *develop a sensitivity* to beryllium will develop the lung disease in five years; Dr. Takaro has already found a handful of people who are sensitized. He fears that up to 13,000 workers may have been beryllium-exposed. This figure does not include construction workers who have encountered contaminated dust when repairing or rebuilding facilities over the years. As the Hanford site is "remediated" (cleaned up), workers will continue to be exposed to dust. An uncomfortable and important finding from other work sites has been the fact that a few people not engaged in manufacturing or cleanup work—such as secretaries and security guards—have somehow been exposed and sensitized to beryllium. There have been reports of disease after a single known exposure.

Happily, the vast majority of people who are exposed to beryllium do NOT become sensitized. This fact involves individual genetic differences—some people are extremely sensitive to the element, others not sensitive. One known genetic biomarker, known as Glu-69, has shown a high correlation with incidence of chronic beryllium disease development. However, there are other genetic factors involved in the disease that have yet to be identified. One version of the blood test used to determine sensitivity is also a research tool for understanding additional genetic factors. The possibility of using genetic testing to determine predisposition has been explored by Department of Environmental Health researchers and found to have potential value; such testing does, however, present problems concerning privacy, discrimination, and other issues.

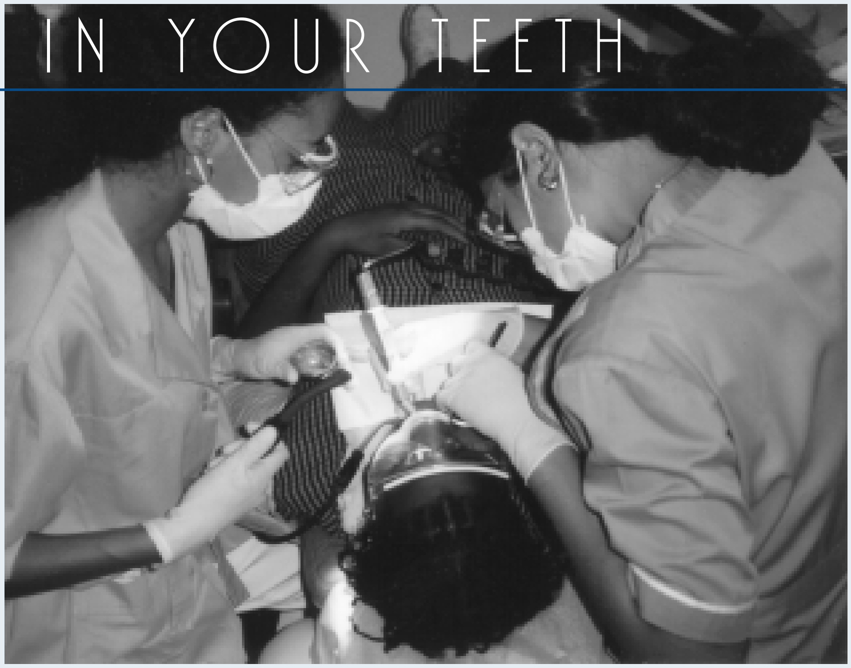
A worker protection program has now been mandated at Hanford by the US Department of Energy, and includes medical surveillance of employees who worked in buildings where beryllium is known or suspected to have been used. Occupational and medical histories are taken using questionnaires, and blood samples are collected for analysis. Although no CBD symptoms may be present, the blood sampling establishes the sensitization that may progress to disease. What lab technicians do with a blood sample is to culture T lymphocytes, a subset of white blood cells, with beryllium. They then look to see to what degree the T lymphocytes have increased in number. Millions of cells must be counted, using either isotopes or a dye, to establish the degree of proliferation.

Suppose you were to look at a Biological Exposure Index (BEI) produced by the American Conference of Governmental Industrial Hygienists (illustrated on page 9) to get information about beryllium standards in the workplace. You would not find beryllium listed. This is not because there are no workplace standards for beryllium—the US Occupational Safety and Health Administration (OSHA) has air standards—but because beryllium affects the lungs through a complicated immune response, rather than through a direct hit. This sort of effect is not on the BEI. In some ways it resembles the way asthma affects the lungs. An asthma attack is the end result of a complicated response to an allergen such as pollen; beryllium functions as an antigen (foreign substance) which sets off an immune reaction.

Dr. Takaro noted that OSHA now recognizes that its current standards are not sufficiently protective and need to be updated. The fact that current standards do not protect, he said, has "enormous implications" for workers—not just at Hanford, but across the US at other former weapons facilities and at the many smaller industrial operations and dental laboratories where beryllium is used.

Dr. Takaro's work is funded by CRESP, the Consortium for Risk Evaluation with Stakeholder Participation. Founded in 1995, CRESP is a partnership of university researchers in Washington State and New Jersey working to help the US government make decisions about cleaning up the nation's nuclear weapons sites. *—PC*

THE MERCURY IN YOUR TEETH



At the School of Dentistry at the University of Lisbon, a Portuguese child receives a filling.

Photo: Michael D. Martin

Going to the dentist today to have a tooth filled? If so, chances are your filling will be made of an alloy containing about 50 percent mercury, the standard amalgam used around the world for dental restoration work. Millions of mouths contain mercury fillings, yet definitive research is still underway as to whether or not mercury amalgams represent a human health concern.

The dangers of high-level mercury exposure have long been recognized. Whether mercury amalgams (which also contain silver and other materials) represent a case of chronic, low-level mercury hazard has yet to be determined. Two scientists connected with the Department of Environmental Health, Professor Jim Woods and Affiliate Associate Faculty member Diana Echeverria of the Battelle Centers for Public Health Research and Evaluation, are addressing the issue.

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Dr. Woods is currently active in projects involving two different age groups in two different countries: 500 children in Portugal and 400 dental assistants and dentists in Seattle. Dr. Woods is collaborating with Dr. Echeverria in the latter project. Their research is funded by two institutes of the National Institutes of Health, the National Institute of Dental Research and the National Institute of Environmental Health Sciences.

Mercury toxicity affects, especially, the central nervous system and the kidneys, which are its storage sites. According to Dr. Woods, it was once believed that mercury alloys, when fully hardened in a tooth, remained more or less inert; however, we have since come to realize that the material slowly leaches, helped along by saliva. A very small amount is swallowed and simply passes through the body like many other substances; a greater amount vaporizes and enters the lungs. From there it goes into red blood cells and eventually affects the central nervous system. A portion of vapor is oxidized in plasma and ends up in the urine.

Mercury vapor, especially, is very toxic. Dentists and dental assistants come into contact with vapor when preparing amalgams. As the hazards of handling mercury have become more recognized, dental professionals have handled it with more care—squeezing it from a capsule under well-ventilated conditions, using protective gear. With more careful handling, mercury in the urine of tested Washington State dentists has shown a steady decline since the 1970s. Dentists now typically have urinary mercury levels similar to the levels in the general population. Several uses of mercury, such as putting the substance into latex paint, have been abolished; however, people may be exposed through food (especially fish); through certain occupational exposures (such as work with hazardous wastes, thermometer or barometer manufacture, some chlorine-related manufacturing processes); and through releases from fossil fuel power plants and incinerators, to list a few possibilities.

To evaluate chronic, low-level mercury exposure from amalgams, Drs. Woods and Echeverria will do various kinds of testing. To measure vapor exposure, the team will place air monitors in dental settings, and the 400 volunteers will wear mercury-registering dosimetry badges. Blood and urine samples will be taken twice, at six month intervals, and tests given for kidney functioning and for how a rare mercury allergy affects the kidneys.

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In addition, urine samples will be evaluated for substances called porphyrins. Five porphyrins are normally excreted in the urine. Dr. Woods and colleagues have discovered that there is a change in the porphyrin excretion pattern that is unique to mercury. Some of the porphyrins that normally are present in urine in low concentrations increase dramatically when mercury is retained in the kidneys, the principal body storage site. The particular porphyrins that are affected by mercury can therefore be used as *metabolic biomarkers* of mercury body burden. Some of the volunteers who have elevated urinary porphyrins will be treated with a drug (called a chelating agent) that binds with mercury in the kidneys and facilitates mercury excretion in the urine. A decline in urinary porphyrin levels *after* removal of mercury from the kidneys by chelation would confirm that elevated urinary porphyrins accurately reflect mercury retention in body tissues.

Dr. Echeverria will evaluate the central nervous system of volunteers with a standardized battery of tests that she has developed over the past ten years. Mercury is known to affect cognitive and other functions. Cognitive tests—some done on a computer—will measure such things as various kinds of memory; attention span and the ability quickly to switch one's attention; visual and spatial abilities; mood (tension, depression, anger, fatigue, confusion); and motor function. In addition, another set of tests will measure postural sway, imbalance, heart rate interval, nerve conduction velocities, and sensitivity to vibration and smell. Dr. Echeverria will be looking for potential shifts in behavior at very low mercury exposure levels.

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Dr. Echeverria noted that, for dentists, any problem with motor skills (such as poor coordination or tremor) is a potential problem, since dentists need steady hands to work with drills and small instruments. Motor problems correlate with a finding of about 5–10 micrograms of mercury per liter in urine; Washington State dentists evaluated in the 1970s and early 1980s averaged above the upper level of this urinary range, but now typically measure around 3 micrograms per liter. One kind of coordination test requires participants to place a pen in a series of holes with decreasing diameters without hitting the sides. Researchers have observed a clear dose-response effect with increasing mercury concentration.

Drs. Woods and Echeverria are expecting to have their correlated results in about another year. The children's study in Portugal with which Dr. Woods is involved is just beginning its third year and will probably continue for a minimum of seven to eight years. Funding is being provided by the National Institute of Dental Research, and a team of interdisciplinary researchers from the University of Washington, including lead scientists from the UW School of Dentistry, is taking part.

In this study, the 500 children participating are 8 to 10 years old (thus beyond the age for loss of their baby teeth) and are from backgrounds that have not allowed necessary dental care. Pilot studies established that their prior exposure to mercury (or lead) was insignificant. It will be usual for these children to need 15-20 fillings; they have lacked the opportunity to drink fluoridated water, which has now more or less eliminated the need for fillings in the teeth of most US children. Some of the Portuguese children will receive the usual mercury amalgams and others will receive a composite made of a mixture of acrylic resin and finely ground up porcelain. The work will be done at the School of Dentistry of the University of Lisbon. Extensive behavioral and neurological tests will be administered before and after dental treatment and urine monitoring will be done. This is one of the first studies focusing on the safety of mercury amalgams for children, who are, generally speaking, more sensitive to toxicants than are adults.

Dr. Woods observed that any substitute for mercury in amalgams should have certain qualities. It must not be so costly that people will see a dentist less often; it must be durable; and it must have "expansive" properties that enable it, once inserted, to fill in all crevices of a tooth cavity, leaving no air pockets.

Neither Dr. Woods nor Dr. Echeverria recommends that mercury amalgams in one's mouth be replaced, barring some unusual circumstance, such as an allergy to mercury. This is because mercury vapor is released in excavating a filling for replacement. While Dr. Echeverria noted that such decisions are personal ones at the present state of knowledge, she commented that "the person who will feel the benefit [of replacement] is rare."

—PC

MERCURY DISTINCTIONS

Elemental mercury is a natural metallic element that occurs everywhere on earth and vaporizes into the atmosphere (volcanoes and hot springs are emitters, for example), then falls in rain over the land, rivers, and oceans. By combining with other chemical substances, elemental mercury forms both *inorganic* and *organic* mercury compounds.

Mercury and compounds of mercury may be absorbed through the skin, the lungs, and the gastrointestinal tract. (Mercury in urine is about 98 percent inorganic.) One organic form, *methylmercury,* is created by microbes that act upon inorganic mercury. Methylmercury is taken up in the bodies of aquatic organisms that are, in turn, consumed by creatures higher on the food chain, such as birds and fish.

Since human beings eat fish, the amount of methylmercury fish can contain is regulated to prevent health hazards. The US Food and Drug Administration has authority over fish sold in markets and eaten in restaurants. Many states have advisories for those catching fish in certain waters, advising against eating fish or suggesting limits on the number of fish consumed from those waters. Sometimes the advisories are aimed at pregnant women, nursing mothers, and children under 15, who are particularly vulnerable to mercury hazards. However, the subject of methylmercury in fish has become highly controversial, with differing positions being taken as to what is safe. The heart of the matter is a standard risk assessment problem: Fish have nutritional value that must be taken into account in setting mercury safety standards. Expect to see more discussion of this issue. *—PC*

MERCURY IN WONDERLAND

In Lewis Carroll's tale of Alice, why is the hatter mad?

Although the hatter pours tea over the dormouse and has an eccentric view of Time, he's really no "crazier" than many of the other characters in *Alice in Wonderland*. But according to Martin Gardner, author of *The Annotated Alice*, the phrase "mad as a hatter" was common at the time Carroll wrote, and a reason for Carroll's creation of his "mad" hatter.

Gardner writes that the "mercury used in curing felt [for hats] was a common cause of mercury poisoning. Victims developed a tremor called 'hatter's shakes,' which affected their eyes and limbs and addled their speech. In advanced stages they developed hallucinations and other psychotic symptoms."

Felting involves the interlocking of materials–such as wool, fur, and certain hairs–that, because of their structure, can be combined without adhesives. In an interesting 1992 article in *Occupational Medicine*, Dr. Martin Cherniack explains that felters applied a solution of mercury and nitric acid to rabbit skins. The fur was then dried, cut, and brushed. So dusty was this procedure that mercury levels in air "could range from...100-1000 times the [US early 1990s] workplace exposure limit."

As the dangers of mercury were recognized, the British Parliament took action to outlaw uses by the mid-1860s. In the US, important mercury exposure studies were done in the 1920s. However, a US Public Health survey of 25 felt-hat plants as late as 1941 found widespread use of mercury and of mercury-induced symptoms. *—PC*

ASSESSING WORKER EXPOSURES

The Department of Environmental Health has a weekly Seminar Series for students and faculty, which features speakers from within the department, public agencies, and other university departments. During autumn quarter, DEH faculty member Michael Morgan presented a talk, from an industrial hygienist's perspective, on biomonitoring in the workplace. A report on some of his remarks, supplemented by a later interview, follows. Professor Morgan directs DEH's Undergraduate Program.

Consider this scenario: Workers using a powerful solvent suspect that levels of a chemical in the air around them are not being accurately recorded by air monitors in the room where they work. Although the monitors are recording low levels, the odor of solvent is very strong. They raise this issue with their union representative, who in turn raises it with their manager. Eventually arrangements are made for biomonitoring.

What is biomonitoring? While there are different kinds, used for different purposes, that employed by industrial hygienists involves the planned, repeated collection, over time, of some form of biological specimen—most commonly urine, blood, expired air, or a secretion such as saliva or sweat. While ambient air monitoring has served us well in the past to protect workers from toxic chemicals, and should almost always be employed in conjunction with biomonitoring (so that "body readings" and monitor readings can be compared), inhalation is not the only route by which a chemical enters the body. Thus the use of biomonitoring as an adjunct to air monitoring should be considered.

There are interesting international differences in attitudes towards biomonitoring in societies across the world.

From the standpoints of both workers and employers, Dr. Morgan noted, biomonitoring can be seen as having both positive and negative attributes. Among the positives are the fact that biological specimens taken from workers will account for such routes of exposure as skin contact, because the specimen will "sum up" all exposures; can take into account how chemicals are processed differently in different individuals; can reveal nonoccupational exposures to chemicals (if a worker's specimens, say, reveal differences on a Monday morning following a weekend off); and can help test the performance of protective equipment, since specimens can be taken both before and after equipment use.

Among the possible drawbacks are such problems as worker dislike and suspicion of being monitored; the fact that monitoring is a repetitive process that may require a good deal of data collection before results can be interpreted; and the process can be expensive, both in terms of the costs of lab analysis and because certain professionals may need to be added to the monitoring team if some kinds of specimens—blood samples, for instance—are to be collected.

There are interesting international differences in attitudes towards biomonitoring in societies across the world. In such places as Japan and Sweden, for example, as well as in other countries of Europe, biomonitoring is simply something that is done. In the US, workers tend towards more suspicion of their employers, with concerns about how data will be used and what employers are "really" looking for, such as illegal drug use. Biomonitoring can also be seen as an unwanted nuisance at the end of a long day or week. For these and other reasons, workers are perhaps as likely to reject biomonitoring as to accept it, unless they are, as in the scenario with which this story opened, concerned about some toxic hazard. The presence of a labor union, representing an opportunity for organized worker discussion, may make workers more inclined to biomonitoring than they would otherwise be.

One question to be asked when considering biomonitoring is whether there is a definitive analytic method available for dealing with a suspected problem. In testing for exposure to the solvent toluene, for instance, one needs to know that toluene taken into the body is largely metabolized into hippuric acid. However, finding a large amount of hippuric acid in a urine sample is not a reliable indicator of toluene exposure, because hippuric acid also appears in urine as a result of eating such foods as cereals, fruits, and vegetables. Since hippuric acid is not a good indicator of toluene exposure, hygienists instead look at the level of o-Cresol (ortho-Cresol), even though only about 1 percent of toluene is converted into o-Cresol. In the case of another substance, benzene, experience has led hygienists to switch from looking at phenols in urine samples to examining, instead, mercapturic acid.

Finding any substance in urine or some other bodily excretion does not take one too far without a guideline or standard of comparison to help interpret what the presence of the substance at that level might mean. Here the work of professional associations and government agencies comes into play.

Dr. Morgan is currently chair of the BEI Committee of the American Conference of Governmental Industrial Hygienists (ACGIH). This international committee, made up of volunteer scientists and practicing professionals in a variety of fields, has the job of developing reference values against which observed biological concentrations of a substance may be compared, in order to form judgments about workplace conditions. The reference values are published as a list of Biological Exposure Indices–BEIs–and are periodically reviewed as new scientific information becomes available. The review process involves many steps and has been described in an article by Dr. Morgan that is referenced at the end of this story. See the table below for examples of how reference values are set forth. The complete ACGIH list contains approximately 35 compounds or groups of compounds; another list, compiled in Germany, contains about 40 compounds, with overlap between these two major lists. Much important biomonitoring work is now being done in Europe.

In the US, the Occupational Safety and Health Administration has made biomonitoring mandatory for only two substances to which workers may be exposed: lead and cadmium. So much is now known about the dangers represented by different levels of lead in the blood, in fact, that it is one of only two cases in which the ACGIH does not correlate blood sample results with monitor readings. Cholinesterase inhibitors–found in pesticides–are the other case.

Dr. Morgan described one company's experience with worker exposure to N, N-dimethylacetamide, a solvent used in making acrylic fibers. Although air monitors usually showed acceptable (or even better) air conditions, both the company and workers were aware that some kind of chemical contact was occurring; the question became whether the protective gloves used by workers were performing adequately. A three-month biomonitoring study, involving urine specimens, showed that in some workers skin absorption was indeed taking place. While it is not known how many US companies have done or are doing biomonitoring, because there is no developed reporting system, this case demonstrated that a biological indicator revealed much more about worker exposure to a chemical than did air monitoring alone.

Dr. Morgan concluded his talk by noting that the future will bring industrial hygienists new tools, as research is done to develop molecular biomarkers, better sampling techniques, and more data on how chemicals are processed within the body. These tools should contribute to the principal goal of the industrial hygienist: the prevention or minimizing of work-related illness.

—PC

For Further Reading

Morgan, M. 1997. The Biological Exposure Indices: A key component in protecting workers from toxic chemicals. *Environmental Health Perspectives* 105 (Supplement 1, February): 105–115.

SAMPLE PRESENTATION OF THE BEI INDICES*

Chemical Agent	Biological Exposure Index	Reference Value	First Adopted	Last Revised
Acetone	Acetone in urine	50 mg/liter	1994	1999
Cobalt	Cobalt in urine	15 µg/liter	1995	
	Cobalt in blood	1 µg/liter		
Lead	Lead in blood	30 µg/dl	1987	1995

* The chemical agents listed here are chosen merely as examples. As explained in Dr. Morgan's article in *Environmental Health Perspectives* (see For Further Reading), the BEI for lead has been set at a level to prevent or minimize effects that are believed to result in persistent functional impairment of the worker or his or her offspring. Certain effects may be seen at blood lead levels below the BEI of 30 micrograms per deciliter, but are not believed to represent significant impairment for various reasons. Few substances of health significance have been so thoroughly studied by epidemiologists as has lead. Abbreviations used above: mg = milligram; µg = microgram; dl = deciliter.

CONTINUING EDUCATION

For course details, call (206) 543-1069, or visit the departmental home page on the Web at *http://depts.washington.edu/envhlth/*. Upcoming courses:

NW CENTER FOR OCCUPATIONAL HEALTH & SAFETY

Mar 16-18	Hazardous Materials Incidents: Improving Interagency Response (*Bellingham, WA*)
Mar 22-26	Comprehensive Review of Industrial Hygiene
Mar 30	Ergonomics in the Forest Products Industry
April 8	Safety & Health in Commercial Fishing
April 20	Occupational Skin Disorders: Management and Prevention
April 28	Effective Worker Training: What Safety & Health Professionals Need to Know
May 27	Implementing An Ergonomics Program in Your Workplace (*Anchorage*)


DEH Archives

Dr. Rolfe Hahne

OSHA TRAINING INSTITUTE EDUCATIONAL CENTER

Mar 15-18	OSHA 600: Collateral Duty Course for Other Federal Agencies
Mar 22-25	OSHA 501: Trainer Course in OSHA Standards for General Industry
Apr 5-7	OSHA 226: Permit-Required Confined-Space Entry
Apr 14-16	OSHA 502: Update for Construction Industry Outreach Trainers
Apr 19-21	OSHA 503: Update for General Industry Outreach Trainers
Apr 26-29	OSHA 201A: Hazardous Materials
May 3-6	OSHA 510: OSHA Standards for the Construction Industry
May 7	OSHA S: Scaffolding Users Course
May 10-13	OSHA 500: Trainer Course in OSHA Standards for The Construction Industry
May 24-27	OSHA 309A: Electric Standards (*Portland*)
June 2	OSHA 225: Principles of Ergonomics
June 7-10	OSHA 501: Trainer Course in OSHA Standards for General Industry


DEH Archives

Dr. Matt Keifer


DEH Archives

Participants in Costa Rica.

FOUR-DAY COURSE IN SEATTLE

Comprehensive Review of Industrial Hygiene — March 22-26, 1999

This special course is specifically designed to assist practicing industrial hygienists in preparing for the American Board of Industrial Hygiene (ABIH) core and comprehensive exams (it is not intended for entry level professionals). Sponsors are DEH's Northwest Center for Occupational Health and Safety and the Center for Occupational and Environmental Health of the University of California at Berkeley. Classes will meet at the HUB on the UW campus; however, registration is through the Berkeley center. For more information, call (510) 231-5645 or use the Web home page at http://socrates.berkeley.edu/~coehce/.

PEOPLE & PLACES

Sharon Morris has been appointed to a four-year term as a member of the Board of Scientific Counselors of the National Institute for Occupational Safety and Health (NIOSH). This 15-member board advises the NIOSH national director on current needs in the fields of occupational safety and health, and on the degree to which NIOSH-funded research activities are producing intended results.

DEH's Matthew Keifer, Rolfe Hahne, and Tim Takaro, along with epidemiology doctoral candidate Larry Engel, recently travelled to Costa Rica to conduct a five-day course on occupational and environmental epidemiology at the National University of Costa Rica. Attendees included scientists and public health practitioners from Panama, Ecuador, Nicaragua, and Honduras, as well as Costa Rica. The course was a joint effort of the National University, the Carolinska Institute of Sweden, and a project called International Scholars in Occupational and Environmental Health (ISOEH). ISOEH receives funding through the Fogarty International Center, which in turn is supported by the National Institutes of Health. At the University of Washington, ISOEH is housed in the Occupational Medicine Program, a joint project of the Department of Environmental Health and the Department of Medicine.

While in Costa Rica, Rolfe Hahne spoke to a group of 50 occupational hygienists on current trends in occupational hygiene in the US, and addressed faculty and students at the Technological Institute of Costa Rica on strategies for reducing chemical exposures. These activities were also supported by the Fogarty International Center, which has as its purpose the training of scientists from developing countries.

Rick Gleason is lecturing in March in Anchorage, AK; Richland, WA; and Portland, OR, in connection with OSHA safety and health programs. His Portland presentation ("Advanced Machine Guarding Techniques") is part of the Oregon Governor's Safety and Health Conference.

Gerry Croteau, an M.S. student in Industrial Hygiene, recently published a paper in *Applied Soil Ecology* (December, 1998, coauthor L. M. Zibilske). The paper was entitled: The influence of papermill processing residuals on saprophytic growth and disease caused by *Rhizoctonia solani.*

LETTER TO READERS

Dear Readers:

We're interested in hearing from you!

As you've probably observed, articles in *Environmental Health News* are derived from the important and varied research done by faculty and staff of the Department of Environmental Health and its many affiliated departments and institutions, both within the University of Washington and beyond.

While this will continue to be the case, we'd be happy to know: Are there topics you'd like to hear more about? Is there some special feature you'd like to see instituted on a regular basis? How does our publication meet—or not meet—your needs? Beginning with this issue, you will find the editor's E-mail address on our back cover. (Our regular mailing address is there too, of course.) Please accept this invitation to send us your thoughts.

—SM

P.S. If you haven't yet mailed back the prepaid address update card enclosed in our Autumn 1998 issue, please do so.

A Reading List For This Issue

continued from page 1

Ottoboni, A. 1997. *The Dose Makes the Poison: A Plain Language Guide to Toxicology*. John Wiley and Sons, Inc., New York, NY.

Rosenstock, L., and M. Cullen. 1994. *Textbook of Clinical Occupational and Environmental Medicine*. W. B. Saunders Company, Philadelphia, PA. Chapter 8, on toxicology, was written by DEH's Dr. David Eaton and by Dr. William O. Robertson of the Washington Poison Center. (Several members of the Department of Environmental Health contributed to other chapters of this book.)

Berger, B. 1994. *Beating Murphy's Law: The Amazing Science of Risk*. Dell Publishing, New York, NY.

Chu, E. 1997. Integrating risk, people, and the environment. *Environmental Health News* (Winter): 1–10. Contains additional bibliographies.

Cherniack, M. 1992. Diseases of unusual occupations: An historical perspective. *Occupational Medicine* 7 (No. 3, July–September): 369–384.

TOXICOLOGY & YOU

Answers to questions on page 1

1. There is no single answer. A good example of human variability.
2. It certainly can—and also to a child with facial deformities and speech and learning problems. Pregnant women should not drink alcohol.
3. No. Even in Europe, there is still lead in gasoline in some countries.

Help with questions on toxicants and/or indoor air pollution

- Community Outreach and Education Program, UW Department of Environmental Health: (206) 616-7557
- Master Home Environmentalist Program: (206) 441-5100
- Washington Poison Center: 1-800-732-6985

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