

The Scientist

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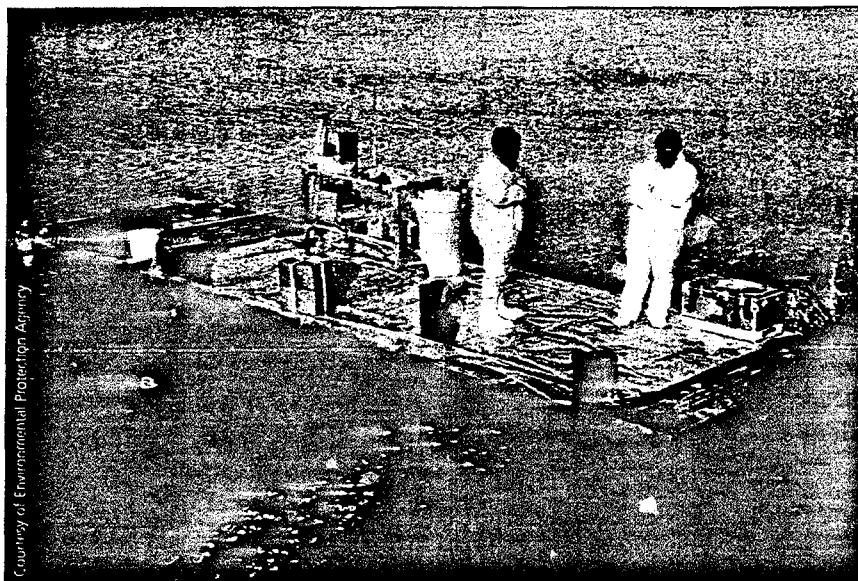
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PCB DILEMMA



Workers prepare for a sediment coring demonstration on the Hudson River

Government, industry, and public debate dredging vs. bioremediation in the Hudson River

By Ricki Lewis

To dredge or not to dredge, that is the question. In communities near the Hudson River in upstate New York, debate rages over whether the Environmental Protection Agency should remove polychlorinated biphenyl (PCB)-containing sediments from "hot spots" along a 40-mile-long stretch or continue to leave them be.

The EPA recently announced its "preferred remedy": targeted dredging to lower the burden of PCBs that General Electric deposited in the river at Hudson Falls and Fort Edward between 1947 and 1977. According to the plan, sealed buckets and hydraulic dredges will remove some

2.65 million cubic yards of sediment containing more than 100,000 pounds of PCBs, which will cost GE nearly half a billion dollars. "It will be dewatered locally, then shipped by rail to a Texas hazardous waste site," explained Richard Caspe, director of Superfund for EPA Region 2, at the first public comment session that was held December 12 at the Saratoga Springs City Center. Local reporters had a field day with the statistics, most eloquently Carl Strock of Schenectady's *Daily Gazette*, who quickly converted the figure of 3,900 acres of river bottom to two Yankee stadiums worth of muck.

Dredging isn't all that's proposed. The plan also includes "monitored natural attenuation," government-speak for letting bacteria keep on degrading the molecules, as well as institutional controls such as no-fishing signs and plugging any persistent leaks of PCBs into the river. In 1984, the EPA had deemed a "no action" policy sufficient, because appropriate removal technology was not yet available. But the art of dredging has improved, and all sides agree that just letting microbiology take its course could be a two-

(Continued on page 14)

Fighting Darwin's Battles

Symposium marks evolutionist victory, anti-evolution growth

By Eugene Russo

For the past 80 years, the teaching of evolution has flirted with extinction several times in several states. From the famous 1925 Scopes Monkey Trial in Tennessee, to the recent debate in Kansas, Creationist challenges to the teaching of Charles Darwin's theory have persisted despite mounting evidence in support of it. According to a panel of scientists and historians speaking at a symposium at last month's American Association for the Advancement of Science meeting, such challenges, often involving proposals to give "equal time" to Creationist and evolutionist theories, will continue both nationally and internationally.

The AAAS symposium took place four days after the February 14 decision by the

(Continued on page 13)

New Mexico Talent Fuels Startups

National labs and initiatives spur biotech businesses

By Steve Bunk

Behind an anonymous door in a semi-industrial sector of Santa Fe, N.Mex., the principals of QTL Biosystems plot what they hope will become a revolution in biosensing. QTL is one of the most recent of the many high-technology startups that have spun off from the state's research institutions, especially Sandia National Laboratories (SNL) in Albuquerque and Los Alamos National Laboratory (LANL) in Los Alamos. Capitalizing on an extraordinary concentration of research talent in the region, private and government initiatives have nurtured 40 high-tech startups in the past seven years, including such ventures in biomedicine as QTL.

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PCB DILEMMA

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century proposition.

The December 12 public comment session had a 1960s ambience, with a small group of demonstrators braving near-zero temperature outside the city center to sing "Jingle Bells" with GE-bashing lyrics. Inside, the several-hundred-strong throng was polite, but clearly fractionated. Sierra Club members up front wore shirts proclaiming "Clean Up the Hudson River: For Our Families, For Our Future." A GE contingent filled the back of the room. And in between were many residents whose lives the EPA's decision will directly affect. The areas in question are mostly rural or suburban, with the southernmost tip the city of Troy.

EPA officials distributed a 30-page summary of its six-volume feasibility study, which clearly outlines the arguments for targeted dredging. The peer-reviewed plan considered data from academic, industrial, and government researchers, including risk estimates for human health based on animal and epidemiological studies; sediment surveys; water and air quality measurements; and effects of PCBs on river life and crops. "We used a complex mathematical model to predict what will happen to the river if we do what we have proposed—or if we do not. It is a common-sense approach," explained Caspe.

SOUND SCIENCE, OR OVERKILL?

An environmental dredging project of this magnitude is unprecedented. "There have been projects, although not of this scale, proposed, but not yet implemented. However, all of the technologies have been used; this isn't anything new. What we are doing is putting them all together into one large package," says Douglas Tomchuk, EPA's Remedial Project Manager for the Hudson River PCB site.

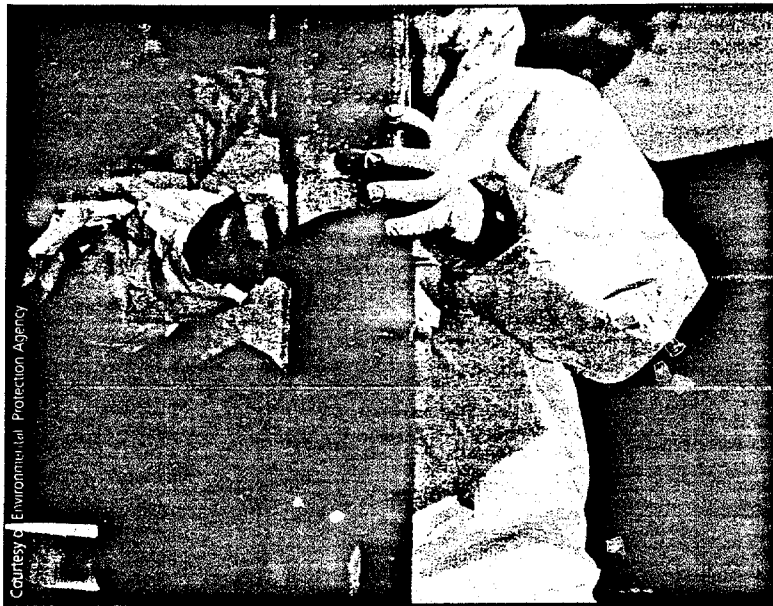
EPA's plan includes close scrutiny. "Turbidity monitoring in real time will be done downstream from each location. There will also be daily PCB measurements," Tomchuk comments. Devices called silt curtains will contain particulates. Even if dredging stirs up the mud somewhat, the process should ultimately take out more than it liberates from the bottom. "We will be getting rid of the places that leak one to two pounds of PCBs a day, while adding only about 20 pounds a year by resuspension," Tomchuk estimates. And EPA will have help. The New York State Department of Environmental Conservation "will serve as a watchdog throughout this process to ensure that EPA uses sound science at every step," explained commissioner John P. Cahill.

The EPA claims that the project will take five years; GE sees a timetable at least twice that long. And although Cahill claims that "the cleanup work must not significantly interfere with activity on the river or traffic in the cities, towns and villages along its banks," the true extent of intervention remains to be seen. When a resident of Westport, a town near Lake Champlain, asked EPA representatives at the public comment session exactly how the proposed action would affect his community, the answer was that for any one targeted hot spot, dredging would proceed six days a week, 24 hours a day, for six months. And even if everything works just fine and disruptions and noise prove tolerable, PCB levels in fish won't drop to acceptable levels until at least the year 2070, the EPA projects from smaller-scale PCB dredging efforts.

NATURAL BIOREMEDIATION—TOO SLOW?

At the crux of the debate seems to be the natural process of bioremediation that is taking place in the river. Both sides—EPA and GE—agree that this is happening, but questions arise over the pace and degree of degradation. The EPA's summary report and poster displays at the meeting conclude, "PCBs in sediments will not be naturally 'remediated' via dechlorination. The extent of dechlorination is limited, resulting in probably less than 10 percent mass loss of PCBs."

But Larry Bopp, one of the research scientists who identified the steps of natural bioremediation of PCBs at GE from 1977 through 1987 and is now at the VA Medical Center in Albany, insists that bacterial dismantling of PCBs is an observable biological phenomenon,



A cylindrical core sample is sliced for subsequent analysis

not a company ploy. It happens in two steps: buried anaerobic bacteria strip off chlorines, thereby converting one congener (a type of PCB, see page 15) into another, and then aerobes in the water column above cleave the biphenyl rings. Still other microbes eventually degrade these products into carbon dioxide, water and chloride, Bopp says.

"As the PCBs are dechlorinated, they become more soluble, and therefore more mobile. Over a long time, they will slowly migrate to the aerobic surface sediments by diffusion and be degraded by the aerobes. This will not occur quickly, but it will occur," Bopp says. And while dredging may lead to removal of "No Fishing" signs faster than just leaving the river alone, it may not be a permanent solution. "If you sequester PCB-laden sediments in a sealed landfill, which is essentially entirely anaerobic, this progressive degradation will not occur," Bopp adds.

Others echo unease with the EPA's proposed plan, sometimes by their silence. "I am in favor of dredging with qualifications: Dredging alone will not solve the problem, because you have to put highly toxic materials in a place where they will stay forever. Ideally, we would dredge and treat sediments to remove PCBs, but no technology now can do that. Still, the health effects are so overwhelming that to do nothing is unacceptable. Dredging is the best of the short term solutions," says David O. Carpenter, a professor of Environmental Health and Toxicology at the School of Public Health at the University at Albany in New York.

All camps involved in the PCB debate are anxiously awaiting a full report from the National Academy of Science's National Research Council. NRC Chairman Bruce Alberts sent an executive summary of the report, "A Risk Management Strategy for PCB-Contaminated Sediments," to the EPA on December 29, 2000, offering 11 general recommendations for environmental dredging. Noticeably absent was any advice specific to a site.

"We are avoiding the issue for good reason. There are not a lot of sites where you can make a good assessment of the variety of processes used. Yes, there has been a lot of dredging, but not much environmental dredging," says NAS project director Roberta Wedgwood. Dredging has been attempted in New Bedford Harbor, Rhode Island and in the Lake Michigan region, she

points out, but neither resembles the Hudson river situation—New Bedford is a saltwater estuary, and Lake Michigan is deep, fresh water. "The sites are all very, very different, and I cannot say whether or not dredging will work. Long-term monitoring has been done at very few sites," she adds.

Lenore Clesceri, professor emerita of biology who worked on PCB bioremediation at Rensselaer Polytechnic Institute, is absolutely clear on what should—or shouldn't—be done. "Leave the PCBs in the mud. Concern over long-term effects is valid, but it's not a perfect world. Dredging is not only extremely expensive, but disruptive and wasteful. The river will be improving. We can't expect it to happen overnight; we need decades. We have to change our mentality and demand instant gratification."

With public comment still at the boiling point in many towns along the Hudson, and with GE, the EPA, and environmental groups still engaged in the battle of the TV ads, the issue is still far from settled. The EPA will continue to consider public comment until April, and will render a final decision in August. Stay tuned—and mean-

while, don't fish in the Hudson. ☐

Ricki Lewis (rickilewis@nasw.org) is a contributing editor for The Scientist.

Resources

Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov/facts17.html

American Council on Science and Health
www.acsh.org/press/editorials/pcb121200.htm

Environmental Protection Agency
www.epa.gov/hudson

General Electric
www.hudsonvoice.com
207.141.150.134/dredging/dredging20.html

National Resource Council
www.nationalacademies.org/news

New York State Department of Environmental Conservation
www.dec.state.ny.us

Sierra Club
www.sierraclub.org

Evaluating the Evidence

By Ricki Lewis

The problem of what to do with polychlorinated biphenyls (PCBs) in the Upper Hudson River Superfund Site in New York is as intractable as the suspect sediments themselves. On one level, the fate of the PCBs is a standoff between corporate giant General Electric and the Environmental Protection Agency, whose proposed "targeted dredging" of 2.6 million cubic yards will come at company expense. On another level, the PCB problem is a scientific challenge of almost unimaginable complexity.

"There are 209 possible PCBs, or congeners, and each has its own profile of toxic effects," says David O. Carpenter, a professor in the school of public health at the University at Albany. Tracking industrial PCBs—mixtures of interconverting congeners—in the environment is difficult. "PCBs are not uniformly buried. It is a very dynamic system in which PCBs are coming out of the sediments and redepositing themselves. They comprise a major contaminant in the top nine inches of the river, and 500 pounds a year flow over the Troy dam en route to the lower river," Richard Caspe, director of Superfund for EPA Region 2, told an audience of more than 600 at the first public comment session in December.

The PCBs, according to Caspe, present a "serious health threat" to individuals who routinely eat fish from the Hudson River, and this justifies dredging. Sierra Club literature calls the chemicals a "toxic legacy now poisoning the Hudson" and "causing a host of serious ailments." But the published medical and scientific literature paints a decidedly less grim portrait.

Most studies extrapolate risk from nonhuman animal data or correlate elevated PCB levels in blood or body fat to health effects, which are usually subtle. But just because the residents of Hudson Falls and Fort Edward, where GE capacitor plants released PCBs for three decades, do not have three heads doesn't mean that ongoing biomagnification of these compounds in the environment won't eventually harm health. Cautions Howard Frumkin, chair of the department of environmental and occupational health at the Rollins School of Public Health at Emory University in Atlanta, "Absence of proof does not equal proof of absence."

AN EPIDEMIOLOGICAL QUAGMIRE

PCBs were used extensively to manufacture hydraulic fluids, capacitors, transformers, pigments, and electrical equipment from the early 1930s until a U.S. ban in 1977.¹ The endurance that made them valuable industrial chemicals also accounts for their persistence in the environment. Half-lives of the congeners range from 10 to more than 80 years—PCBs are in all of us.

As the chemical name indicates, a PCB is built of two phenyl groups (a type of six-carbon ring) and varying numbers of chlorine atoms. Although the more highly chlorinated forms have been considered to be more toxic, some of the others may be associated with neurodevelopmental deficits, according to Carpenter. Human tissue usually has at least three dozen different PCBs.

Establishing exposure to PCBs is challenging, says Steven Stellman, an epidemiologist at the American Health Foundation in Valhalla, N.Y., who teaches at Columbia University. The two dozen studies examining PCBs and breast cancer illustrate the problem. "These studies do not use exposure, but a surrogate,

which is the current body burden measured in blood or fatty tissue. Trying to summarize lifetime exposure to very low levels of a persistent compound in terms of a single number requires faith in body burden as an adequate measure of cumulative exposure," he says. More meaningful links between environmental exposure and disease, he adds, come from historical situations where the dates and doses are well documented, such as spraying of Agent Orange in Viet Nam and associated reproductive problems.

Tracking health effects is also a sticky situation, because the primary route of human exposure to PCBs is contaminated fish, which the financially strapped are more likely to eat. Clearly, "just saying no" to eating fish from waters containing PCBs doesn't work. "The EPA's mission is to protect human health, and we know that not everyone follows fishing advisories. When the economy is bad, a lot of people rely on the river for food," says Douglas Tomchuk, remedial project manager for the Hudson River PCB site. Alison Hess, also a remedial project manager, brings up a broader concern: "birds and fish do not read advisory signs."

The Kalamazoo River watershed offers another example of fishing PCB-containing waters. The area includes an 80-mile Superfund site and feeds Lake Michigan. Deinking and recycling of carbonless copy paper from 1957 to 1971 by Allied Paper Inc. added PCBs, related organic molecules, and metals to the watershed. Signs of a stressed ecosystem include thinned eagle eggshells, infertile mink, and fish, ducks, and turtles with high PCB levels. But detecting effects in people isn't as easy.

"Tribespeople from Laos settled here after the Vietnam war. They keep to themselves, and eat a lot of carp, which is one of the most contaminated fishes, with 30 parts per million [ppm] PCBs. The epidemiological problem is to try to study them and tell them not to eat fish, which is part of their culture," comments Charles Ide, director of the Environmental Institute at Western Michigan University, which just nixed a study because it



Workers use a grab sampler for the Ecological Sampling Program

would cost more than \$1 million just to sign people up and evaluate them. Meanwhile, Ide is using DNA chips to track gene expression in response to PCB exposure in

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News

frogs, rats, carp, and humans, a new approach to identifying exactly what PCBs do.

Interpretation is yet another complication of evaluating PCBs. A 1998 angler survey by the Michigan Department of Health for the Kalamazoo site, for example, found that the average level of PCBs in blood of frequent fish eaters is 2.1 parts per billion (ppb), compared to 1.1 ppb for non-fish eaters. Comparatively speaking, this is nearly a doubling of risk—but is it high enough to even affect health? Is the difference less than the error in such a small measurement?

Sometimes researchers draw different conclusions from the same data sets by asking different questions. This happened with a cohort of people diagnosed with pancreatic cancer in San Francisco. A study of a subgroup of the cohort showed that both those individuals with mutant *k-ras* oncogenes and those for whom this cancer-causing gene was normal had the same PCB levels, a finding interpreted to indicate no causal relationship between the chemicals and the mutation.² Yet another study of 108 of the San Francisco group compared to 82 healthy controls showed that "median concentrations of ... PCBs ... were significantly greater among cases than controls."³

WHAT'S KNOWN—AND WHAT ISN'T

The PCB literature is confusing, at best.

Neurological Effects: We know the most about PCBs' effects on the nervous system, thanks to a "mass poisoning" of more than 2,000 Taiwanese in 1978 and 1979. The people were exposed to PCBs and their breakdown products, dibenzofurans, when contaminated rice oil was heated. Fetuses fared worst. Within four years, 21 percent of those exposed in utero had died. Survivors were left with a distinctive constellation of symptoms dubbed Yu-Cheng, which means "oil-disease." They were undersized before and after birth, have hyperpigmented hair and nails, characteristic facial features, chloracne, and deficits in neurocognitive development.⁴ Short stature, intellectual impairment, and behavioral problems persist into adulthood.⁵ "They had horrendous neurological developmental problems and birth defects. I don't know of incidents in the Western world that come even close," relates Stellman.

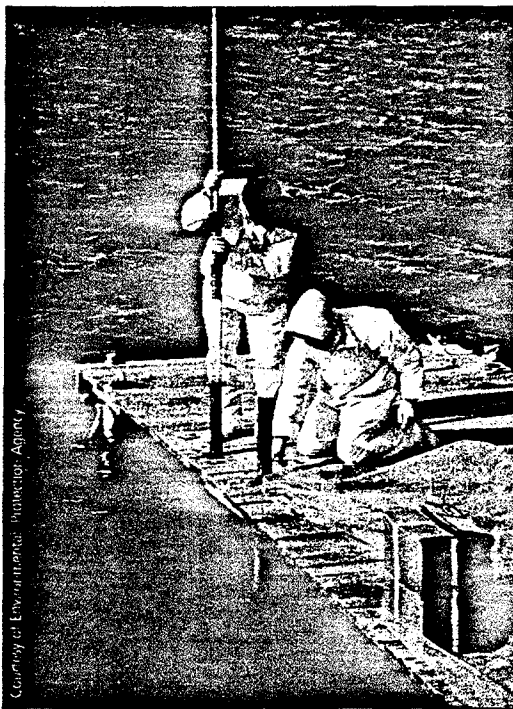
Lower exposures are linked to more subtle neurological effects, say Frumkin and Carpenter. "There has been a long history of demonstrating behavioral effects very much like lead exposure in children. Exposure before birth and possibly after is associated with lower IQ, of five to eight points. That's not to say that all these kids are stupid, but that they are less bright than they otherwise might have been," explains Carpenter.

Most studies of PCB's effects on the nervous system involve children or laboratory animals. Kaye Kilburn, a professor of medicine at the University of Southern California School of Medicine, has conducted one of the few investigations to date on neurobehavioral effects in adults.⁶ She compared a battery of symptoms and functions among 98 people exposed to PCB-containing pumping fluid to 50 matched controls, and found statistically significant deficits in such skills as reaction time, memory, ability to place pegs in boards, color discrimination, balance, and visual performance. These signs of compromised neural function can have practical repercussions, such as "legal blindness, inability to follow a story plot, or getting lost in familiar places," she says. And the New York State Health Department is currently looking for neurobehavioral effects among 100 long-time residents of Hudson Falls and Fort Edward who have not worked with PCBs, compared to residents of another town farther from the river.

Cancer: The PCB-cancer connection is widely misrepresented. The EPA, the World Health Organization, and others consider PCBs to be probable carcinogens, based on nonhuman animal data. "There is no question that PCBs are carcinogens in animal models, where they cause tumors in liver and kidney. It is a long-standing belief in the [United States] that a proven animal carcinogen is a potential human carcinogen," explains Stellman. But some environmental groups distort meaning by eliminating qualifiers, such as "risk." Sierra Club literature, for example, refers to PCBs as "cancer-causing

pollution." In contrast, EPA material carefully states that "People who eat PCB contaminated fish from the Hudson River face risk of cancer and other serious medical conditions."

Basing human cancer risk on animal studies always requires caveats, but this is particularly true for PCBs, because they consist of interconverting mixtures. Replicating environmental conditions in the laboratory is nearly impossible. "To get around these problems, people have worked for a long time with purified individual congeners that were never used commercially. So even if there were valid data supporting carcinogenesis in an animal model, it is undoubtedly based upon the use of single congeners in high concentrations. Realistically, this type of exposure could not have occurred in human populations," says Larry Bopp, who investigated PCB bioremediation as a research scientist at GE from 1977 to 1987 and is presently a research scientist at the VA Medical Center in Albany, N.Y.



Sediment samples are taken by pushing a hollow tube into the river bottom and removing a core for sampling.

EPA's proposed dredging plan is based on a calculation showing that the cancer risk associated with PCBs exceeds by 1,000-fold Superfund's guidelines for acceptable risk. Phrased absolutely rather than relatively, this means that PCB exposure ups lifetime cancer risk by an additional probability ranging from 1:1,000 to 1:10, whereas the accepted elevation in risk is 1:1,000,000 to 1:10,000. The calculation is based on the "reasonably maximally exposed" value of consuming half a pound of Upper Hudson River fish a week for 40 years, according to data from a 1986 angler survey. The Kalamazoo study revealed that only 11 percent of anglers tackle half a pound a week.

Fish eating habits aside, cancer risk figures are challenging to derive, because "it takes a large number of observations to detect a small increase in risk," says Stellman. Adds Frumkin, "The best populations to study are occupational exposures such as GE capacitor workers, but those groups are too small—you can't see an excess in cancers." The largest study, of 7,075 capacitor workers at the GE facilities, revealed no increased incidence of cancer.⁷ The work was and still is criticized, however, for several reasons: it included workers who had very limited if any exposure to PCBs, and GE funded the work.

Other studies have shown either no elevated cancer incidence, fewer than expected cases, or a slight increase in cancers of the biliary tract in exposed populations. Elizabeth M. Whelan, director of the American Council on Science and Health, an independent consortium of physicians and scientists, points out that standard medical texts on cancer focus on cigarette smoking and excess sun exposure as environmental causes, and do not even mention PCBs. (GE funds 1 percent of the organization's budget.)

Because finding populations large enough to reveal cancer links is difficult, "another approach is to look at people with cancer and ask if they have more PCBs than controls," says Frumkin. These studies too, do not reveal a cancer-causing trend. For example, researchers at the Karolinska Institute in Stockholm screened 154 women with endometrial cancer and 205 controls for 10 PCB congeners and found that the women with cancer were no more likely to have high levels of PCBs than women who did not have cancer.⁸

Evidence for a PCB-cancer link in humans is so negative that Frumkin has more confidence that the chemicals don't cause breast cancer than that they do cause any other type of cancer. Concluded a report to the U.S. Congress from the Northeast and Mid-Atlantic Breast Cancer Study in July 2000 that reviewed many investigations, "There was concurrence among projects in observing no association between breast cancer risk and blood levels of ... PCBs."⁹

Endocrine: Hormonal effects are difficult to assess because of the many interactions among hormones and their target tissues. Evidence is emerging, however, of a link between PCB exposure and production of thyroid hormones. Specifically, rats, mice and marmosets exposed to PCBs as fetuses have lower levels of thyroxine. However, increased levels of the enzyme that converts thyroxine into another thyroid hormone, triiodothyronine, suggests a compensatory mechanism to maintain thyroid function.

Studies of hormones in wildlife probe the tops of food chains, where health effects would stand out against a backdrop of biomagnified PCBs. For example, harbor seals held in captivity for three years and fed fish from the PCB-polluted Baltic Sea had lower levels of thyroid hormones and lower reproductive rates compared to seals fed fish from the cleaner northeast Atlantic.¹⁰ In other studies, cormorants and ducks hatched in the laboratory from eggs collected from waters containing PCBs had lower levels of thyroxine and fewer of them survived fledglinghood compared to controls.

Preliminary results of an investigation of 10- to 15-year-olds of the Akwesane tribe in Messina, N.Y., near the Canadian border, suggests that PCBs may affect the thyroid gland in humans too. "General Motors operated three aluminum foundries along the Mohawk River. These are traditional fishing waters. In the 1980s, the federal and state government advised against eating the fish. The tribal elders reinforced that advisory, and they stopped eating fish," reports Carpenter.

Before 1990, milk from tribeswomen had significantly elevated PCB levels compared to milk from women living elsewhere in the state, and then the level fell, Carpenter says. The youngsters in the present study, born when the women were eating the fish, have blood PCB levels up to 5 ppb, with an average of 2 ppb. "We found a direct relationship between PCB level and thyroid hormone level. The higher the PCBs, the lower the thyroid hormones—the level of PCBs is sufficient to affect thyroid hormone level. This doesn't mean they have disease, but that background levels do affect the biology of the human. And that isn't good," he adds.

Reproduction and Development: PCBs are powerful teratogens. "PCBs don't seem to do much to adults, unless the exposure is very high, like occupational or accidental incidents. But the developing animal is exquisitely sensitive to them," says Ide. In rats, guinea pigs, and rhesus monkeys, PCBs disrupt conception and pregnancy.

Several studies in humans reveal similar sensitivity in the prenatal period. Children exposed shortly before and after birth in Bela Krajina, a PCB-contaminated area in

Ratting-Out the Genome

Academic and private institutions will team up to sequence the rat genome, an arrangement made official on February 28 with a grant from the National Heart, Lung, and Blood Institute (NHLBI), and the National Human Genome Research Institute (NHGRI). Sequencing the rat genome should aid pharmacological, physiological, and behavioral studies for which the rat model is key. Along with the mouse genome, the rat sequence will also facilitate the annotation of the human genome. The Baylor College of Medicine and Celera Genomics of Rockville, Md., will split the new \$58 million grant; Baylor will receive \$37 million, Celera \$21 million. The money is in addition to \$58 million in government funds already allocated. Other partners include Genome Therapeutics Corp. (GTC) of Waltham, Mass., The Institute for Genomic Research of Rockville, Md., and the University of British Columbia. They plan to produce a draft sequence in the next two years. "It's a good introductory relationship between a public and private group under the umbrella of public funding," says Richard Gibbs, director of Baylor's sequencing center. "We've seen some of that but not on this scale." Unlike

mouse genome sequencing efforts, which have relied on a rich history of genomic data, the rat genome is really a "clean slate," says Gibbs. As part of a hybrid sequencing strategy, Celera and GTC will do sequence reads; Baylor will do reads and use semi-random BAC clones as a scaffold to actually assemble the genome. Rat sequence data will be released weekly; Celera has agreed to put all data in the public domain.

—Eugene Russo

R&D Budget Caveats

President George W. Bush's delays in making major science and technology government personnel appointments at the Defense Advanced Research Projects Agency, the National Institutes of Health, the National Science Foundation, the Office of Science and Technology Policy, and other government agencies could have budgetary consequences for the science and technology arena, says one Washington D.C. observer. In comments delivered at an American Association for the Advancement of Science symposium last month, Edward Furtek, associate vice chancellor of science and technology policy and projects at the University of

California, San Diego, warned that "delays in S&T policy appointments mean there are few participants in the budget preparation process with vested interests in its effects on R&D." Furtek based his comments on discussions with members of Congress and President Bush staffers. President Bill Clinton, in his first term, had similar staffing delays. Also speaking at the symposium, Kei Koizumi, director of the AAAS R&D budget and policy program, tried to expel several myths about federal R&D funding. Koizumi emphasized, for example that, strictly speaking, there is no "R&D budget"; money for R&D is scattered throughout 26 federal government agencies. He also mentioned the lack of budget coordination between R&D programs that is due, in part, to different agency budgets being assigned to separate appropriation bills—for example, money cannot be simply siphoned off from the NIH budget and reassigned to the NSF budget. For more on R&D budget analysis and plans, including an agency by agency breakdown of President Bush's fiscal year 2002 budget "blueprint" released on February 28, see the AAAS policy Web site at www.aaas.org/spp/R&D.

—Eugene Russo

EVALUATING THE EVIDENCE

(Continued from Page 11)

Slovenia, had defects in tooth enamel.¹¹ Researchers found 12-pound greater average body weight among white adolescent girls who were part of the North Carolina Infant Feeding Study, but not in other participants. The connection holds only for girls exposed prenatally, not via breastfeeding.¹² And men exposed in Taiwan when their pregnant mothers ate PCB-laden rice oil have sperm with slightly lower motility and slightly more abnormal forms.⁴ Exposed females in Taiwan today report significantly higher incidence of abnormal menstrual bleeding, stillbirths, and childhood deaths than controls.¹³

Immunity: Information on immune system effects is scarce. Pediatrician Nynke Weisglas-Kuperus is studying the incidence of common infections among 85 healthy mother-baby pairs at Sophia Children's Hospital in Rotterdam, the Netherlands, considering PCB levels in blood from mothers, umbilical cords, and children at 42 months. She finds that prenatal PCB exposure correlates to an increase in the number of cytotoxic and memory T cells; a decrease in antibodies to measles, mumps, and rubella vaccine; an increase in ear infections; and a decrease in allergies.¹⁴ Overall, the effects on health, she says, are mild.

Despite the media portrayal of the PCB problem as a war between environmentalists and corporate America, the sides agree on some issues: PCBs are in the environment and food webs, they will not vanish on their own anytime soon, they adversely affect wildlife and laboratory animals, and therefore they likely have similar effects on humans in certain circumstances. While the debate rages over whether to dredge the Hudson or let

natural bioremediation take its course, scientists will continue to confront the methodological nightmare of modeling the precise PCB mixtures in the environment that could affect human health.

Charles Ide sums up the PCB situation best: "It would be great if they would just go away."⁵

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