

JUL 19 1977

Hunting a Chemical in the Haystack

Last of three parts
By Stuart Diamond
Newsday Environment Writer

If you wanted to pick the best place for a toxic chemical to get into the environment and cause widespread health problems, where would you put it?

How about in marine paints on the outside of boats so it washes into the water? Or in highway stripes so it washes into the soil? Or in 800 million fluorescent light fixtures, billions of sheets of paper and countless appliances so that it would be almost impossible to retrieve it?

That is what has been allowed to happen during the past five decades with a group of flame-retardant chemicals called PCBs, polychlorinated biphenyls. They came into wide use as an insulator in electrical equipment and as a preservative in numerous other items. Now they have been shown to cause cancer and reproductive failure in test animals and skin lesions in people.

Nine years ago, the first serious illnesses were reported in humans from PCB poisoning—February, 1968, in Yusho, Japan. Five years ago, Japan banned the chemical and an American interagency task force concluded that PCBs are highly persistent, could be found in all parts of the environment and could have serious adverse effects on human health.

And during the past four years, the Environmental Defense Fund and the Natural Resources Defense Council, two leading American environmental groups, petitioned and sued the federal government, demanding strict regulations to limit domestic use of the chemical and its exposures in the population.

Yet the federal government still has not set minimum allowable limits that many scientists consider safe for all segments of society in the consumption of PCB-contaminated fish, the chemical's chief pathway to people. Further, there are no regulations to prevent the hundreds of millions of pounds of the toxic chemical now in use from getting into the environment and causing more harm.

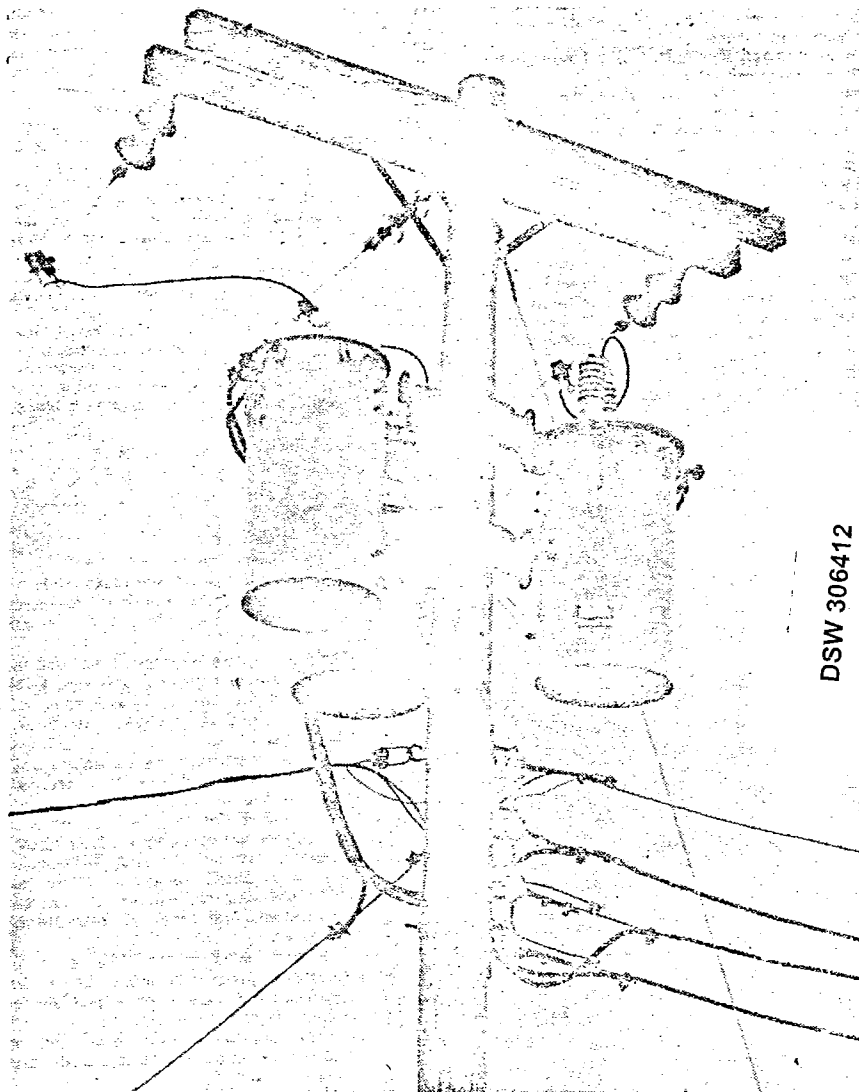
In February, the federal government banned discharges of PCBs into the environment as of Feb. 2, 1978. Monsanto Chemical Co., the nation's sole supplier of PCBs, has announced it will cease making the chemical by Oct. 31 of this year.

But since the Yusho incident, Monsanto has produced more than 400 million pounds of PCBs, and thousands of pounds have been discharged into the environment by industries, homeowners, businesses and a multitude of other sources. The Food and Drug Administration is proposing to lower by 60 per cent its limits on the consumption of contaminated fish, but even then, it concedes, the doses will not be safe enough for children and women of child-bearing ages to eat more than four meals of such fish per month.

The Environmental Protection Agency is preparing regulations for the safe disposal of the more than three-quarters of a billion pounds of PCBs still in use. It was supposed to enact the regulations by July 1, but it wasn't ready. The proposals pointedly exempt a large proportion of the PCBs from regulation, because the agency doesn't know how to collect the substance. The agency's Office of Toxic Substances is still grappling with the problem, and rules are expected within two months.

"The EPA's proposed regulations are atrocious—an outrageous response to the problem," charged Joseph Highland, biochemist for the Environmental Defense Fund. "Hundreds of millions of pounds of this stuff will wind up in the environment because the government is unwilling to regulate it. If that material gets out there, there will be a national catastrophe."

Highland's group first sued the EPA in 1973 because it had not limited discharges of toxic chemicals, as provided in the Water Pollution Control Act of 1972. The EPA then tried to propose limits for nine chemicals but was overwhelmed by industry attorneys in 1974. After further court suits, Russell Train, in one of his final actions as outgoing EPA administrator, signed the discharge ban on Jan. 18 of this year—more than four years after the discharge standards were mandated by Congress.



These transformers contain PCBs

Newsday Photo by Bob Lickey

Federal officials questioned do not dispute the substance of Highland's comments about the dangers of PCBs. But they refused to take the blame for the delays or for the regulations. "We have a very perplexing problem here," said George Wirth, a chemical engineer whose unit in EPA wrote the disposal regulations. "PCBs are practically in the hands of every American. . . . It is the fault of the society as a whole that we did not take better care of what we have produced and done with this chemical since Day One."

PCBs are similar in structure to the insecticide DDT and to other organic solvents and pest-killers. But PCBs are much more stable—resistant to acids, bases and biological breakdown. Because of this PCBs have been used in a myriad of everyday products—as insulators, heat-conductors, anticorrosive agents and plasticizers. Among the products are refrigerators, television sets, transformers, capacitors, sealing agents, inks, copy paper, electric motors, microwave ovens, paints and varnishes. Not all of these items contain PCBs—in fact, many do not. But it is difficult or impossible for the non-expert to tell if the chemical is present. Usually, the substance is not listed as an ingredient and almost never as PCBs. Monsanto's marketing name is Aroclor, but it has also been sold in this country

under the names of Chlorextol, Dykanol, Iaerleen, Noflamol, Pyramol and Therminol.

About 1.4 billion pounds of PCBs have been produced in this country, and only 55 million pounds, or 4 per cent, have been degraded in the environment or destroyed by special high-temperature incineration. Another 150 million pounds, or 11 per cent, have been released to the environment and are in the air, water and soil. An equal amount has been exported.

That leaves a little more than a billion pounds. Of that, about 300 million are in varying degrees of control in landfills and about 750 million are in use.

The EPA's proposed marking and disposal regulations are aimed at two-thirds of the 750 million pounds in use. Those PCBs are distributed in 8.1 million large transformers and high-voltage capacitors used by utilities and major industries, and they are fairly well monitored and inventoried by their owners. The EPA plans to draw up strict rules for the orderly collection and disposal of the items, first in approved chemical landfills and, after July 1, 1979, by incineration.

That leaves about 250 million pounds of PCBs, dispersed in 895 million capacitors, or "booster," in

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the nation's highway lights, in air-conditioning motors in numerous commercial buildings, in individual small appliances and in fluorescent light fixtures. Each item contains an average of 3.5 pounds of PCBs, although some have only a few ounces of the chemical.

Not only is the EPA unsure what to do about this material, but the agency acknowledges that most of it may eventually wind up in the environment, as appliances are discarded and leak, paints erode, and fish—and people—consume the residue. The agency also believes some of the material now in landfills eventually may find its way into the soil and water. All told, the EPA says, 540 million pounds of the chemical could wind up free in the environment. That is more than a third of the entire domestic production since it began 48 years ago. And it is 2½ times the amount now free in the environment.

"Although banning the production of PCBs will help the problem of toxic contamination, it will not solve it," says Nolan A. Currey, an expert consultant on hazardous chemicals for the EPA. "The cases of sealed units [appliances, etc.] now in use can be ruptured, and will discharge PCBs . . . Control of the disposal of electrical units now in use will also be difficult. And the job of intercepting and destroying toxics after discharge into the environment will be more difficult, if not impossible."

The agency's proposed regulations, in fact, exempt the owners of the 800 million fluorescent light fixtures and 50 million small appliances from marking and disposal. "This means that the article can be placed into the normal trash collection system used by the occupants," the regulations say. The article would then be taken to a dump or incinerated with other refuse.

The EPA suggests an educational program to encourage repair shops and commercial buildings to turn in their PCB-laden equipment when the equipment is no longer useful over the next 20 to 30 years.

But how successful could that be? "How successful is the paper-recycling program in this country?" said Thomas Kopp, a chemical engineer with the office of toxic substances. "How successful were the attempts to cut the use of gasoline? Not too successful."

Some officials balk at a full program to inform people of the risks of PCBs so they will not discard items containing the chemical. "The problem is that we don't want to scare people," said David Wagner of the EPA's toxic-substances office.

Another suggestion by the agency is to pay people a "bounty" to turn in their PCB-laden items. A \$2 bounty on each item, however, would mean a government outlay of \$1.8 billion. That does not count collection and advertising costs. The EPA says it has "reservations" about the practicality of collecting those items. It is asking for suggestions.

The proposed regulations also would not control the disposal of PCBs in "widely used commercial products," if the concentrations of the chemical are below 500 parts per million. These products are too numerous for the agency to define: the carbonless copy paper sitting in file cabinet inventories, the half-cans of marine paint on people's shelves, the caulking compounds on windows. These traces total 8 million pounds of PCBs, in addition to the 750 million currently in use and accountable.

Since municipal sewage and sludge usually has

PCBs in concentrations below 500 parts per million, that, too, will go unregulated under the new guidelines. Recent surveys have disclosed the toxic chemical in a number of the nation's sewage effluents—in Illinois, Michigan, Wisconsin, Ohio, California, New York and Florida, among others. Beyond that, discharges from plants that produce recycled paper often contain PCBs in concentrations below 500 parts per million, so they, too, will be exempt from regulation. The chemical winds up in such discharges because of its presence in the original stock.

The incineration of PCBs also poses problems. The material can be destroyed only by burning at 2,200 to 2,900 degrees Fahrenheit. If anything goes wrong with the process, the chemical will merely be spewed into the air with the combustion gases. Most municipal incinerators burn at only 1,500 to 1,800 degrees Fahrenheit. Thus, any PCB-laden material being incinerated now is winding up in the environment intact. To construct special, high-temperature incinerators would cost a large amount of money, he said. "Basically, you would have to build blast furnaces," said Kopp of the EPA.

The Environmental Defense Fund's Highland suggested a national mobilization program similar to the one during World War II. "If people realized the significance of the problem, a small effort by a lot of people would solve it. The government should enact regulations requiring the return of these materials."

Restrictions on the consumption of PCB-contaminated food were first set by the FDA in 1973. In that year, the amount of PCBs in the average American diet reached its highest level ever. The chemical showed up in baby cereal, a variety of processed foods and numerous other items.

The FDA's limits were five parts per million in fish and lower for most other foods. Within two years, the amount of PCBs in the average American diet dropped by half, although 40 per cent of the meat, fish and poultry still contained traces.

The only food in which PCB content had not dropped was fish, which continued to spawn in rivers and lakes where the chemical was being discharged. In 1975, the Environmental Defense Fund again urged the FDA to lower the standards. After the Environmental Defense Fund threatened suit on numerous occasions following months of inaction, the FDA this past April proposed lowering the maximum PCB level for edible fish to two parts per million. Long Island would be a principal area targeted by the government. Both bluefish and striped bass in Long Island waters exceed those limits, according to recent tests by the State Department of Environmental Conservation.

Many East End residents and fishermen are opposed to the new limits, expected to be enacted this year, because of the loss of revenue they would cause—\$1.5 million annually, according to state estimates. The national loss estimated by the FDA would be \$49 million a year.

The Environmental Defense Fund opposes the new standards from the other side. It wants the allowable PCB limit to be zero—or, if that is not possible because of detection problems, one part per million.

"Sports fishermen should be advised of the risks involved in eating these fish and of feeding it to their families," Highland said. "The zero-tolerance could cost [the fishing industry] a lot of money but

the health problems without it will cost even more."

Beyond these problems is the issue of how to purify the soils and river sediments already contaminated. Even if the sediments contain PCB levels above 500 parts per million, the EPA's rules would exempt them from regulation unless the material is removed from the waterway. The same is true with contaminated soil. The city of Bloomington, Ind., for example, faces a cost of \$25 million for replacing sewer lines and cleaning up the local river after Westinghouse Corp. discharged tons of PCB-contaminated effluent into a landfill and into the municipal treatment plant. Residents also want reparation because they unknowingly planted their gardens with PCB-contaminated soil conditioned from the treatment plant. Now they can't eat their vegetables or drink milk from their cows. Nor can they fish in 40 miles of the local river.

In New York State, the Hudson River has accumulated sediment levels of PCBs that measure up to 6,000 parts per million—3,000 times the proposed limits for edible fish—from discharges by General Electric Co.'s plants near Albany. Officials estimate it will cost up to \$30 million to clean up the waterway.

Numerous substitutes for PCBs have been developed since 1971, none of them with the fireproof qualities of PCBs, but all of them less toxic. To prevent fires, Underwriters Laboratories will require special protection of items containing the new materials, a lab official said. Since Japan has banned the use of PCBs, indications are that there has been no increase in fires traceable to the substitutes, EPA's Kopp said.

The question of why it has taken so long for the United States to get to the point that Japan arrived at four years ago continues to be a touchy subject with many officials. "Sure, we can be faulted for not acting two or three years earlier," said John Spagnoli, head of PCB monitoring and research for the state conservation department. "But we didn't know about the health problems . . . Only the scientists knew about the health problems after Yusho. These things take time. Agencies don't work as closely as they should. The point is, we're doing something about it now."

The FDA's proposed limit of two parts per million in fish will affect only those sold in interstate commerce. State officials are opposed to a similar ban for fish caught and sold within the state. They plan to issue only a caution and let people decide for themselves.

"Everything has some contamination in it," said Anthony Taormina, in charge of preserving coastal resources for the state environmental unit. "Of course we should reduce the risks. But to expect no risks from eating fish is to expect no risk from flying in an airplane. It is part of our technological society. Whether good or bad, this is the price we have to pay."

With PCBs, however, the price is continually rising. First, scattered chickens were destroyed. Then, commercial fishing was stopped in Lake Michigan. Then, Lake Ontario was closed. Then the Hudson River. Kopp said the new FDA limits will destroy the fresh-water fishing industry in most parts of the country.

"Wherever you look, you are going to find it," he said. "And if you find it, what are you going to tell people? We have no answer. It's there. It shouldn't be. It isn't good."

"We have seen only the tip of the iceberg."

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Animal Tests Show Reproductive Failure

FOR a year and a half, 16 female monkeys were fed food contaminated with the chemical PCB (polychlorinated biphenyl) in concentrations similar to those found in fish caught off Long Island and elsewhere in the United States.

When the monkeys mated, seven miscarried. Two could not conceive at all. Uterine growths were recorded. The monkeys developed facial sores and swollen eyelids and lost their hair. Their offspring all were undersized and contained detectable levels of the toxic chemical.

The infants were then breast-fed. They all developed the same symptoms as their mothers. Within four months, half the infants died. Two years later, even when taken off the breast milk, the other monkeys still exhibit learning and behavioral disabilities.

Last year, the Environmental Protection Agency began testing the breast milk of American women for PCB contamination. The chemical was found in the milk of 78 of the first 80 women tested from all over the country. The average levels were about half the lowest concentrations found in the monkeys, and about an eighth of the highest concentrations.

That study, by Dr. J. R. Allen, a pathologist at the University of Wisconsin, is one of the principal reasons why the federal government is preparing to lower drastically its allowable limits of PCBs in fish. In its proposed standards, expected to be enacted this year, the Food and Drug Administration goes even further and cautions women of child-bearing age and children to eat as few PCB-laden fish as possible, even if the fish are just under the limit.

"PCBs are more toxic than we had originally thought," said Elizabeth Campbell, an agency chemist who wrote the new guidelines. "The more information we collect about them, the worse they seem to be."

Few negative effects from regular exposure to

long-term, low-level doses of PCBs have been observed in humans, although consumers have been eating contaminated fish for years. The fatty tissues of workers exposed to PCBs have been found to contain levels dozens of times the proposed limits, but the main detected symptoms have been skin sores that cleared up after the exposures ceased.

Animal studies, however, show reproductive failure, cancer, decreased resistance to disease and other ailments at doses not far above what humans could get over a period of many years, since PCBs accumulate in the body, once ingested, and do not break down. Currently, 90 per cent of the people in this country have detectable levels of PCBs in their fatty tissues and the fatty portion in the breast milk of the average woman has levels that approach or exceed the new safe limits for edible fish.

Recently, studies have found PCBs in the embryonic fluid surrounding developing human fetuses and in the placenta and other tissues, in amounts many times the safe levels. In fact, children are being born with PCBs in their tissues.

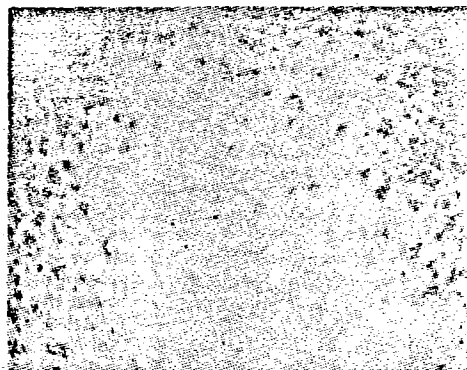
Moreover, an official of the National Cancer Institute calculated for Newsday that a person eating the low levels of PCBs present in Long Island fish increases the risk of liver cancer by 8 per cent.

The most widely known and accepted animal studies have found that:

- Complete reproductive failure occurred when minks ate food contaminated with five parts per million of PCBs, which is the current federal safe limit. After 105 days at 3.6 parts per million, all the test minks died. That level is similar to the average in Long Island bass and bluefish. Minks, of course, are smaller than humans, so exhibit more symptoms at lower doses.

- Chickens, rabbits and birds fed doses of PCBs from 10 to 100 parts per million showed various symptoms including loss of feathers, skin lesions, tremors and diminished growth.

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A 1968 victim of PCB poisoning in Yusho, Japan, shows acnelike skin sores, called "chloracne."

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Animal Testing Shows Reproductive Failures

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● Eighty per cent of the exposed rats tested showed cancerous or pre-cancerous growths, compared to less than 1 per cent of an unexposed group. The doses were about 350 times higher than people would get if they ate contaminated fish. An interagency study of PCBs last year said that although such doses (100 parts per million) are high when compared to daily consumption by humans, they are not very high for PCB workers or for people who eat a lot of fish contaminated with the chemical.

● All detectable levels of PCBs in water, no matter how small, were found to collect in the tissues of marine organisms. At a tenth of a part per billion in water, fish offspring became lethargic, stopped feeding, developed fin rot and started dying 24 hours after hatching. At one part per billion of PCBs in water, half the exposed shrimp died in 15 days. This concentration is similar to that in the Hudson River from the General Electric Co.'s discharges at plants near Albany. Reproduction rates in all species were reduced at varying concentrations. Resistance to disease was lowered; many species died of viruses that did not infect an unexposed group. Even exposed organisms placed in clean water transferred the chemical to their offspring.

● The female rhesus monkeys tested by Allen developed telltale PCB acne after about one month on a continuous diet of the contaminated food.

Of the female monkeys fed food with five parts per million PCBs, reproduction dropped by more than 80 per cent. Of those fed 2.5 parts per million, reproduction dropped by about 55 per cent. Male monkeys, on the other hand, had few symptoms at those doses, Allen said.

"These studies indicate that women who plan to have children had best discontinue eating [contaminated] fish," Allen said. He said that a woman who simply stops eating fish once she gets pregnant may already have consumed and collected PCBs in her tissues. Since the monkeys weighed about 12.5 pounds, a tenth what the average woman weighs, it would take a woman about 10 times as long to accumulate the same doses, he said.

Even the proposed federal two-parts-per-million limit on edible fish is not meant for daily consumption, especially by women and children, said the FDA's Campbell. "We figure that four fish meals per month at those levels should be the maximum, especially for women and children," she said.

The caution on the consumption of PCBs by children is based primarily on the fact that since children are smaller than adults, the PCB doses they receive when eating a contaminated fish are much larger per pound of body weight.

"An average child nursing at mother's breast for a year could ingest what adults ingest in a decade," said Joseph Highland, a biochemist and PCB expert for the Environmental Defense Fund, a Washington-based organization that prodded the

federal government two years ago into taking action to curtail consumption of PCBs.

In the absence of human analysis, the chemical can still be shown to be harmful in theory. PCBs are foreign to the body and are viewed by the system as pollutants. The liver tries to change the substance in some way so that it can be metabolized and excreted as waste. But PCBs are so stable that they cannot be broken down by the body, except slightly, in some instances. The liver works hard to metabolize the substance, and can be damaged in the process.

Laboratory tests indicate that PCBs, even if they do not produce negative effects themselves, can change the liver in a way so that the body is more prone to cancer from other toxic substances.

Since the body cannot metabolize PCBs, they generally cannot be excreted. They concentrate in the lipids, or fatty tissues, which are the body's storage area for most pollutants and excess food energy. The areas include the layer under the skin, the breasts and the abdominal area. They average about 20 per cent of the body's tissues for a person of average proportions.

Negative health effects of PCBs were initially reported in 1936, seven years after the material was first produced commercially. A U.S. Public Health Service report said workers had gotten skin sores from PCB exposures. The sores are believed now to be caused by concentrations of the chemical in the fatty layer under the skin. The ailment became known as "chloracne," or acne from chlorinated hydrocarbons.

Why, then, wasn't the material curtailed?

"The reports were evaluated as an example of misuse and poor handling," said William Papageorge, a biochemist and PCB expert for Monsanto Chemical Co. of St. Louis, the sole manufacturer of PCBs.

But in the mid-1960s the chemical started turning up in human hair, bird eggs and fish. Then, in February, 1968, about 1,200 Japanese consumers ate rice oil contaminated with PCBs. The chemical was used in a closed heating element and had accidentally leaked into cooking oil as it was being prepared in a factory in Yusho, Japan. By March, victims had skin eruptions, swelling of the eyelids and joints, impaired vision, loss of appetite, nausea, vomiting, overall fatigue, darkened skin, abnormal menstruation, impotence, jaundice, fever, hearing difficulties, headaches and spasms.

The offspring born to contaminated parents had darkened skin and PCB concentrations in their tissues. The skin symptoms persisted to a lesser extent after three years. Of the 13 contaminated women who became pregnant, there were two stillbirths and 12 of the 13 babies were smaller than national standards, according to scientific papers in a new book, "PCB Poisoning and Pollution."

Up to Sept. 13, 1973, 22 deaths had occurred

among the 1,200 PCB victims. Of those, nine were from cancer, "suggesting a possible excess mortality [from cancer]," according to one of the scientific papers. The paper adds, however, that the "rigorous statistical analysis" has not been done.

Among the 22 dead were a 13-year-old boy and a 25-year-old truck driver. Autopsies discovered internal growths similar to chloracne and various irregularities in lymph nodes, glands or the liver. Neither of those two died from cancer.

The average concentration of PCBs consumed by the Japanese victims over several weeks was 2,000 to 3,000 parts per million. That is 1,000 to 1,500 times the proposed federal limits for fish consumption. In Long Island waters, the average concentration of PCBs in striped bass and bluefish—those with the highest levels—is about three parts per million, with levels up to 21 parts per million.

To reach the minimum levels that caused adverse symptoms at Yusho, a person would have to eat about 500 pounds of contaminated fish. The doses are cumulative, however: Each meal consumed brings one closer to danger, scientists say.

The average Long Islander eats about 50 pounds per year—about four times the national average, according to J. L. McHugh, a biologist at the Marine Sciences Research Center of the State University of New York at Stony Brook. A 10-year dose of contaminated fish would equal the minimum Japanese accumulation. Sports fishermen, however, usually consume more than the general population, perhaps as much as 150 pounds annually, according to Robert Rance, head of Save Our Strippers, a Long Island sport fishing association. If a fisherman and his family ate only contaminated fish, they could therefore build up enough for the minimum Yusho concentration in less than five years.

Officials are quick to point out that the figures are for the worst case. Not all the fish are contaminated, and there is no way of determining which are, without a laboratory analysis.

In the last five years, the more studies that have been done, the more places PCBs have been found. Recently, the chemical was found in fish 11,000 feet beneath the ocean. The government has been holding hearings in Washington this month on the cleanup possibilities and alternatives. Detailed epidemiological studies on humans are just being started, and in a much-disputed study, University of Pennsylvania researchers linked PCB to cancer in New Jersey workers.

The Environmental Defense Fund's Highland contended that unless drastic action is taken to limit exposures, it will be just a matter of time until health problems start showing up in the general population.

But scientists do not yet agree on the best course of action. There is consensus on only two aspects. First, there is no easy answer. Second, as one federal expert put it, "the animal studies give us very great cause for concern."—Stuart Diamond

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PCB:

The Ubiquitous Contaminant

From Antarctica to Albany,

First of three parts

By Stuart Diamond

Newsday Environment Writer

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 FDA. "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 striped 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,



Newsday Photo by William J. Senti 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.

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.

"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 Horn, 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 \$5 million per year in spinoffs 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 nationally 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 Cafer U

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