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PCB:
The Ubiquitous Contaminant

From Antarctica to Albany,

First of three parts

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In the snows of Antarctica, in coastal fish eaten daily by millions, and in the breast milk of nursing mothers, the toxic pollutant PCB is showing up in increasing concentrations.

A PCB (polychlorinated biphenyl) was first produced in 1929 as an electrical insulating fluid, but the harmful properties of the group did not become widely known until the mid-1960s, after millions of pounds were produced, used in a variety of everyday products like paint and refrigerators and discharged into the environment.

Now, based on research showing that large doses of the clear, oily fluid cause skin lesions in humans and produce cancer, genetic damage, and death in test animals, the U.S. Environmental Protection Agency this year banned the production of the material, effective 1979, and the Food and Drug Administration has proposed strict limitations on the allowable levels in fish, the principal pathway to humans.

But it may be too late. More persistent than the pesticide DDT, their chemical cousin, PCBs have invaded the flesh of living creatures throughout the world. They virtually surround the daily routine. They have been found in the air, in soil and in river sediments throughout the country. As a preservative and plasticizer, they have been a component in marine paints, highway stripes, copy paper, grain silos and ink. More than 90 per cent of the people in this country have it in their tissues, according to EPA studies. And 5 per cent of the population has PCB levels that exceed the proposed guidelines for contaminated fish, the studies found. Seals in Scotland, marine life in the Pacific Ocean, chickens and birds in many countries and microorganisms at the bottom of the food chain have shown various debilitating effects from PCBs in the environment, including reproductive failure, deformity, sickness and death.

"It is a ubiquitous contaminant, as bad as DDT ever was," said Joseph Highland, a biochemist for the Environmental Defense Fund, which first prodded the federal government four years ago to take action to control the material. "Its importance has not been recognized nor publicized." Elizabeth Campbell, chemist for the Food and Drug Administration who wrote new standards to limit consumption of the material sharply, agreed: "PCBs may be the chemical scare of the '70s."

While virtually all experts agree that PCBs pose a significant environmental threat, the issue is complicated by the fact that few adverse health effects have been noted with humans. The only major instance of human sickness from PCBs occurred nine years ago in Japan, after an accidental contamination of rice oil with the chemical. That contamination, which affected 1,200 people, caused a number of serious illnesses and, some suspect, deaths. The PCB doses, however, were in concentrations up to 1,000 times the levels found in contaminated fish. Moreover, occupational exposures in the last five decades have produced chemical concentrations of PCBs in humans dozens of times higher than in the contaminated fish, but few adverse effects have been noted.

"What does this mean? It doesn't necessarily mean that PCBs have no long-term effects," said Frank Cordle, a PCB expert and epidemiologist for the EPA. "We know nothing about the long-term effects. We haven't seen any because we haven't looked."

But animal studies have been so convincing that many scientists believe it is just a matter of time until human ailments are documented. In a study completed this year, PCBs were found for the first time in the embryonic fluid surrounding developing human fetuses, in concentrations several times over the allowable safe limits. "Wherever you look you are going to find it," said Thomas Kopp of the EPA's office of toxic substances. "It's there. It shouldn't be. It isn't good."

The Environmental Protection Agency is sufficiently convinced by the studies to say in its disposal guidelines for the chemical that the evidence already at hand demonstrates "conclusively" that PCBs are toxic to humans and to a wide range of fish and wildlife.

"Our methodology [with human studies] is very crude," said Dr. Blair Smith, a researcher for the National Institute of Occupational Safety and Health who has examined workers for PCB concentrations. "But the animal studies give very great cause for concern."

The largest potential exposures to PCBs are in the fish-eating population. "For the occasional consumer of fish, PCBs pose no special threat," said Dr. David Axelrod, PCB expert for the New York State Department of Health. A. C. Kolbye, one of the FDA's chief scientists, said, "There is no reason for Panicsville." But he staunchly supported the proposed sharp reductions in the consumption of PCB-contaminated fish.

The Environmental Defense Fund disagrees. "We think PCBs are a very serious problem, not

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Scientists Wait and Worry

only for those consuming fish," Highland said, "but for any potential mother in this country." He noted that recent experiments have found PCBs in the breast milk of women throughout the country. Studies have shown that the chemical is transferred from mother to fetus through the placenta.

It is unclear how long it takes for the chemical to break down to a harmless compound, but scientists say it is at least many decades. DDT, on the other hand, has shown substantial decreases in a shorter amount of time. Many scientists feel that PCBs, in the long run, will be even more toxic than DDT, the most publicized chemical pollutant.

The principal fish contaminated with PCBs on the East Coast is striped bass, which is popular both for eating and sport fishing. It had previously been thought that only about 10 per cent of the bass spawning grounds, those in the Hudson River, were contaminated. But recent studies show that the Chesapeake Bay area, the largest bass spawning ground, has yielded striper eggs with PCB concentrations above the safe limits.

About 1.4 billion pounds of polychlorinated biphenyls have been produced in this country in five decades. Four per cent of the total has been destroyed, 11 per cent is free in the environment, and 19 per cent is under varying degrees of control in landfills. The rest is in billions of items not yet discarded. The EPA is studying regulations to stop the discarding of more of the material but acknowledges that that will be difficult.

Meanwhile, the FDA's proposed standards would reduce by more than half the PCB levels allowed in edible fish. Recent tests by the New York State Department of Environmental Conservation show that bass and bluefish caught near Long Island have average concentrations in excess of the proposed new limit. Should the new limits be enforced, both commercial and sport fishing for these species would be decimated, observers say. Beyond that, both federal and state tests have shown high PCB concentrations in a variety of species eaten throughout the country, including tuna, salmon, trout, eel, pike, perch, shad and weakfish.

Polychlorinated biphenyls, first synthesized in 1881, belong to a class of chemicals called chlorinated hydrocarbons, which include most of the common pesticides and solvents. Many of the substances, such as DDT, Mirex, dieldrin, aldrin and trichloroethylene, have been banned after causing cancer in test animals. Another such substance, vinyl chloride, has caused cancer in humans.

The hydrocarbon part of the chemical is a molecule composed of hydrogen and carbon, the building block of petroleum, gasoline and other fuels. Two attached "rings" of hydrocarbons are called a biphenyl. Most hydrocarbons are extremely flammable. But scientists found that by substituting chlorine atoms for hydrogens in the biphenyl, they could create a substance that was flame-resistant. Such molecules with more than one chlorine atom are called polychlorinated biphenyls, or PCBs.

In 1929, Monsanto Chemical Co. of St. Louis began producing PCBs commercially, for use as a flame-retardant and electrical insulator in transformers, capacitors and similar equipment. It replaced mineral oils, which had resulted in many fires. So perfect were PCBs that within a few years they became the fluid of choice in the electrical industry. In addition to preventing fires, they were so stable as to be resistant to strong acids and bases and biological degradation.

Soon, numerous other uses were found. The chemicals are able to absorb and hold large amounts of heat, so they were used in heating coils to heat products in factories, where an open flame would have caused a hazard. PCBs extended the life of caulking compounds around the windows of skyscrapers. Since PCBs would not react with ink, they prevented smears on carbonless copy paper. They became a lubricating and cooling oil for industrial drills. In the electric motors of refrigerators, air-conditioners, typewriters, power saws, clothes washers and dryers, dishwashers and furnace blowers, PCBs became common. In capacitors, or "boosters," they held an extra electric charge to help start fluorescent lights.



Newsday Photo by William J. Bratt Jr.

Tim Kromer of Amagansett holds a 35-pound striped bass. Striped bass, a favorite of sports fishermen and fish fanciers, have been found to contain dangerously high concentrations of PCBs.

"In terms of performance, it was the best material—as perfect as an industrial chemical can be," said William Papageorge, a chemical engineer and PCB expert for Monsanto, the sole U.S. producer. "It doesn't burn, it doesn't break down, it doesn't react with other materials. In virtually every case, the substitutes that have been developed have had to sacrifice some characteristics that PCBs contributed."

In the first three decades of their production, PCBs occasionally caused lesions, called "chloracne," among workers. When workers were transferred to noncontaminated areas, the lesions cleared up. There were some reports of death after exposures to PCBs, but no sophisticated studies were done and the exposures often were in combination with other toxic chemicals, so it was impossible to sort them out.

Meanwhile, 3,000 pounds of the material were discharged into the aquatic environment each year by industries. In addition, appliances that were discarded leaked PCBs into the groundwater. Incinerators burning PCB-laden paper spewed the chemical into the air. Recycled, the paper wound up as cereal boxes, where the chemical found its way into the food.

"PCBs were not identified as a contaminant until the mid-1960s, when the technology was developed enough to measure it in the environment," said Smith, of the occupational safety and health institute. The first real indication that something was amiss came in 1966, when Swedish scientists found PCBs in fish, bird feathers and human hair. Two years later, the accidental factory leak of PCBs into cooking oil sickened 1,200 consumers in Yusho, Japan. They suffered from swollen joints, severe skin lesions and other disorders.

In 1969, another accidental leak, from a factory near Pensacola, Fla., contaminated marine organisms in Escambia Bay. Studies showed that at concentrations of less than one part per billion in the water, the chemical killed half of the exposed shrimp within 15 days. After three months in clean water, the chemical persisted in fish, although reduced by more than half. DDT contamination, on the other hand, has been shown to be completely eliminated in less than a month.

In 1973, the FDA set five parts per million as the safe limit permitted in edible fish. The new FDA standards, which sources say will be enacted this year, would set the level at two parts per million. The sickening concentrations that were consumed at Yusho in the accidental contamination were 2,000 parts per million, but that was a one-time exposure, not a continuing one.

In 1971, Monsanto voluntarily stopped producing PCBs for "open" applications such as paints and limited the chemical's use to sealed containers. Of the leading PCB-using plants that have contaminated the aquatic environment with their discharges, five are in the Northeast. Two are owned by General Electric Co. in Fort Edward and Hudson Falls, N.Y. Discharges from those plants were responsible for a ban imposed last year on all commercial fishing of most species in much of the Hudson River, state officials said. The ban is to continue indefinitely. PCB concentrations of 1,000 parts per million have been found in the sediments near Albany and up to 178 parts per million in the fish.

The concentrations in the sediments are almost beyond belief," said Edward Hoyn, staff member of a state committee that is trying to figure out a way to remove the pollution.

Of the other three plants, one is a transformer-manufacturing facility owned by General Electric on the Housatonic River in Pittsfield, Mass. The other two make capacitors.

The economic effects already have been felt by the Hudson River area. State officials project a loss of $500,000 annually in commercial fishing and losses of as much as $6 million per year in spendfs from recreational fishing, which has been banned or restricted on the Hudson in the Albany area and in various upstate rivers and lakes, including Lake Ontario. On Long Island, the new federal standards would cost the fishing industry up to $1.5 million each year, the state estimates. And across the country, the loss faced by the fishing and food processing industries would total $49 million annually, according to Food and Drug Administration estimates.

Residents of eastern Long Island, with its traditionally known fishing areas, are unhappy with the PCB controversy and the threat that the new standards pose to local commerce. "Nobody wants to put poisonous fish into the consumer stream, but we question whether there is a threat to health," said Marshall Helfand, president of the Montauk Chamber of Commerce. "I don't think there has been enough testing, one way or the other. An industry should not be severely crippled without sufficient tests to determine the health effects."

NEXT: The Fish That Carry It

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