MAY 13 [illegible]



MONS 000973

TROUBLED WATERS

By Lawrence Wright

In Biscayne Bay, fish are turning into diseased monsters. In New Orleans, where 112 different chemicals have been found in the drinking water, the rate of cancer mortality is soaring. From coast to coast, people and animals alike are paying a fearful price for the continuing contamination of our fresh water, our sea water, and our tap water

In 1969 Walter Kandrashoff, a commercial fisherman in Miami Beach, Florida, noticed something wrong with the croakers in Biscayne Bay. "The abnormality was always the same," he recalls. "Emaciation." Kandrashoff is a blunt, squared-off man with a fisherman's drab leather skin and the observant, meticulous nature of a born scientist. It wasn't the first time Kandrashoff had seen strange things happen to the fish. For 20 years he had fished the waters off the coast of his native New York, and had watched his catch diminish to the point that he could no longer support his family. What was more ominous, sometimes the fish he took had things wrong with their bodies. "I heard way back, long before I saw anything myself, that the snapper feeding around the sewage outfalls were getting tumors around their mouths," he says. Like most other fishermen he avoided the area. Then in 1967 he noticed that the fluke, a flatfish like the flounder, had developed ragged fins. Sometimes their tails were completely missing. Kandrashoff thought they had been towed too long in the nets, but he had never seen it happen before. In the summer, when he fished off the coast of New Jersey around Raritan Bay or Sandy Hook, he would find fish swimming in circles. Most of the whirling animals were menhaden, an inedible but extremely important industrial fish, which the Algonquin Indians once used to fertilize their corn.

By 1968 Kandrashoff could see that there was no future as a fisherman in New York. He moved his family to the bluer waters of Florida, to the prosperous and wonderfully diverse fishing grounds in Biscayne Bay, which separates Miami from Miami Beach in the northern part of the bay and, in the south, from the island of Key Biscayne, where President Nixon had just installed his Florida White House. The first year Kandrashoff fished in Biscayne Bay he did well. The fish were abundant and perfectly formed. So when he began taking emaciated croakers he knew something was wrong. He was concerned enough to write a letter to the *Miami Herald*. In early 1970 Kandrashoff caught his first emaciated pompano, and from June to December of that year he caught more than a hundred pompano that were "just skin and bones." Some of these fish he took to scientists at the Rosenstiel School of Marine and Atmospheric Science at the University of Miami, who speculated that the fish had parasites, although on examination they couldn't find any. "In the beginning they'd say, 'Show me where you're catching them.' And I couldn't do that—it was just one or two fish at a time, then. It was a slow process, in other words. It wasn't dramatic at first." The scientists couldn't really agree with Kandrashoff's assertion that the condition was "abnormal," because they didn't have a baseline for comparison—in this case, a survey of fish at another time or place that would establish how many emaciated pompano might be expected in an average population. After that, Kandrashoff began to make careful notes on his catches.

The next year Kandrashoff recorded black mullets with tumors. In March he caught a porgy with a thick white tumor deeply embedded in front of its dorsal fin. On April 30 he took a crevalle jack whose whole body was covered with red sores; near the jack's tail was a spongy tumor the size of a thumb. "When you've been a lifetime fisherman and you've never seen this sort of thing before, you know something's wrong," Kandrashoff says.

He found himself going from door to door with his horrible trophies, trying to get scientists to help him. They told him they were sympathetic, but they just weren't funded to study his particular problem. Come back another time, they'd say—and sure enough, next week they'd hear Walter's loud Brooklyn accent ringing in the hall as he'd appear with new samples. Half annoyed, the scientists would kid Kandrashoff about his persistence. "Well, I'm a Polack," he'd tell them. "I come from a long line of very stubborn people."

Kandrashoff began to frequent Dr. M. Michael Sigel's virology lab at the University of Miami Medical School. Sigel's group happened to be doing some work on fish diseases, and once Kandrashoff got wind of that fact, he wouldn't leave them alone. "Walter comes on very strong," remembers Dr. Robert McDonough of Atlanta, who used to work in Sigel's lab. "He would bring in a fish and an hour later he'd call and demand to know what was wrong with it. Being an intern and the least man on the telephone pole, I always got the call. The big joke was to call me to the phone and say it was my wife, and it would be Walter."

Harbinger: Walter Kandrashoff with pin fish from Biscayne Bay. Note emaciated tail of fish on left

PHOTOGRAPH BY PETER ANGELO SIMON

MDNS 000974

Walter picked up what he could from the labs. He learned that the "patches of red," as he called the bloody areas on the fishes' bodies, were hemorrhages, and that the eroded fins he had seen in New York and was now finding in Biscayne Bay were caused by bacterial fin rot, a poorly understood disease thought to be influenced by sewage effluent.

Kandrashoff finally decided he had to take his case to the community. He began to pester reporters from the newspapers and television stations. The Tourist Development members said he was an alarmist and certainly they were quite alarmed when Walter started turning up at meetings of the Chamber of Commerce carrying a canvas satchel of diseased fish. (It was a point of honor always to bring fish he'd caught that very day.) There were newspaper articles and talk shows, but somehow the message was slow to get across. "The man has an eighth-grade education, if that much," remembers McDonough. "Of course, he's got a tremendous intellect, but it was because of his education that a lot of people thought he was a clown."

When support did come, it was from a totally unexpected source: the Miami-Dade Chamber of Commerce. A few members were horrified to see what was coming out of the bay, and horrified as well at the possible consequences to tourism. Doctors were already reporting great numbers of urogenital infections in young women who had been swimming in Miami-area waters. In the spring of 1971 Walter Kandrashoff and Richard Brusuelas, then an ecologist for the Chamber of Commerce, drove out to the National Oceanic and Atmospheric Administration's Tropical Atlantic Biological Laboratory on Virginia Key, which happens to be in the very middle of Biscayne Bay. Kandrashoff took along a big sack of specimens he'd been keeping in his freezer, and spread them out before Dr. Carl Sindermann, the director of the laboratory. There were a lot of fish—"mainly mullet, porgy, snapper, plus whatever else was available"—and they were a pathetic display: withered, bleeding, eroded, some with mushrooming tumors corrupting the symmetry of their bodies. It is a shock to see such fish. "Dr. Sindermann was very interested in my specimens," remembers Kandrashoff, "and I knew they made a hell of an impression on Mr. Brusuelas." Sindermann kept some of the fish for further examination; he explained that he really wasn't funded to study the problems of Biscayne Bay at the time he was studying tuna off the coast of West Africa—but he agreed that somebody should take the problem more seriously.

Four months later, on August 27, 1971, Kandrashoff took a pound-and-a-half croaker that was especially distressed. Although one side of the fish was perfectly normal in appearance, on the other side the eye bulged hugely out of its socket. "I saw some fish with cloudy eyes in New York," says Kandrashoff, "but I never saw a fish that looked like that. It was all wild—you couldn't see the pupil anymore. It was all obliterated." When he touched the swollen growth, blood rushed through the eye. Kandrashoff carefully cut the affected eye out of the head, and using a technique he had picked up in Dr. Sigel's lab, he preserved the tissue in a formalin solution. Sigel diagnosed the disease as lymphoblastoma, a form of leukemia, the first such cancer found in a fish. He sent a slide to Dr. John Harshbarger at the Smithsonian Institution, who listed it as one of the "highlights of the decade" in the *Registry of Tumors in Lower Animals*. "Find another fish like that and you'll be a famous man," Sigel told Walter. Kandrashoff was pleased by his new

The fish in Biscayne Bay are turning into monsters

acceptance in the scientific community, but by that time he was finding tumors on black mullet that were "dangling off the body like grapes."

Even before World War II, observers had associated fish diseases with pollution, especially in the Schuylkill and Delaware rivers in Philadelphia, which was already highly industrialized. But in spite of the intimations that the postwar infusions of chemicals and plastics into the environment were affecting the fish, as late as 1962 it was still widely believed that fish could not metabolize many of the environmental irritants called carcinogens, which the National Cancer Institute estimates cause 60 to 90 percent of the cancers in people. The massive fish kills of the last two decades should have demonstrated that fish are fantastically reactive to foreign substances in the water, yet seldom were the survivors of these catastrophes examined for subtle, sublethal effects. One reason for the misapprehension was that fish proved to be more sensitive than the equipment scientists had to work with. For instance, when rainbow trout in many different hatcheries simultaneously turned up with hepatomas—tumors on the liver—the cause was traced to a change in diet, specifically to a new food pellet that was contaminated with chemicals called aflatoxins. Subsequent laboratory tests showed that trout could develop hepatomas when fed concentrations of an aflatoxin as low as *400 parts per trillion*. At detectable levels the fish simply died.

Cancer in fish is still not well understood. Trying to translate the disease of one animal into terms that apply to another is a tricky business, especially when one is comparing a cold-blooded species with warm-blooded mammals. Tumors in fish may be caused by viruses and parasites as well as carcinogens; and cells that are considered cancerous in man, in the sense that they generate tumors elsewhere in the organism and interfere with the necessary processes of the body, may in fish remain localized, with undetermined effects on the health of the animal. Unless an affected fish is held in an aquarium to see what develops, it is often impossible to distinguish between what is benign and what is malignant; yet even when the tumor obviously "endangers the continuation of the host's ecosystem," which is the best definition of malignancy scientists have to work with, the disease is seldom called by its true name. "People who run the fisheries are aware of the emotionality attached to the word cancer," says Dr. Clyde Dawe of the National Cancer Institute, the principal authority on neoplasms (tumors) in aquatic animals. "The view I take is that any tumor, whether it's metastasizing or not, is not good." Some tumors, such as hepatomas in rainbow trout, may require several years to metastasize, and in the wild the disease is seldom allowed to progress that far. As Dr. Don Malins of the Northwest and Alaska Fisheries Center points out, "The problem is that, unlike a lesion on a person or a dog or some animal we normally observe in society, in the marine environment, once an animal becomes impaired, a predator will snap it up."

That's what surprised Walter Kandrashoff. "Everything gets sick in the world," he says, "and what the hell, a fish will get sick, too. But normally a fish like that will get eaten up. I couldn't figure out why all these sick fish were still swimming around. I found my answer when I started looking at the lemon sharks. I haven't found a healthy one yet."

By 1972 Kandrashoff's fishing business was more or less ruined. The 30' Maine yawl he once enjoyed had been replaced by a 13' Boston whaler [illegible] barely

MONS 000975

enough to navigate even the generally calm waters of the bay. Obviously the fishing would be better somewhere else, and a lot of fishermen had already left. "We had a pretty good fleet here at one time, catching kingfish and Spanish mackerel," Walter recalls. "Most of them went down to the Keys—the water's cleaner down there."

But Walter decided not to join them. He was captivated by the havoc, like a man watching a forest fire; and although he was often treated like a crackpot by scientists and even other fishermen, Walter had come to believe that he was enrolled in something larger than his own feelings or aspirations; in his own way, he decided that he was doing his part in the fight against cancer. He explained that to his wife and she understood him. She even went to work at night as a waitress. What she didn't understand was having her refrigerator full of disfigured fish parts, the kitchen table littered with jars of formalin, and stacks of manuscripts and newspapers junking up the living room. Looking back, Walter admits, "I realize I might have gone overboard. I was talking about disease all the time. Of course, I was fascinated by this chance to see the whole thing barreling along. I was watching the degradation of the entire bay in front of my very eyes." Mrs. Kandrashoff told her husband that she didn't mind what he did, she just didn't want to hear about it anymore.

Walter had to take a part-time job cleaning fish in a market. It was a real humiliation for him. "I used to be a leader in the technique of how to catch fish," he remembers. "I had guys following me all over the water." At least in his new job he was able to observe that he wasn't the only fisherman bringing in diseased fish. "We wouldn't sell anything with a tumor or something that didn't look right," he says. He kept a special locker for specimens he thought might interest his friends in the lab.

By now Kandrashoff had a disciple: Dr. Robert McDonough, the young intern under Dr. Sigel. "I was always the one delegated to talk to him," McDonough recalls, "and the man began to fascinate me. Finally I had lunch with him one day. That's all it took. A person like that is a real hero. I know that sounds silly nowadays, but Walter cares; it's not just a sham. I knew Walter for three years while I was in Miami, and after that first conference I don't think there was a single night I didn't talk to him at least once on the phone."

McDonough's support gave Walter some of the respectability he knew he



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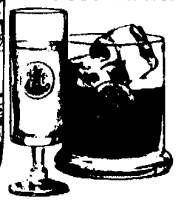

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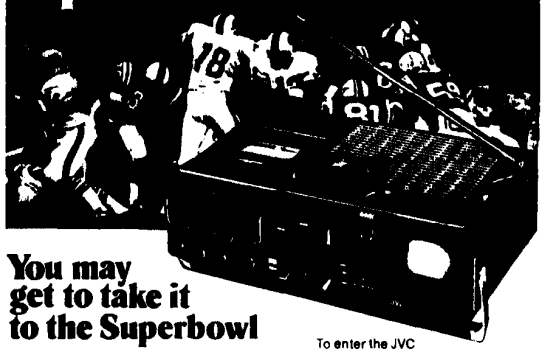

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needed. In 1972 he and McDonough arranged a "Conference on Fish Pollution." "I had really done it up right," McDonough remembers. "I had slides and maps of the bay, Walter had his fish, and we had invited everybody—the Chamber of Commerce, the Tourist Development Authority, the U.S. Marine Fisheries, television, radio—everybody. Walter and I got up and we each gave our little pitch. And then some guy from the Marine Fisheries said he had done a survey of all the fish markets in Miami Beach and he hadn't found a single diseased fish. The fish markets! Walter just hit the ceiling. I thought they were going to have to call the cops."

But the message was finally beginning to come through. In 1973 the University of Miami received a federal grant to study fish diseases in Biscayne Bay, which meant that at last somebody was funded to study "Walter's problem." In an independent study, the Florida Department of Natural Resources conducted a survey and found that fishermen of the Gulf Coast of Florida around Crystal River were also taking fish with tumors. Other projects in other states were beginning to examine fish in their areas. In California, a seven-year survey found approximately 5 percent of the entire saltwater fish population afflicted with fin rot, tumors, parasites or abnormal colorations. In Maine, scientists studying organisms near oil-spill sites were finding cancerous growths in as many as 22 percent of the soft-shell clams. In the estuaries and lakes along the Mississippi Gulf coast, half of the freshwater sport fishes caught today, such as largemouth bass and bluegill are covered with red sores; sometimes the lesions in the bluegill are so deep the bones are exposed. Dr. Robin Overstreet of the Gulf Coast Research Laboratory in Ocean Springs, Mississippi, estimates that during the summer lesions occur on approximately 10 percent of the spot and southern flounder, and on 5 percent of the Atlantic croaker, pinfish and spotted sea trout. Overstreet sorted through a fisherman's haul in three different spots in the Mississippi Sound and found nine striped mullet with as many as 10 tumors per fish. He diagnosed the growths as fibrosarcomas, a cancer, and entered them in Harshbarger's registry.

Harshbarger himself came to Florida to study catfish in central Florida lakes, which receive agricultural runoff containing pesticides and fertilizers from Florida's farmlands. He found lip tumors in both yellow and brown bullheads, and cancerous growths in the mouths of brown bullheads. Like the croaker in salt water, the catfish is a bottom-feeder, and the tumors in both fishes suggest that the sediment is contaminated. In the Great Lakes, a survey of coarse fishes (which are often the only kinds of fish that remain) found tumors in the gonads of 100 percent of the adult male carp in some areas; the tumors invariably render the fish sterile. An examination of museum specimens collected from the lakes 25 years ago found no such tumors, and the fish were reported to have been active breeders. In parts of Lake Ontario over 50 percent of the white suckers have tumors like pink cauliflowers on their lips. These findings are all the more disturbing because of the increasing dependence on the Great Lakes as a source of drinking water for the 30 million people who live and work near the lakes.

In the ponds of the South, catfish are developing twisted and brittle backbones, which eventually snap in half. This same "broken back syndrome" has also been recently observed in Long Island Sound among the striped bass. Recent studies have described cancerlike epizootics (epidemics among animals) in shellfish in Washington, Oregon, Virginia, Delaware, Maryland, Connecticut, Massachusetts, Maine and Florida.

Scientists who have been monitoring the flatfish in Puget Sound for over 12 years have recorded instances of skin tumors in young English sole and starry flounder as high as 50 percent. Recently they decided to take a look at flatfish in the Duwamish River estuary, which flows through Seattle and receives heavy industrial pollution before dumping into the sound. They found that 32 percent of the English sole had hepatomas. "People are now beginning to look, and as a consequence they're beginning to find," says Don Malins in Seattle. "One of the present problems which we face is that we don't know what is normal in fish. Unless it is a gross thing then people don't know whether there's been an actual increase of disease or not." However, Malins admits that the incidence of hepatomas in the Duwamish seems extraordinary; other scientists say the figure is astronomical. And yet the situation in the Duwamish is not unrepresentative, and it may not even be that unusual.

In 1974 Walter Kandrashoff wrote in his notes: "This year showed not only a continuation of the previous symptoms in many species of fish, but also changes were occurring that, to my mind, were startling. Either the genetic code was being altered or fish showed abnormal development in the early stages of life. It is my personal belief that both of these changes were taking place simultaneously." On many fish Kandrashoff found round patches like coins where the scales go all awry. "This is alarming, this thing," says Walter. "I never saw such a thing in my life." According to Dr. Lanny Udey of the Marine Pathology program at the University of Miami School of Medicine, scale disorientation is found in about 30 percent of the fish in the bay, and in some species the incidence approaches 50 percent. "So far, I understand this scale disorientation is unique to Florida," Walter says. "I wish they'd put my name on it. I wish they'd call it the 'Kandrashoff Syndrome.'"

At first, Kandrashoff thought it was the bacteria in the sewage causing these problems. "Then as time went on I refined my thoughts. It can't be just bacteria, house waste—it can't be that alone. Over the years I began to think it must be chemicals. Then I got to thinking, what chemicals? Well, what's being used? That's when I thought of chlorinated hydrocarbons—the pesticides, the ones Rachel Carson warned us about. I'm not a chemist, I'm not a scientist, but there's something very deadly about this group of chemicals."

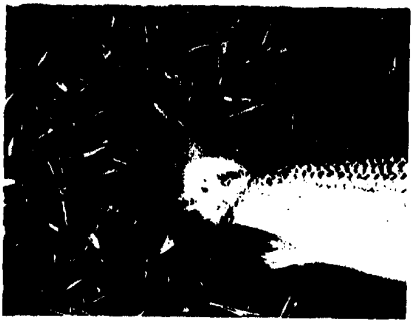
The Synthetic Stew

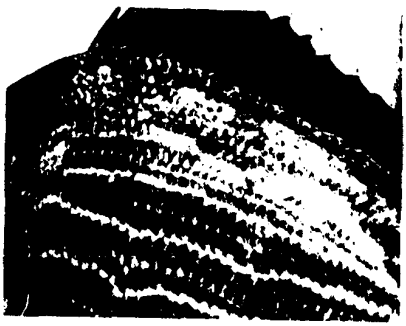
"They should not be called 'insecticides,' but 'biocides,'" wrote Rachel Carson. In the 15 years since the publication of *Silent Spring* the family of chlorinated hydrocarbons has reared a new generation. Although many of the worst poisons in this group have been banned or restricted, including DDT, dieldrin, aldrin, heptachlor and chlordane, they've been replaced by new compounds, such as Mirex and Kepone, which have long-term effects that are just being discovered. Many chlorinated compounds that are not used as pesticides are also damaging to life. Vinyl chloride, which is used to make rigid plastics, is a chlorinated hydrocarbon; so is carbon tetrachloride, a common cleaning fluid. Both of these compounds are carcinogens, as are many other members of the family.

"Chlorinated hydrocarbons are broken down slowly and tend to be persistent in the environment," explains Ken Kamlet of the National Wildlife Federation. "They are even more insidious because they exert a number of poorly understood sublethal effects, including the most horrifying of all—a tendency to interfere with reproduction, and in animals very similar to man."

These chlorinated compounds are soluble in fat but not in water; this ac-

MONS 000977







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PHOTOGRAPH BY DAN BUDNIK/WOODFIN CAMP







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Help! Tail erosion and scale disorientation are now increasingly found in Florida fish (top). In New Orleans, industrial muck is dumped directly into the Mississippi (middle). Paper mill discharges more of the same into the unfishable Hudson, while chlorine plant gives Miami water a swimming-pool taste

counts for the phenomenon known as bioaccumulation. The compounds tend to settle into the sediment, where they are picked up by microorganisms that are subsequently eaten by fish. The fish can store chemicals in their livers and fatty tissues at high levels—at levels as much as a millionfold greater than the contamination of the surrounding water. Shellfish are especially adept at picking up extraneous chemicals, with the result that "off limits" signs are a common sight on clam and oyster beds all over the country.

Kepone, an ant and roach killer, became notorious when an investigation of the Life Science Products plant in Hopewell, Virginia, disclosed neurological disorders in many of the workers who manufactured the chemical. Tons of this material have been discharged into the James River, which empties into Chesapeake Bay. The projected field study to examine the effects of this chemical on fish in the river hasn't begun yet; however, Dr. John Couch of the EPA's Gulf Breeze Laboratory in Florida has done a controlled lab experiment on sheepshead minnows, which are a common fish along the coast from Texas to Maryland. He found that when he exposed the fish to four or five parts of Kepone per billion in sea water—nearly the lowest detectable level—he got what he called "quite a striking effect." The fish convulsed. Within seven days 100 percent of the test fish had developed black tail, which indicates neurological damage, and the broken-back syndrome. Upon examination, Couch found that the fish had actually splintered their own backbones through their violent convulsions. "The implications of these lab tests are—how would you say it?—dire," says Couch.

Kepone has been found in human tissues and mother's milk, especially in the South where Mirex, which is differentiated from Kepone by a single atom of oxygen, is sprayed on farmlands to poison fire ants. Other chlorinated compounds, including "disturbing traces" of dieldrin, are found in human tissues, according to the EPA. No one knows the consequences of this.

The most malevolent member of the family of chlorinated hydrocarbons may be a group of compounds known as PCBs—polychlorinated biphenyls. PCBs have been used primarily in closed electrical systems such as transformers, but also in plastics, paints and lubricants. Although they were never sprayed over the landscape, as many chlorinated pesticides still are, they are ubiquitous in the environment. Their presence in rivers



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and oceans derives almost entirely from spills and industrial waste. That's the great irony about PCBs; the incidental discharge of these compounds may result in a greater destruction of the fishery than decades of concentrated, deliberate pollution.

Along the Hudson River, which was to have been a showcase for the cleanup of the nation's waterways, two General Electric plants until recently have been discharging PCBs in amounts that ranged from less than 10 to as much as 30 pounds per day; now thousands of pounds of residue have settled in the bottom of the river, and they're likely to stay there for many years. The fish that live in the Hudson are accumulating PCBs in high and sometimes fantastic doses. Downstream from the plants the average fish has concentrated nearly 100 parts per million (ppm) in his tissues. The champion is an eel with 575 ppm of PCBs. The limit for edible fish, according to the Food and Drug Administration, is 5 ppm. It will be a long time before fishing is allowed in the Hudson. And who can say what is happening to the over 100,000 people who draw their drinking water from the Hudson?

The Hudson River, though the most conspicuous symbol of PCB pollution, is hardly the only one. Fish in lakes and rivers all over the country are contaminated far in excess of the FDA "limit," yet enforcement has largely been left to the states, which are under great pressure from sport and commercial fishermen to disregard or evade the standard. In Lake Michigan, for instance, where trout have been found with concentrations of 165 ppm, fishermen have been advised not to eat more than one fish per week. This, despite the fact that mink fed on Great Lakes fish stopped reproducing. (Dr. Robert Ringer at Michigan State University later found that mink failed to reproduce when fed PCBs at 0.164 ppm, which is 30 times lower than the FDA limit. At 3.57 ppm, the mink died.) In Seattle, scientists suspect that PCBs may be the agent that is causing liver tumors in the English sole, although the PCB concentrations in the edible fillets (which are usually the only portion measured) are 10 times lower than the FDA standard. Most female monkeys fed PCBs at exactly the FDA standard were made sterile. Those that did conceive (only 12.5 percent compared with 90 percent of the control group) had smaller offspring; and of the offspring nursing from mothers fed on this diet, half were dead within four months. The survivors showed various mental defects and learning disabilities.

Fish are almost the sole source of PCB contamination in humans, which is increasing rapidly. According to the EPA, the *average* concentration of PCBs in human breast milk is 1.8 ppm, which means that nursing infants are getting 10 times the concentrations of PCBs recommended as "safe" for babies.

In the face of all this, the FDA announced on April 1 of this year that it is proposing lowering its PCB standard from 5 ppm to 2 ppm, which is the Canadian standard. (Currently, fish that are too contaminated to sell in Canada are sent to the U.S.) Of course, strenuous enforcement of even the *present* standard would shut down fishing all over the country. Many of the major rivers, bays and important reservoirs would be closed. That's already happened in some cases, although enforcement by the states is irregular, and when the contaminated body of water falls between two states, the confusion can be comical. Lake Hartwell, on the Georgia-South Carolina line, is closed in South Carolina and open in Georgia; on the other hand, the Coosa River is closed in Georgia, but open in Alabama, where it dumps into Lake Weiss. In Chesapeake Bay, where the principal contaminant is Kepone, Governor Mills Godwin of Virginia believes that bluefish are unsafe to eat, while Governor Marvin Mandel says that they are okay in Maryland.

The Monsanto Corporation, which was the sole producer of PCBs in this country, has recently volunteered to stop manufacturing the product, but that doesn't mean PCBs are no longer a threat. Other countries still manufacture PCBs, and about a million pounds are imported into this country each year. Even if the EPA achieves the goal of eliminating all PCB emissions, there are enough accidental spills or unreported discharges to continue to affect the environment. In March of this year, for example, a trucker in Iowa mistook a shipment of PCB solvents for crankcase oil; he was about to spread it over the gravel roads when a state official caught him. The official said there were enough PCBs in the solvent to kill or cripple nearly every citizen of Iowa.

The real danger of chlorinated hydrocarbons and PCBs—aside from the obvious implications for human health—is that fish may stop propagating. In many places this has already happened. The Maryland Department of Natural Resources reports that there hasn't been a successful spawning of oysters in Chesapeake Bay since the mid-sixties. In the Great Lakes, the U.S. Fish and Wildlife Service has spent $175 million to restore the trout population. "The fish are living and thriving," says Steve DiAngelo of USFW, "they just aren't reproducing."

The Invisible Menace

In 1973 researchers at the National Institute of Environmental Health Sciences in North Carolina noticed that their experimental mice and rabbits were producing fewer offspring. Spontaneous abortion had increased, and there were unexpected numbers of dead and malformed among the litters. Although many of the compounds tested in the NIEHS lab can affect reproduction, none of these animals had been involved in any experiments. The problem seemed to be in the water, which happened to be tap water from the city of Durham. Scientists were not able to explain satisfactorily what in the water might be affecting the animals, but when it was purified through filtration the anomalies stopped.

In New Orleans, citizens were used to drinking yellowish drinking water with an oily consistency and a poor taste; some days the odor was offensive, and if a consumer had known about such things he might have been able to correlate it to a barge spill upriver in the Mississippi, where the city gets its drinking water, or to a rain in St. Louis that overburdened a sewage treatment plant. New Orleans has the disadvantage of being downstream from 40 percent of the nation, and by the time the Mississippi reaches the city it is laden with fertilizers, insecticides, feed lot wastes, topsoil, mine slag, dyes, acids, an array of heavy metals, and industrial chemicals with exotic pedigrees. After 1967, fish caught in the Mississippi below Baton Rouge were spiced with such strange flavors that they could no longer be sold. The Federal Water Pollution Control Administration examined some of the chemicals found in both raw and treated water in New Orleans, and reported in 1972 the identification of 46 organic compounds, which they said represented less than 2 percent of the total chemical load. Some of the chemicals they discovered are toxins, and at least three (chloroform, benzene and carbon tetrachloride) are carcinogens. The EPA concluded that Mississippi River drinking water was dangerous, especially to the elderly, the ill and children.

This report got little attention until 1974, when Dr. Robert H. Harris of the Environmental Defense Fund made the connection between the quality of the drinking water and the rate of cancer mortality in New Orleans, which is 32

MONS 000980



Research: Autopsy conducted at University of Miami microbiology lab reveals tumor in male porgy (top) caught in Miami's Biscayne Bay by Walter Kandrashoff (bottom left) and biologist Dana Kent

percent above the national average. In a press conference, Harris suggested that the polluted water might account for 10 to 20 percent of the total cancer death rate in the city. His figures showed that increased purification of the drinking water to remove carcinogens would alone save the lives of over 50 white males each year. The city health director angrily replied that drinking New Orleans water was no more dangerous "than driving a car." Few people in the city had thought of such a comparison, but once made, it seemed unfortunately apt.

The next day the EPA released its own study of New Orleans water. They had now found 66 organic chemicals in the treated water, including several known and suspected carcinogens. (Since then, finding chemicals in New Orleans water has become a sort of graduate students' contest. The count is now 112, and Stewart Brehm, director of the New Orleans Sewer and Water Board, gamely estimates that the final tally will be over 900.) What was more disturbing is that some of the most dangerous chemicals in the finished water weren't found in the raw river water. They seemed to have been formed during treatment; and since the bulk of the new compounds created were chlorinated hydrocarbons, primarily chloroform, the implication was that New Orleans had jeopardized the health of its citizens by disinfecting the water with chlorine, a practice common to nearly every American city.

Another EPA study of 80 cities found that the New Orleans situation was not unique. In places where the water source was known to be polluted, as in Philadelphia and Cincinnati, the organic chemical content was high; but even in cities where the raw water was thought to be relatively clean, chlorination generated known or suspected carcinogens. As a matter of fact, the most polluted water happened to belong to Miami, which draws its water from wells. The water drains out of the Everglades into a shallow underground lake known as the Biscayne Aquifer, and when it arrives in the Miami wellfield it is full of natural humic chemicals, which give the water a brown hue. Brown water is thought to be a poor risk by the tourist industry, so for years the City of Miami has been adding extra doses of chlorine during treatment as a bleaching agent; the result is a product with an appetizing clarity, which sometimes tastes like swimming-pool water. The chloroform content of Miami's water is 311 parts per billion, the highest in the nation; by comparison New Orleans'

water has only 133 parts per billion.

Chloroform was used for years in cough syrup, and one of the arguments favored by waterworks supervisors was that it would take as many as 16 years of drinking New Orleans water to get the equivalent dose found in one bottle of Vicks Formula 44. Now that chloroform has been removed from the market by the FDA that argument is not so popular. In any case, the concern was not that a person would fall over dead after a glass of water, but that after a lifetime of drinking water contaminated in small quantities he might develop a cancer he wouldn't otherwise have. People selectively store some carcinogens in their bodies, and it is generally suspected that the total burden of these unwanted chemicals invites an increased chance of cancer. "We live in water; our cells are bathed in it," remarks Dr. Daniel Jackson, director of the Drinking Water Quality Laboratory at Florida International University. "Even though chloroform in the water may not be an immediate hazard, it is quite possible that it makes our cells more vulnerable to other assaults." In New Orleans, Dr. John Laseter has found chloroform as well as carbon tetrachloride and tetrachloroethylene in the blood of local residents, and although the citizens may have been exposed to these chemicals elsewhere in the environment, all three are present in the water. More disturbing is Laseter's discovery that some carcinogens, including chloroform, benzene and carbon tetrachloride, are present in the blood of human fetuses, and at concentrations greater than in the blood of their mothers. Apparently the chemicals tend to accumulate in the embryo, and that may have grave implications for children who are born with higher levels of these chemicals. Statisticians at the EPA and the National Institute of Environmental Health Sciences have demonstrated positive correlations between chloroform levels in the water and certain cancers, especially bladder and rectal cancers.

The National Academy of Sciences has just prepared a study of chemical contamination of drinking water for EPA, in order for the agency finally to set standards for organic chemicals. The study points out that chlorination also produces brominated hydrocarbons, such as bromodichloromethane, dibromochloromethane and bromoform. According to Dr. Joshua Lederberg, a Nobel laureate at Stanford University who has studied chlorine and its compounds, these brominated chemicals may be even more hazardous than their chlorinated cousins. The family of brominated hydrocarbons includes several well-known flame retardants, some of which are strikingly similar in structure to chlorinated pesticides. Notable among these flame retardants are Tris, which has just been banned from use in children's sleepwear, and the polybrominated biphenyls (PBBs), which accidentally contaminated livestock feed in Michigan, caused the slaughter of 32,000 cattle and nearly 2 million chickens, and endangered the state's citizens.

Cities continue to chlorinate water because it is the cheapest, most effective way to kill bacteria. "But can you get them without getting us? That's the question," says Lederberg. "I think it's disgraceful that we haven't long since looked at alternatives to chlorination."

Purer water is easy to produce, but it may be expensive—at least, more expensive than Americans are used to paying for their water. Waterworks supervisors in six cities have EPA grants to look at different techniques of disinfection and filtration. Jim Becnel, director of the Carrollton waterworks in New Orleans, is studying ozonation, but he is skeptical that these new methods will ever be used, at least in New Orleans, where the water board can't even get a rate hike to replace equipment that's been in use since the turn of the century.



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MONS 000982

"The tests will show, say, that for two cents a hundred gallons there'll be no effect on the organics in the water; for 20 cents a hundred gallons there'll be some effect, and for $2 a hundred gallons we can remove one-third of the organic load. Then we say, 'Okay, Public—is it worth it to you?'"

"Ultimately we're left up in the air with a risk assessment," agrees Dr. Herman Kraybill of the National Cancer Institute. "Maybe a chemical will cause 15 cancers in a population of 100,000. Well, will you allow that? Before cities spend a couple of hundred million dollars they're going to have to make such decisions."

Last September, at a conference on aquatic pollution sponsored by the New York Academy of Sciences, Dr. Robert Miller of the National Cancer Institute reviewed some of the health implications of water contaminants. "It is clear that contamination of water has shrunk the size of newborn babies, starved others of oxygen, pustulated the skin for years in persons of all ages, caused bones to ache with every step and addled the brains of newborns, children and adults," he said. "With this array of adverse effects on the integrity of the human organism, is there really a need to invoke the specter of cancer to achieve clean water?"

The answer to Dr. Miller's question may lie in the history of the efforts to clean up the waters of this country. In 1972 Congress passed amendments to the Federal Water Pollution Control Act that called for restoring "the chemical, physical, and biological integrity of the nation's waters" by July 1, 1983. The report of the President's Council on Environmental Quality characterizes the first half decade of this act as a period "of high expectation and significant frustration." Industry has tied up pollution permits in court so many times that the EPA has actually backed off some standards; in other cases the General Accounting Office has found that dischargers were not obeying the permits anyway. Congress is now considering the National Commission on Water Quality's recommendation that the 1983 deadline be put off for as long as 10 years.

The Safe Drinking Water Act of 1974 has encountered similar defeats. EPA was supposed to set standards for measurement of total organics in the drinking water within three months of the bill. When it did, municipal waterworks directors reacted so strongly that EPA withdrew its standards, saying there was inadequate data about technology and health effects. Now there's a lot more information about health effects and none of it is encouraging, but in the meantime EPA has been advancing proposals based on what most cities can easily meet, not what's safe. The final "total trihalomethane" standard, which would include chloroform and the brominated compounds formed by treatment, will probably be between 100 and 150 parts per billion, which Robert Harris says is "cosmetic." Herman Kraybill of NCI agrees. "I'll always remember the mental gymnastics they [the EPA] went through to get these figures," he recalls. "Finally they asked [the Waterworks Association] if they could meet 100 ppm and they said yes." The preponderance of cities, including New Orleans, would have to make little or no adjustment in treatment techniques under this standard. "There are some government studies that may suggest such levels of chloroform could result in an increase in certain kinds of cancer by as much as 30 percent," says Harris.

The latest piece of legislation is the Toxic Substances Control Act, or

Dr. Robert Harris made the connection between the quality of the drinking water and the rate of cancer mortality in New Orleans, which is 32 percent above the national average

TOSCA, which requires industries to provide the EPA with information on the toxicity of new chemicals *before* they go into production, in the hope that dangerous chemicals may be stopped before they get into the environment. Similar laws were supposed to protect against pesticides, but last year three EPA attorneys resigned from the agency, protesting that in too many cases the EPA accepted obviously fraudulent data from industry and allowed the use of hazardous pesticides, disregarding the effects on the environment. "Anyone who believes that TOSCA is going to be a cure-all is living in a dream world," says Calvin Menzie of the U.S. Fish and Wildlife Service. "However, it is the first real effort to prevent, rather than to react."

Today, one person in four will get cancer in his lifetime, and one in five will die of it. Both the incidence of cancer and the cancer death rate are going up. Human cancer takes a long time to produce—the latency period is usually between 20 and 30 years—so most of this year's cancers reflect environmental conditions that prevailed in the 1940s and 1950s. According to the U.S. Tariff Commission, the production of synthetic organic chemicals has increased 1200 percent since the end of World War II. Robert Harris at EDF has charted the rise in synthetic organic chemicals with the cancer death rate. "Look at this," he says, pointing to the lines for production of plastics and pesticides, which begin to ascend in 1950 and become almost vertical after 1960. "These industries really began to take off after 1955," he says. "Of course, cancer death rates have been going up all along, about 1 percent a year. But look what happened last year, about 20 years after these industries got going: suddenly we have a doubling of the rate of increase. The line charting the death rate turns up sharply, just as the lines for plastics and pesticides did two decades before. If these lines continue to correspond," says Harris, "all hell is going to break loose."

The Deadly Silence

The use of pesticides will increase another 50 percent by 1984, estimates Frost and Sullivan, Inc., a New York research firm. For many parts of the country that means approaching or exceeding the amount of pesticides currently used in Florida, which is fourth in the nation in this category; and, according to Dan Jackson at Florida International University, more pesticides are used in Palm Beach and Miami's Dade County than in any other section of the state. He believes that the pesticides have contaminated the aquifer from which Miami draws its water.

Much of the residue from the chlorinated pesticides washes into the canals and sewers that empty into Biscayne Bay. PCBs have also been found in high concentrations in the canals. Kandrashoff believes that the chlorinated hydrocarbons are responsible for what he calls "the one-two punch": the chemicals are breaking down the fishes' immune systems and making them more susceptible to other diseases. There is some evidence that this may be happening. Dr. Couch at EPA's Gulf Breeze Lab exposed shrimp to low levels of PCBs (three parts per billion) for a period of 30 to 40 days and got a tripling of the incidence of bacterial infection.

In any case, PCBs and pesticides are not the only sources of chlorinated hydrocarbons in the bay. On Virginia Key the City of Miami maintains a sewage disposal plant; sewage there is treated and, according to accepted policy, heavily chlorinated to kill the bacteria.

MONS 000983

MONS 000964

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Pike Attacks PCB Standards

By Bob Wacker

Rep. Otis G. Pike (D-Riverhead) has entered the controversy over PCB chemical contamination of fish by telling the U.S. Food and Drug Administration that there is a lot of difference between two parts per million and 2,000 parts.

In a letter to Sherwin Gardner, acting FDA commissioner, made public yesterday by Pike's office, the congressman challenges the proposed new regulation lowering the acceptable PCB level from five parts per million to two. He observed that the PCB alarm began when residents of the town of Yusho, Japan, suffered birth defects, skin disorders and other physical ills traced in part to PCB contamination. But in that incident, he said, "individuals consumed rice oil contaminated at levels of 2,000 to 3,000 parts per million . . . .

"The particular rice oil involved in the Japanese poisoning episode had other toxic impurities," Pike went on, " so as the report indicates, 'it is likely that amounts of pure PCBs greater than those reported in this episode would be required to produce the reported toxic effects.'"

FDA officials said that Pike's letter, dated May 27, had not yet arrived at Gardiner's office, in Rockville, Md. "It often takes three days for mail to get from Washington out here, and we had a Memorial Day weekend," Robert Wetherill, an FDA congressional liaison officer said.

Pike, who could not be reached for comment, has also joined commercial fishermen and Suffolk County officials in challenging the FDA economic impact estimate that dropping the tolerance level would cost the nation's entire fishing industry $7 million annually; he claims that the potential loss to the striped bass and bluefish industries in Suffolk County alone would be $636,624.

Anthony Taormina, state director of marine and coastal resources for the DEC, said that about 450 Long Island commercial fishermen would be affected by the lower limit.

Another FDA spokesman said that the PCB ban would be enforced by sampling fish destined for interstate commerce in warehouses—and only those with contamination above the two-parts-per-million limit would be condemned. Studies of fish caught around Long Island by the State Department of Environmental Conservation have shown mean levels of 3.89 PCB parts per million in striped bass and 2.57 in bluefish.

Tuesday was the deadline for the FDA to receive written comment from interested parties on the proposed change. A decision will be announced, the FDA spokesman said, after all the comments have been studied. That, however, might be several weeks from now, as the FDA's mailroom is swamped with written comments on the saccharine controversy. "We're falling farther behind in opening our mail every day," a mail clerk said.