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Sea Sense

PCB TIME BOMB

The growing menace of polychlorinated biphenyl pollution

By Thomas G. Jackson

A new and dangerous "ecological time bomb" threatens the aquatic environment. It menaces some of the nation's great commercial and sport fisheries. It has caused skin disease, reproductive failure and neurological disorders in human beings. During laboratory tests it has sparked a form of cancer in small animals.

It is polychlorinated biphenyl (PCB) pollution. Apart from DDT it is the most ubiquitous synthetic pollutant in the biosphere.

Wildlife from New England to the Great Lakes and part of the Pacific coast are tainted by significant PCB contamination. Measurable levels of this long-lasting industrial chemical can now be found in half the population of the United States. PCBs were first detected in 1966 by the Swedish scientist Soren Jensen who discovered traces of it in pike and, later, in the hair of his entire family. However, only a fraction of the PCBs, produced domestically since 1929, is causing this crisis. Most of the chemical is either still in use, locked in landfills or lurking in the bottom mud of lakes and waterways.

Now used primarily in sealed electrical components, PCBs are valued as an insulating medium which will not burst into flame at high operating temperatures. As such, it has been used in up to 95 percent of all capacitors and five percent of the transformers manufactured in the United States. PCB parts are currently found in such common household appliances as air conditioners and fluorescent light fixtures. It is also used in certain marine caulking compounds and investment casting waxes.

This extreme stability is an attractive feature for industries and the characteristic which makes PCBs an environmental time bomb. Once released into the environment, PCBs last for decades. Slowly the chemical rises along the food chain until contamination concentrations are massed in fish and predators which eat the fish. Incineration at temperatures exceeding 2,400°F is the only known disposal method for this tough toxic substance.

Faced with this hazard, electrical industry officials have agreed to stop using PCBs as soon as an "acceptable substitute" is available. The Monsanto Chemical Corporation, sole American manufacturer of the compound, has already agreed to phase out PCB production as new insulating fluids are developed. Five years ago this company voluntarily restricted PCB sales to "closed systems" such as electrical parts.

Switching to a new insulating fluid will not, however, end the PCB problem. Prior to 1971 this chemical was poured into a wide range of consumer products. Carbonless carbon paper, paints, textiles, hydraulic fluids and sealants often contained PCBs. Buried in landfills with decaying electrical machinery, these materials are believed to be a significant source of pollution.

Imports, which topped 300,000 pounds in 1974 alone, and direct PCB discharges from industry are two additional contamination sources.

PCB contamination in wildlife and man is measured in much smaller terms — usually parts-per-million. Low levels of this powerful pollutant are magnified by the natural process of bioaccumulation. Through this process, PCBs are concentrated in animal tissues at levels up to 40,000 times greater than those in the surrounding environment. Bioaccumulation can also account for a single factory fouling a major river system.

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contaminant settles to the bottom of the pond, stream or harbor. It is basically nonsoluble in water but is able to enter small marine life.

Owing to its insolubility in water, PCBs tend to accumulate in the fatty tissues of fish and other animals. As each predator eats a smaller organism it absorbs and retains the PCBs present in the smaller or weaker animal. By the time an osprey, gull or man feeds on the fish, PCB levels, which cannot readily be detected in the water, can have bioaccumulated to significant readings.

One of the first signs of growing PCB pollution came through nature's own early warning system – contamination of wildlife. Since 1970, pesticide monitoring by the United States Fish and Wildlife Service has reflected a deterioration of environmental quality.

Exceedingly high levels of PCBs are now found in fish from the Hudson River in New York; the entire Great Lakes system; New England's Merrimac and Connecticut Rivers; the Mississippi, Missouri and Ohio Rivers in the midwest; the northwest's Columbia River system; the Sacramento River in the west; the Rio Grande and other Gulf Coast streams; the Yukon River in Alaska and the waters of the Los Angeles bight.

"The omnipresence of PCB residues in our environment looms as a very dark cloud casting an ominous shadow upon all our fish and wildlife resources programs which depend on environmental quality and healthy habitats," said Assistant Secretary of the Interior Nathaniel P. Reed. "In particular, PCBs pose an immediate threat to our efforts to preserve and protect threatened and endangered species.

"Under present conditions, PCBs may very well pull the rug out from beneath us by destroying marginal species in spite of our best efforts for preservation," Reed warned.

Government efforts to restore the Atlantic salmon in the northeast as well as restoration of the Great Lakes fisheries – a seventeen-year project with a $33 million price tag – are jeopardized by this pollutant. Large lake trout and salmon from Lake Michigan have repeatedly surpassed maximum PCB limits for safe human consumption. Contamination of commercial species is also present in carp, chubs, smelt and alewives taken from this area, Reed affirmed.

Should the United States Food and Drug Administration cut its PCB maximum from 5 to 1 or 2 ppm, then virtually all species would be restricted and the entire Great Lakes fishery would be curtailed. These fisheries have an annual dockside value of $19 million and contribute some $95 million a year to the economies of Canada and the United States when processing, shipping and retailing are considered.

"Nothing short of immediate drastic action will enable us to raise anything better than lakes full of eunuchized fish," the assistant interior secretary said. "With the present preponderance of PCBs, the life span of Great Lakes fishery will be limited to a single generation.

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"We must immediately respond to the dangers posed by PCBs. They represent an ubiquitous degenerate influence on our national health and well being."

A 1968 incident in Japan revealed the clear – and tragic – impact of this chemical on human health. For several months more than 1,000 unsuspecting people consumed rice oil accidentally laden with up to 2,000 ppm PCB.

Stillbirths, miscarriages, visual impairment, skin disease, neurological disorders, hearing loss, discharge of a cheese-like substance from the eyes, swelling of the eyelids, systemic gastrointestinal symptoms with jaundice – these were the primary symptoms manifested by Japanese victims. Scientists now call the case the "Yusho syndrome."

"In some patients, symptoms persisted for three years after PCB exposure was discontinued," a background report on the incident by the National Institute for Occupational Safety states.

"Infants born to poisoned mothers had decreased birth weights and showed skin discoloration due to PCB placental passage," it continued.

Authorities say the contamination began when heat transfer pipes immersed in the oil during processing developed pin-size holes which allowed PCBs to mix with the product. Most patients suffering from the Yusho syndrome recovered very slowly, suggesting that the toxic compound remains in the body for time after it is first ingested.

But the full effect of this mishap cannot be gauged in scientific terms or measured in parts-per-million.

Kamino Rioko was twenty-eight years old when the poison struck. Skin lesions covered her body. Long after her exposure to the PCB-laden rice oil, Ms. Rioko suffered from nausea, a low-grade fever and monthly swelling of her face and le-

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sions. She still carries the scars of PCB poisoning.

"After I was stricken, I began to envy my friends who have babies to take care of," Ms. Rioko said in a recent television interview. "Thinking of those happy women, I felt lonely and desperate.

"If I get married and my husband lets me have babies, they might be stricken too. That would be too much of a burden for my husband. So, if someone proposes to me, I won't accept. I can't marry unless I am completely cured.

"A number of my friends are married. They have one or two children already. Sometimes I visit them, but when I do, their children ask me, 'What happened to you? How did you get holes in your face?' Children are shocked when they see me. Children are honest and to them what's ugly is ugly."

Although PCB concentrations in this rice oil were unusually high, data on the incident was the best toxicological information available to the United States Food and Drug Administration (FDA) officials for establishing a limit for the compound in American foods. Some FDA scientists say use of this data led the agency to underestimate the effect of low-level PCB doses on human health. New studies suggest ingestion of this chemical at levels well below federal maximum tolerances may be harmful.

Factory workers in plants manufacturing PCB-filled capacitors and transformers have been exposed to this toxic substance at close quarters for long periods. As might be expected, the effects on health attributable to this compound have been studied by the industry and medical officials at agencies such as the National Institute for Occupational Safety and Health (NIOSH).

A NIOSH report on this compound states that "The known effects of PCBs in humans include an acne-like (skin) eruption – chloracne – pigmentation of the skin and nails, excessive eye discharge and distinctive hair follicles." "For a number of years, chloracne of the face and neck have been reported among workers exposed to chlorinated hydrocarbons (a chemical classification which includes PCBs)."

Other symptoms cited after PCB exposure include digestive disturbances, edema of the face and hands, burning of the eyes, impotence and hematuria.

"It's just like you have water blisters underneath the skin, and there's a lot of pussy blood," one man explained after working in a factory with PCBs for several years. Working with PCBs made one's hands sore. The skin would crack open and the fingers hurt. Gloves were needed to perform simple tasks. Two or three times a day the gloves had to be changed. They were full of blood and pus.

The long-term effects of PCBs may not be easily controlled. Recent experiments imply that the compound can, even at low levels, wreak havoc on the health of laboratory animals.

At the University of Wisconsin Medical School, Dr. James Allen is probing the impact of PCB doses at and below the current FDA "safe limit."

Despite concentrations of only 2.5 and 5 ppm, Rhesus monkeys used in the tests had stillbirths and miscarriages and suffered skin lesions and hair loss. Allen's findings suggest an inverse relationship between PCB exposure and successful reproduction. After three matings with males, 12.5 percent of the monkeys exposed to 5 ppm PCB feed became pregnant. Three matings led to pregnancy among 37.5 percent of the animals eating 2.5 ppm PCB food. But in the control group – which did not consume any PCBs – 90 percent became pregnant after three attempts.

Other similarities between test results and the Yusho syndrome surfaced in Allen's findings. Young born to PCB-infected mothers were smaller than normal baby monkeys. Because the reproductive system of the rhesus is similar to that of humans, this monkey is often used in medical experiments. Yet Allen and other researchers agree that current experimental data cannot be applied directly to man. Perhaps the most disturbing

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part of the new research being conducted is a study suggesting that PCBs can cause a form of liver cancer in some animals. Reported by Dr. Renate Kimbrough, of the United States Center for Disease Control in Atlanta, 184 female rats were used in the experiment. After ingesting food tainted with 100 ppm PCB for twenty-one months, twenty-six of the 184 rats had developed malignant liver tumors. Only one of the 146 control animals developed this disease. Of the 184 rats in the PCB group, 146 developed tumorous liver lesions.

Faced with this kind of data and increasing signs of continued PCB contamination in wildlife, Canada imposed, last fall, a new PCB limit in human foods. Set at 2 ppm, Canada's limit is less than half the United States tolerance.

FDA officials are now in the midst of

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reviewing the American standard. Some admit there is little scientific basis for the current 5 ppm PCB figure. According to Staff Scientist A. Karim Ahmed, the Natural Resources Defense Council (NRDC) has petitioned FDA to set a new limit of zero for PCB contamination in human foods.

But, Dr. Ahmed admitted, the stricter the standard, the more severe the impact on sport and commercial fishing. Setting a limit close to zero – or even one or two ppm – would close some of the country's greatest fishing resources. It may take decades for natural purification of these fisheries. Until then the only way for many people to control their PCB intake may be to eat less fish.

PCBs are a global form of pollution. Though centered in urban areas, PCB pollution extends to the Chesapeake Bay, Puget Sound, the Hudson River and the San Francisco Bay.

The range of wildlife affected by this potent pollutant includes one of America's favorite waterfowl – the canvasback duck. The canvasback likes to feed on small snails which absorb high levels of PCBs and are susceptible to other forms of contamination. Survival of the duck may be determined by the fate of these snails and their ability to stay alive despite the contamination of the environment.

Dr. Donald White, of the Patuxent Wildlife Research Center in Laurel, Maryland, reported that the duck wings from Massachusetts, Rhode Island, New York and Connecticut were the most contaminated of the samples taken from the fourteen Atlantic coast states tested. He found that some composite samples of wings registered twice the FDA limit for poultry.

Unfortunately, many Hudson River fish have been hit harder by PCBs than the fowl of the Atlantic flyway. Striped bass, rock bass, large-mouth bass, shiners, smallmouth bass, northern pike, sturgeon and white perch in this waterway all bear the mark of the chemical.

This pollution has closed a $1.25 million commercial striped bass fishery in the Hudson and endangered an even larger sphere of sport fishing. Owing to the migratory movements of striped bass, some scientists fear the contamination may spread to populations caught in Chesapeake Bay, Long Island Sound and the Delaware River.

PCBs in the Hudson appear to be concentrated near two General Electric (GE) factories in the Fort Edward-Hudson Falls area north of Albany. Environmental groups charge that the plants have dumped up to thirty pounds of the chemical per day into the river. Capacitors insulated with PCBs are produced in the two GE plants.

Composite values for fish caught near one GE facility registered typical readings near 20 ppm during New York State tests. The concentration of the chemical in an American eel exceeded 400 ppm. The PCB levels in striped bass caught near Albany ranged from twice the FDA limit to 89.76 ppm. Near West Point – some fifty miles above New York City – readings from striped bass ranged between 1.17 and 7.54 ppm. An American shad, taken near Poughkeepsie, registered 9 ppm PCB.

Based on this kind of data, Ogden Reid, then commissioner of New York's Department of Environmental Conservation, warned the public against eating striped bass from the river. Reid's move, according to some ecologists, ended a state cover-up of the problem. His action also began the current interest in PCB pollution and led to a series of state hearings on General Electric's discharges.

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The first set of state hearings ended with a preliminary finding that GE had violated state laws regulating the discharge of toxic substances into New York waters. The hearing examiner ruled that General Electric had contributed to the Hudson's PCB contamination.

A second series of hearings on possible remedies for the problem have just concluded. One plan for purging PCBs from the waterway focuses on the dredging of bottom mud – where the nonwater-soluble chemical settles and slowly accumulates. This program could cost $30 million, and GE could be ordered to bear part of the expense.

This year, as a result of PCB contamination, New York closed the Hudson to all commercial fishing except for sturgeon, shad and goldfish. Federal scientists estimate it could take decades for an ecosystem, like that of the Hudson, to cleanse itself of this contamination. Sadly, significant PCB contamination of wildlife is not limited to ducks or the Hudson River.

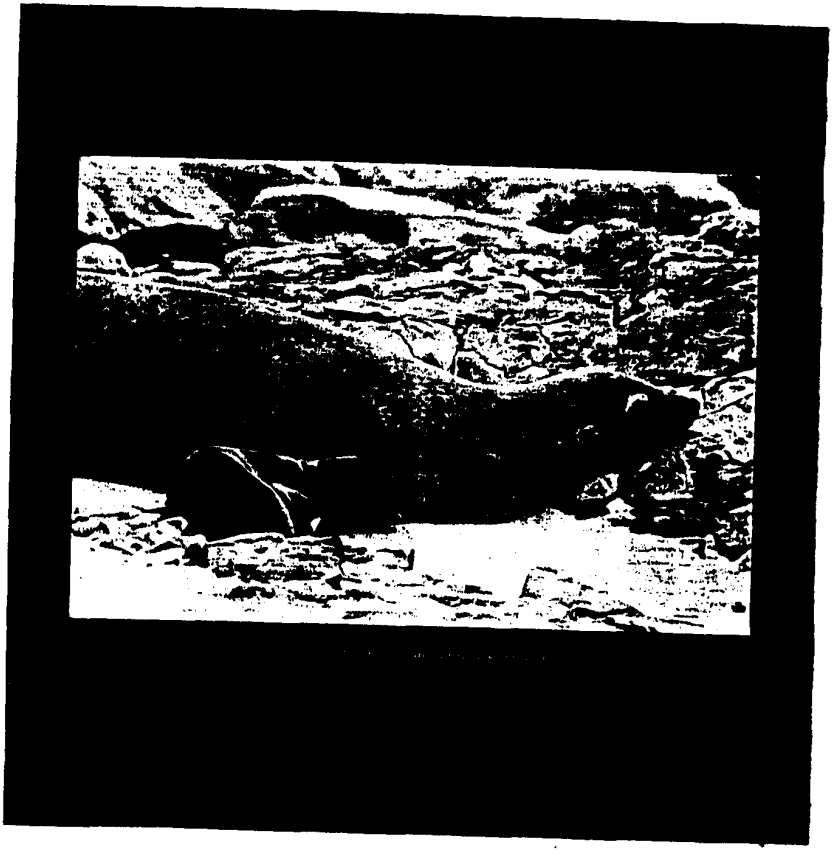
The same United States Environmental Protection Agency (EPA) study reports up to 350 ppm PCB in Hudson fish also includes readings as high as 165 ppm for samples from Lake Michigan. Since 1971 Michigan state authorities have warned against eating salmon or trout from the lake more than twice a week.

Last year 125,000 cans of coho salmon taken from the lake were seized and condemned by federal officials for exceeding FDA PCB limits. An additional 6,640 pounds of frozen coho and chinook salmon from the lake were confiscated for the same reason.

Tests, in 1974, by the Michigan Department of Natural Resources showed PCBs ranging from 10 to almost 25 ppm in Lake Michigan coho salmon and lake trout. Additional studies by the Wisconsin Department of Natural Resources re-

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vealed that this chemical also affected a wide variety of other fish. Readings from lake trout exceeded 40 ppm and from carp surpassed 50 ppm in these tests.

A few months ago, federal officials condemned and buried 20,000 pounds of carp taken from Lake Pepin, part of the Mississippi River downstream from the Twin Cities. Fish from this area contained as high as 40 ppm PCB.

Striped bass caught in the western end of Long Island Sound last fall came within 0.05 ppm of the FDA limit. Five years ago Dr. Robert Risebrough, of the University of California at Berkeley, found significant PCB contamination in fish from this area.

Canadian scientists say the chemical present in smelts and eels from Lake Ontario and eels from the Saint Lawrence Seaway frequently surpasses the country's 2 ppm PCB standard. Along with coho salmon from the Great Lakes, chubs from Lake Huron and lake trout from Lake Superior are also affected.

Although PCB pollution is still a problem, primarily in inland waters, deposits in harbors and along the coasts, particularly near river mouths, are significant. The chemical in fish taken off the coast of Southern California has exceeded the FDA maximum.

Moreover, PCBs have also been found in wildlife and fish from Holland, off the Scottish coast, Germany, the Baltic Sea and Japan during the past decade. They have been detected in marine life ranging from plankton to tuna.

Fish-eating birds have borne the brunt of PCB contamination in the aquatic environment. While studying them on Long Island Sound, Dr. Risebrough found PCB levels between 300 and 1,000 ppm in osprey and cormorants. He also concluded that deformities found in terns on Great Gull Island in the Sound could be caused by contaminants such as PCB compounds.

"Severe reproductive failure has been identified in herring gull colonies around Lake Ontario," Karl Bremer, of EPA's Chicago office, wrote recently.

PCB pollution has closed a $1.25 million commercial striped bass fishery in the Hudson and endangered an even larger sphere of sport fishing.

"There is a positive correlation between early embryonic mortality and PCB concentration," he concluded. Birds like the osprey and gull suffer most from PCB contamination, for they stand at the top of a complex food chain which magnifies low-level PCB concentration up to 40,000 times in one step.

Research scientists in California found a correlation between high levels of DDT and PCBs in adult sea lions and aborted fetuses. While in 1969 the corpses of 12,000 sea birds washed up on the western coast of Britain showed considerable PCB contamination.

More significant, perhaps, was the discovery of PCBs in practically all specimens collected in a survey of the mid-Atlantic. Affected samples included phytoplankton, zooplankton, sargassum weed, flying fish, dolphins, and sharks. The plankton, in particular, contained about ten times as much in proportion to its weight as the other marine organisms.

After the 1968 rice oil incident, Japan moved quickly to ban PCBs. Now the chemical can neither be used in nor imported to the island nation. EPA Administrator Russell Train accepts United States industry claims that a similar move here would simply switch an environmental for a fire hazard.

Train said the key to controlling PCB contamination here rests with disposal practices for the 300 million pounds of the chemical now in use. Another 200 million pounds of potential contamination are buried in landfills.

At the heart of the PCB problem is the EPA's lack of jurisdiction. Until Congress approves a Tax Substances Control Act, the agency is powerless to deal with non-pesticides in use or some of the 600 new chemicals introduced annually.

"PCBs are a significant hazard to human health and the environment," Train told a congressional subcommittee this year. "However, the PCB problem is but one dimension of a much larger picture of environmental degradation by toxic chemicals. We have no authority to control (non-pesticides) uses and must rely on the Federal Water Pollution Control Act and Clean Air Act to achieve pollution control."

Without additional protection, America will continue to use its citizens, fish and wildlife resources to learn what the nation's environmental problems are.

The only prospect on the horizon for control of this pervasive pollutant comes from the work of Dr. Dickson Liu at Canada's Center for Inland Waters in Burlington, Ontario. Dr. Liu found that a variety of common bacteria often present in sewage can reduce PCB concentrations from 300,000 to 20 parts-per-billion. The chemical is broken down into harmless carbon dioxide gas and lightweight organic acids normally found in nature. There is some question whether the process can be applied to large scale industrial polluters or in clean-up drives. A pilot plant testing Dr. Liu's theory is scheduled to open this summer in Canada.

Thomas C. Jackson is the environment writer for two Connecticut newspapers. He is the coordinator of the Connecticut Clearwaters Club and has covered environmental subjects in New England for five years.

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