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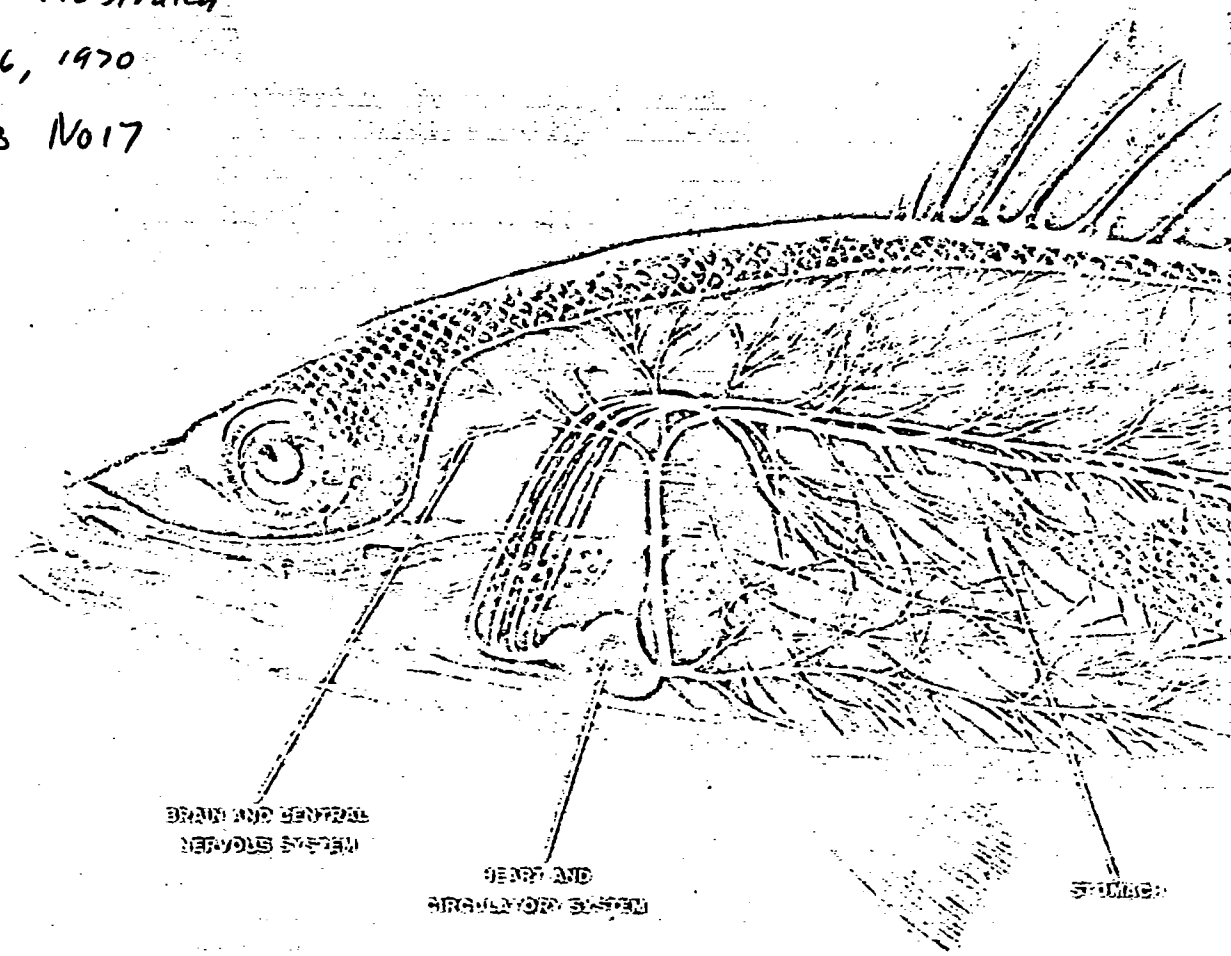

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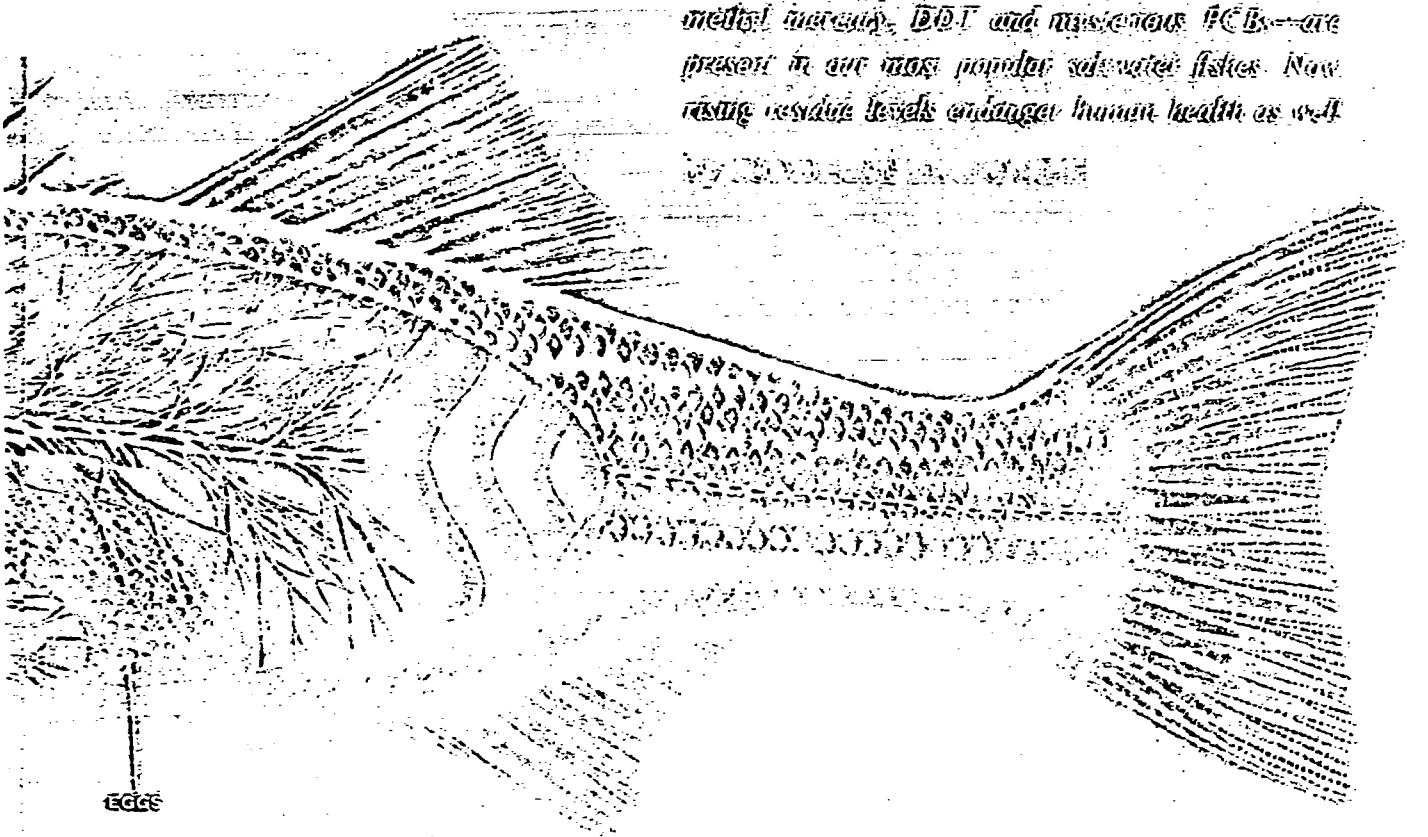
OUR COASTAL SEAS

A new study shows that toxic chemical compounds—methyl mercury, DDT and mysterious PCBs—are present in our most popular saltwater fishes. Now rising residue levels endanger human health as well



Menacing chemicals enter a predatory fish, such as this female striped bass, mainly from food. The stomach then digests the contaminated fish and nutrients and poisons are spread throughout the body in the circulatory system, where they can affect the central nervous system and eggs.

in Madison, Wis., a highly respected laboratory that has done research for the Federal Government, various states and private industry.

Specifically, the study shows that the flesh of striped seafront from Louisiana, striped bass from California and Spanish mackerel from South Carolina contains more mercury than allowed by the U.S. Food and Drug Administration in fish sold for human consumption.

Other tests disclose that the reproductive process of at least four different fish populations may be threatened by high residue levels of chlorinated hydrocarbon pesticides in the eggs. High levels of DDT residues (a combination of DDT, DDD and DDE) are in the eggs of striped bass from California, from the Hudson River, New York, from the Rappahannock River, Virginia, and in the eggs of bluefish caught off the coast of South Carolina. Moreover, the eggs of the California and New York bass have high PCB residues, an industrial compound that has escaped into the environment by accident.

The fish studied were all females close to spawning and were collected last spring and summer by fishermen, biologists and two state fish-and-game departments. The sampling of each species from a given location generally in-

DSW 282691

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cluded from five to 15 individual fish. All samples were wrapped in aluminum foil, frozen and shipped by air in containers with dry ice to WARF in Madison where Francis Coon, head of the chemical department, supervised the analyses. A complete list of fish species, location taken, residue data and analytical methods employed in the study is shown below.

In recent months there has been public clamor about mercury residues in fish, residues sufficiently high to close or restrict fishing in such famous bodies of freshwater as Lake Champlain between Vermont and New York; the Lake St. Francis section of the St. Lawrence River between Quebec and Ontario; the Niagara and Oswego rivers and lakes Onondaga and Ontario in New York; the Connecticut River in New Hampshire; the Savannah River and Brunswick Estuary in Georgia; Mobile Bay and the lower Mobile River, the Tombigbee River and the Pickwick Lake section of the Tennessee River in Alabama; the Detroit River and Lake St. Clair in Michigan; and the Wisconsin River from its juncture with the Mississippi River to Rhinelander, Wis. In fact, mercury pollution is a problem in at least 33 states and eight Canadian provinces.

Mercury pollution of fish, shellfish and birds was first discovered in Japan and Sweden in the 1960s. The pollution came from pulp mills, plastic and chlor-alkali plants and mercury-coated seeds. Despite warnings of mercury contamination elsewhere in the world, nothing was done in North America until last year when Norvald Fimreite, a Norwegian graduate student at the University of Western Ontario, tested pheasants from Alberta. The residues were so high that Alberta closed the hunting season. Still Canadian and U.S. authorities did nothing to try to halt the poisoning. Fimreite then found high mercury residues in fish from Lake St. Clair. The major source of the contamination was a Dow Chemical Company plant at Sarnia, Ontario, which was dumping as much as 200 pounds of mercury a day into the St. Clair River. Subsequent investigations elsewhere have uncovered other polluters. One reason that authorities were slow to act was that everyone apparently believed mercury was too valuable to be thrown away. Another reason was that most authorities mistakenly believed that any mercury released to a waterway would sink to the bottom and be inert. However, Swedish scientists discovered that no matter what form of mercury is discharged to the environment, be it inorganic divalent mercury, phenyl mercury or alkoxy-alkyl mercury, it can be eventually converted by either microorganisms or fish into the most toxic form—methyl mercury.

As a trace element, mercury is found naturally in minute amounts in man. According to Dr. Henry A. Schroeder of the Trace Element Laboratory of the Dartmouth Medical School, the human body contains about 0.2 parts per million of mercury. (Chemical residues are measured by scientists on parts per billion and parts per million basis; in layman's language, one part per million, 1.0 ppm, is the equivalent of one ounce of vermouth in 7,812 gallons of gin—the ultimate dry martini.) The danger to man from eating mercury-contaminated fish or birds comes from raising levels in the body. The World Health Organization has recommended that no

COUNTDOWN ON CONTAMINANTS

SPECIES AND LOCATION WHERE CAUGHT	MERCURY FLESH *FDA limit 0.5*	PCBs FLESH *(estimated)*
ATLANTIC MACKEREL (*Scomber scombrus*) Long Island Sound, Rowayton, Conn.	0.10	0.58
STRIPED BASS (*Morone saxatilis*) Hudson River, Montrose, N.Y.	0.34	4.01
STRIPED BASS (*M. saxatilis*) Rappahannock River, Tappahannock, Va.	0.20	0.56
AMERICAN SHAD (*Alosa sapidissima*) James River Estuary, Va.	0.10	0.37
WHITE PERCH (*Morone americana*) James River Estuary, Va.	0.31	0.77
SPOTTED SEATROUT (*Cynoscion nebulosus*) In the surf off Charleston, S.C.	0.10	0.12
SPANISH MACKEREL (*Scomberomorus maculatus*) four miles offshore, Charleston	0.37; repeat analysis 0.56	0.10
BLUEFISH (*Pomatomus saltatrix*) four miles offshore, Charleston	0.31	0.19
WHITING (*Menticirrhus sp.*) two miles offshore, Charleston	0.15	0.13
DOLPHIN (*Coryphaena hippurus*) 30 miles offshore, Charleston	0.20	0.095
FALSE ALBACORE (*Euthynnus alletteratus*) 30 miles offshore, Charleston	0.40	0.56
SPOTTED SEATROUT (*C. nebulosus*) Lake Calcasieu, Hackberry, La.	2.2; repeat analysis 1.8	0.31
SPOTTED SEATROUT (*C. nebulosus*) Shell Point Reef, Wakulla County, Fla.	0.40	0.096
SILVER PERCH (*Bairdiella chrysura*) Alligator Harbor, Franklin County, Fla.	0.18	0.10
STRIPED BASS (*M. saxatilis*) the Delta, Antioch, Calif.	0.70; report analysis 0.64	0.99
STEELHEAD TROUT (*Salmo gairdneri*) Cowlitz River, Toledo, Wash.	0.12	0.12

DSW 282692

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human food contain any trace whatsoever of mercury, while Japan and Sweden, both countries with strong commercial fishing interests, have set a standard of 1.0 ppm. In Sweden scientists have criticized this maximum as excessive, and one prominent toxicologist has said that the maximum should be lowered to 0.2 ppm. The Swedish government has stuck by the 1.0-ppm standard but recommended that consumption of fish be limited to one meal a week. In the U.S. the Food and Drug Administration maximum in fish is 0.5 ppm.

The human tolerance level of mercury is not precisely known. From 1953 to 1960, 121 persons in Minamata, Japan were killed or severely disabled as the result of eating mercury-contaminated shellfish from Minamata Bay. The mercury levels in the shellfish averaged 20 to 30 ppm. The mercury had been discharged into the bay over a period of years by a plastics plant. In the U.S. three members of the Huckleby family in Alamogordo, N. Mex. suffered severe brain damage after eating a hog that had been fed grain treated with mercury.

Symptoms of mercury poisoning may occur weeks to months after exposure. The symptoms include a numbness and tingling sensation in the hands and feet, disturbed speech, inability to coordinate muscle movement, impaired vision and hearing and emotional disturbances. The 19th century expression "as mad as a hatter" came from cases of insanity suffered by hatters who inhaled vapors of mercury that was used to cure felt. In severe cases the symptoms of mercury poisoning are irreversible. A report submitted by an international committee in Stockholm last year stated: "In infants born to mothers with large amounts of methyl mercury, the symptoms are somewhat different. Most children had mental retardation and also cerebral palsy with convulsions."

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PCBs EGGS *(estimated)*	CHLORINATED HYDROCARBONS, FLESH *FDA limit, 5.0 DDT, DDE, DDD; 0.3 DIELDRIN*					CHLORINATED HYDROCARBONS, EGGS				
	DDE	DDD	DDT	DIELDRIN	BHC	DDE	DDD	DDT	DIELDRIN	BHC
1.16	0.11	0.14	0.24	0.032	0.007	0.23	0.47	0.083	0.039	0.018
11.4	0.81	0.86	0.75	0.17	0.048	2.11	3.20	2.09	0.33	0.031
2.31	0.16	0.19	0.13	0.018	0.006	0.60	0.78	0.65	0.053	0.045
0.056	0.16	0.16	0.20	0.059	0.037	0.025	0.022	0.022	0.005	0.005
1.59	0.26	0.29	0.16	0.15	0.023	0.39	0.47	0.31	0.39	0.031
0.19	0.024	0.020	0.024	0.012	—	0.063	0.036	0.054	0.009	*0.005
0.58	0.020	0.008	0.016	*0.005	—	0.17	0.12	0.13	0.011	*0.005
2.81	0.045	0.022	0.038	*0.005	*0.005	2.47	1.03	0.61	0.017	0.006
0.11	0.026	0.022	0.026	0.006	—	0.029	0.023	0.031	0.006	—
0.18	0.021	0.010	0.025	*0.005	—	0.079	0.024	0.086	0.008	—
0.66	0.22	0.037	0.17	*0.005	—	0.39	0.23	0.18	0.008	—
0.72	0.077	0.41	0.11	0.034	0.054	0.11	0.54	0.22	0.011	0.083
0.12	0.041	0.021	0.026	*0.005	—	0.19	0.11	0.047	*0.005	*0.005
0.10	0.023	0.018	0.022	*0.005	—	0.16	0.087	0.047	0.006	—
17.0	0.45	0.21	0.23	0.021	0.006	3.66	2.47	2.92	0.18	0.10
0.08	0.011	0.016	0.026	*0.005	*0.005	0.009	0.011	0.023	*0.005	0.005

**Below noted level*

INFORMATION ABOUT THE TESTS

All the figures shown on the chart are parts per million. WARF Institute's procedures for determining chlorinated hydrocarbon residues are in the "FDA Pesticide Analytical Manual," Volume I, Jan. 1968, sections 212 and 311. The mercury analysis follows "The Analyst," Volume 86, page 608, 1961, modified by Atomic Absorption Spectrophotometry with boat technique.

Note: DDT residues are a combination of DDT, DDE and DDD. The U.S. Food and Drug Administration has set no tolerance standards for BHC or PCB residues in human food.

DSW 282693

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The highest mercury residues found in the SI study were in the flesh of spotted seatrout from Hackberry, Cameron Parish, La. The initial analysis by WARF Institute revealed 2.2 ppm of mercury, four times more than the FDA maximum of 0.5. In a repeat analysis by WARF, the level was 1.8 ppm. The seatrout were procured from a commercial fish company in Hackberry, and they had been caught in adjacent Lake Calcasieu, a brackish body of water connected to the Gulf of Mexico. On the Gulf coast, seatrout are generally not migratory but localized in one estuary. Last July after SI obtained the fish, the FDA, in an entirely unrelated move, halted interstate shipments of crabs, spotted seatrout, redfish and flounder from Lake Calcasieu because of high mercury levels.

The flesh of striped bass from California also surpassed the FDA limit on mercury. The California Department of Fish and Game took the flesh and eggs from 15 different females caught in the Delta near Antioch, composited flesh and egg samples separately and forwarded them to WARF Institute. The department retained the remainder of the flesh and eggs for testing on its own. At WARF Institute initial flesh analysis was 0.70 ppm; the repeat analysis was 0.68. In order to obtain California striped bass for testing, SI agreed to allow the California Department of Fish and Game to review the results before publication and then to comment upon the significance. After reviewing the data, L. H. Cloyd, deputy director of the department, says that the WARF finding "for the level of mercury was consistent with one of our state laboratory reports." Cloyd also points out "the levels of mercury in stripers, as well as in some catfish, sturgeon—and pheasants—have prompted our governor to assemble a special task force of state agencies and cooperating federal agencies to investigate mercury pollution in California."

Mercury in excess of the FDA limit of 0.5 was also found in the flesh of Spanish mackerel caught four miles off Charleston, S.C. Initial analysis by WARF Institute was 0.57 in the flesh; the repeat analysis was 0.56. The Spanish mackerel is a pelagic fish, one that spends its life near the surface of the ocean and is not known to frequent shallow water. The fish ranges off the coasts of the Carolinas and Florida, and it may migrate into the Gulf of Mexico.

Other species had mercury levels close to the FDA maximum. False albacore from South Carolina, another pelagic fish, had residues of 0.40 in the flesh; spotted seatrout from Shell Point Reef on the panhandle of the Florida Gulf coast had 0.40; striped bass from the Hudson River, 0.34; bluefish from South Carolina, 0.31; and white perch from the James River, Virginia, 0.31. Little is known about the natural or normal mercury level in the flesh of fish, but it is probably not more than 300 parts per billion. The lowest level discovered by WARF Institute was 0.10 parts per million found in the flesh of Atlantic mackerel from Long Island Sound, American shad from the James River and spotted seatrout from South Carolina. SI did not ask WARF Institute to analyze eggs for mercury residues.

The WARF Institute analyzed the egg and flesh samples for DDT residues, dieldrin and BHC, all chlorinated hydrocarbon pesticides. These synthetic compounds have several factors in common. They do not readily break down in nature; indeed, it takes at least a decade for them to lose their toxicity. They are also highly poisonous to a broad spectrum of living organisms. They are used to attack insect pests because they can penetrate the external shell of chitin, a thin layer of hard fatty material that covers an insect body. Once applied, be it on insects, on the ground, on vegetation or in the air, these long-living pesticides are spread by wind and water. Aerial applications of DDT can enter the atmosphere and circle the earth in only two weeks. Last year Drs. Eugene F. Corcoran and Douglas B. Seba of the University of Miami reported surface slicks containing pesticides washing into Biscayne Bay after heavy rains. These areas were several miles long and from five to 300 feet wide, and they contained 10,000 times more chlorinated hydrocarbon pesticides than the water surrounding them.

Once introduced into the food web, chlorinated hydrocarbons are able to move up from phytoplankton to zooplankton to fish to bird or mammal, and they become more and more concentrated as they are retained by a higher level of animals. The chlorinated hydrocarbons tend to center in the body fats, such as those in the reproductive organs, and it is generally agreed that these chemicals are to blame for the current decline in North America of the brown pelican, the peregrine falcon and the bald eagle, our national symbol. All have fish in their food web.

In the past two years the FDA has seized shipments of coho salmon from Lake Michigan and jack mackerel from the Pacific near Los Angeles for exceeding 5.0 ppm of DDT residues, and the U.S. Bureau of Sport Fisheries and Wildlife has noted DDT levels of from 31 to 45 ppm in the flesh of white perch taken from the Delaware River at Camden, N.J. Last month John MacGregor of the U.S. Bureau of Commercial Fisheries announced that a federal study of fish from Santa Monica Bay contained

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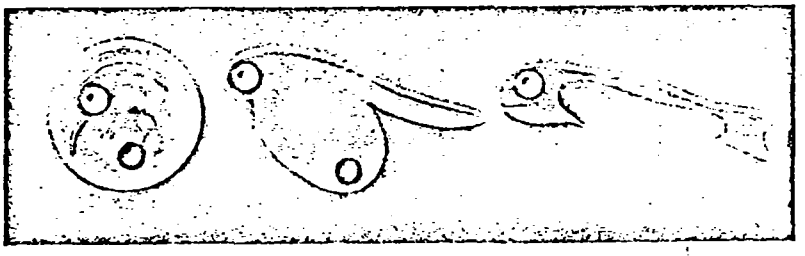
ILLUSTRATIONS BY DONALD MOSS



A coho salmon egg with high DDT levels can hatch, but the DDT concentrates in the oil globule in the yolk and when the yolk is consumed the poison kills by attacking the nervous system.

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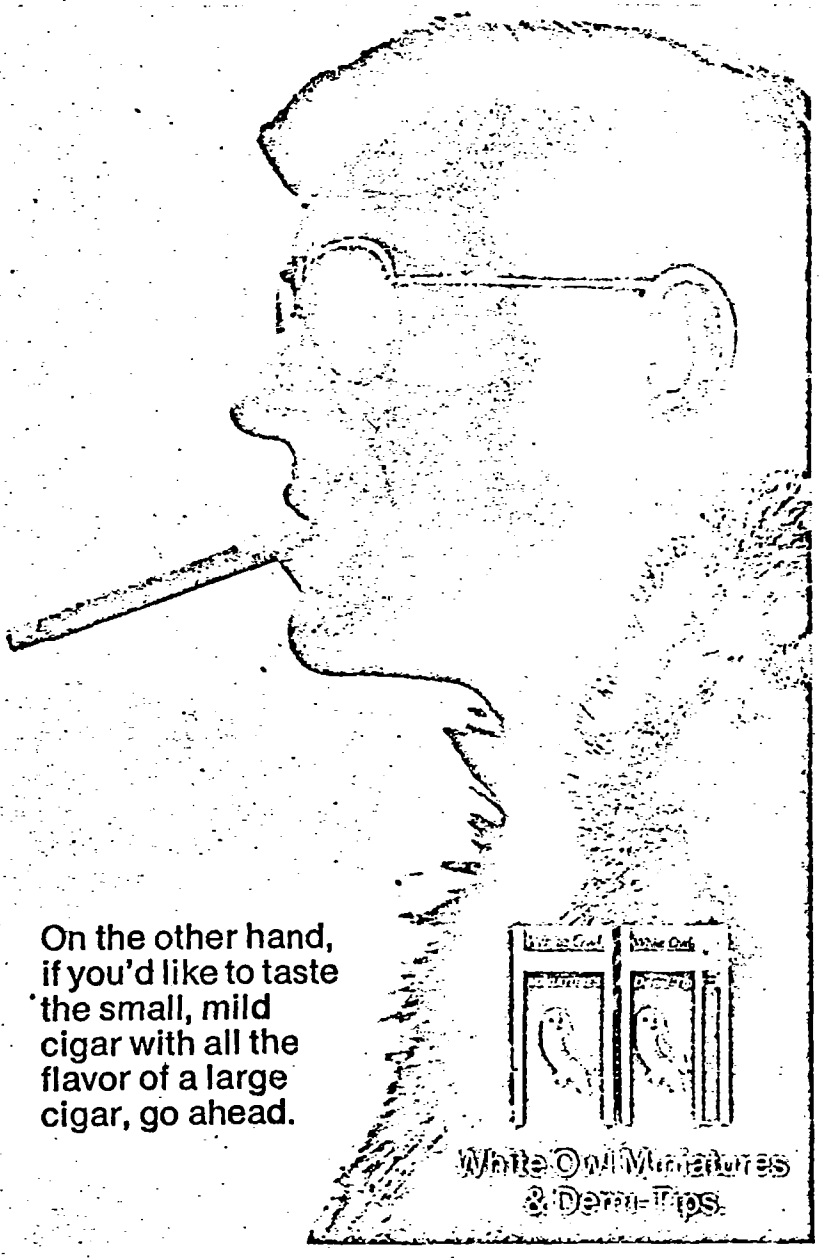
If you just want to look good, don't light it.



On the other hand, if you'd like to taste the small, mild cigar with all the flavor of a large cigar, go ahead.

White Owl Miniatures & Demi-Tips

new research information. The study showed DDT residues in those fish to be astronomically high, ranging from 63 ppm in the liver of Dover sole to 1,026 ppm in the liver of starry rockfish. A major source of the residues was two sewage plants emptying into the bay. The City of Los Angeles plant at Hyperion was releasing one to seven pounds of DDT components per day, while the Los Angeles County White Point plant was daily discharging from 200 to 400 pounds of DDT residues. However, none of the flesh samples tested for SI by WARF Institute approached the federal maximum. DDT residues were detected in the flesh of every species submitted, but the closest to the FDA maximum were the Hudson River striped bass that had DDT residues totaling 2.42 ppm.

The WARF Institute also tested all eggs for chlorinated hydrocarbon residues. Inasmuch as these pesticides have an affinity for fat, it came as no surprise that there were higher residues in the eggs than in the flesh. DDT residues in the eggs can affect reproduction or the survival of young fish. In Jasper National Park, Canada there was a 70% mortality of brook-trout fry hatched from eggs with 0.46 ppm of DDT residues. In Michigan 700,000 coho salmon fry died in hatcheries in 1968. They had been hatched from eggs with DDT residues of 1.5 to 3 ppm. When the larval salmon were three weeks old and absorbed their yolk sac during the so-called "button up" stage they died. DDT residues were in the yolk, and quickly made contact with the central nervous system. Dr. Philip A. Butler of the Bureau of Commercial Fisheries Laboratory in Gulf Breeze, Fla. reports that in a joint study with the Texas Department of Parks and Wildlife virtually no young spotted seatrout were observed in the Laguna Madre in 1968 and 1969. The gonads of females had DDT residues up to 8.0 ppm.

Different species of fish seem to have different levels of tolerance to DDT residues in the eggs. Precise levels are simply not known for most marine fish, but based on the above 0.5 ppm seems to be cause for concern and 1.5 ppm se-

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rious cause for concern about survival of the young. According to WARF Institute results, the highest DDT residues in eggs were in the California striped bass, 9.05 ppm. Commenting upon DDT residues in California stripers, L. H. Cloyd of the Department of Fish and Game notes: "Numerous studies conducted by our department of the levels of recruitment of striped bass demonstrate no adverse effects from the levels of DDT and its metabolites in striper eggs and larvae. We are, however, continuing to investigate this aspect."

Striped bass from the Hudson, which migrate to New Jersey, New York and Connecticut coastal waters, had 7.40 ppm of DDT residues in the eggs. They also had 0.33 ppm of dieldrin. By FDA standards, the eggs of these striped bass should not be eaten. Dieldrin is more toxic than DDT, and the FDA has imposed a maximum of 0.30 ppm of dieldrin on fish products.

The eggs of bluefish caught off South Carolina contain 4.11 ppm of DDT residues. According to Dr. Lionel A. Walford, director of the U.S. Bureau of Sport Fisheries laboratory at Sandy Hook, N.J., where most of the research on Atlantic coast bluefish has been done, these South Carolina bluefish were probably migrating north from Florida when caught. Baby bluefish spawned in Carolina offshore waters in the spring eventually grow up to supply an important sport fishery as far north as southern New England. Striped bass from the Rappahannock River have 2.03 ppm of DDT residues in the eggs. Striped bass from this river and others tributary to Chesapeake Bay, the single most important striper spawning ground on the Atlantic coast, migrate from Virginia to Massachusetts. The majority of fish tested also had traces of BHC, another chlorinated hydrocarbon, in the flesh and eggs. The effect of BHC on fish reproduction is unknown, and the Food and Drug Administration has set no maximum on BHC in fish. As Taylor Quinn of the FDA remarked as this article was being prepared, "It's unusual, to say the least, to find BHC in fish."

WARF Institute also tested all egg and flesh samples for residues of PCBs, the abbreviated name given to the polychlorinated biphenyls, a synthetic chemical compound used by various industries. PCBs are heat resistant and are widely used in the electrical industry as insulating fluids for transformers and capacitors. They are also used in plastics and adhesives.

PCBs have been made in the U.S. since 1929, but they were not identified as such in fish and birds until a few years ago. Chemically similar to DDT, they baffled investigators who reported finding "unknown but chlorine-containing compounds." In 1966 Dr. Soren Jensen, a Swedish scientist, was able to separate the compounds from DDT and identify them as PCBs in a sea eagle and in the bodies of more than 200 fish taken from different parts of Sweden. Dr. Jensen then analyzed eagle feathers in a museum collection. Some of the feathers were collected as far back as 1880, but Dr. Jensen first found PCB residues in feathers collected in 1944. After Dr. Jensen published a paper on his findings, Dr. Robert Risebrough of the Institute of Marine Resources at the University of California at Berkeley found PCBs in a number of Californian, Mexican and Arctic sea birds. He noted that the highest levels of PCBs in birds were from those closest to industrialized areas. In a later investigation he also found PCBs in samples of mother's milk from women in San Francisco and Los Angeles. In a paper in *Environment* early this year he called for the establishment of tolerance limits of the compound in human food. Thus far, the FDA has set no standard.

Another scientist, Robert Huggett of the Virginia Institute of Marine Science, says the toxicity of PCBs to marine animals seems to be about the same as that of DDT. At present, the Virginia Institute of Marine Science is conducting studies to determine the levels of PCBs in estuarine sediments, oysters, fish and crabs in the Chesapeake. The institute is also trying to locate the origins of the PCBs. At the Bureau of Commercial Fisheries lab in Gulf Breeze, Dr. Thomas Duke and associates have found that only 1.0 part per billion of PCBs in water will adversely affect the growth of oysters.

The precise significance of the WARF findings of PCB residues in the eggs and flesh of the fish submitted by SI has yet to be determined. However, PCBs are present in the flesh and eggs of all samples. The WARF findings, it should be noted, are estimates based on one peak on a gas chromatogram, but scientists who have reviewed the data for SI and who have experience in the field say the estimates are valid. The highest PCB residues in flesh are in the Hudson River striped bass, 4.01 ppm. The California striped bass had the highest PCB residues in eggs, 17.0 ppm. Other egg residues of possible significance were Hudson stripers, 11.4 ppm; South Carolina bluefish, 2.81; and Rappahannock stripers, 2.31.

In assessing the WARF findings for SI, Dr. Robert Smolker, an ecologist at the State University of New York at Stony Brook, said, "I'm horrified by some of the data. I am quite surprised to find such residues in fish from the ocean, but I certainly don't think people should panic." What, then, should the public do or demand? There are a number of steps that can be taken.

For one, the study is merely a first effort, and nationwide monitoring programs of more samples are needed to determine the presence and levels of contaminants in wildlife. Moreover, considerable research needs to be done on the ecological side effects of new pesticides coming on the market. This research is very expensive. It now costs as much as $10 million to clear a new pesticide for federal registration. As of this year, however, the Department of the Interior has a ceiling of $3 million in appropriations for all pesticide research, and of that less than $700,000 is allotted to the Bureau of Sport Fisheries and Wildlife for fish research. Several scientists have proposed that the additional needed money come not from Government funds but be raised instead by imposing a small excise tax, based on volume sold, on pesticide manufacturers. No scientist queried doubted the need for pesticides; the only question was which pesticides

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will not damage the environment. At present, problems remain considerable and seemingly insoluble. There has been a great deal of talk about phasing out DDT, but DDT continues to be used on a substantial basis, and the same is true of other persistent chlorinated hydrocarbons. For instance, there has been a rapid increase in the use of two chlorinated hydrocarbons, chlordane and toxaphene, as substitutes for DDT, and both these compounds, which can be discerned in animals only after very involved laboratory testing, are starting to turn up in all sorts of places.

Not long ago Drs. Richard Schoettger and David Stalling of the U.S. Bureau of Sport Fisheries and Wildlife pesticide laboratory in Columbia, Mo. began a study of still another chlorinated hydrocarbon, endrin, in fish. They planned to feed the fish food containing endrin residues of 0.1 to 0.5 ppm. They ordered their test fish, channel catfish brood stock from national hatcheries and, as a routine check, they analyzed some of these fish for endrin. To their dismay, they discovered that the catfish already contained 0.5 to 0.88 ppm of endrin, more than was to be given them in the test food. This should not be surprising. Schoettger has yet to find a commercial dry fish food for sale in the U.S. that is not contaminated by chlorinated hydrocarbons.

Besides establishing a constant monitoring program of contaminants in fish and wildlife, efforts should be made to determine harmful levels to various species. Although worrisome, DDT residues in eggs are meaningless until we know that 5.0 ppm of DDT residues in conjunction with 8.0 ppm of PCBs, or whatever the figures may be, kill off a certain percentage of the hatch, be it none, a third or 90%. Then, of course, we need to know what levels may be harmful to humans.

Writing in *Pesticides*, Dr. Robert van den Bosch of the University of California at Berkeley points out that the public good requires that salesmen for pesticide manufacturers be brought under control. "The salesman is the key to the system, for he serves as the diagnostician, therapist and pill dispenser," van den Bosch says, "and what is particularly disturbing is that he need not demonstrate technical competence to perform in this multiple capacity. In other words, the man who analyzes pest problems, recommends the chemicals to be used and effects their sale is neither required by law to demonstrate (by examination) his professional qualifications (as do medical doctors, dentists, lawyers, veterinarians, barbers, beauticians, realtors, etc.) nor is he licensed. Yet this person deals with extremely complex ecological problems and utilizes some of the most deadly and ecologically disruptive chemicals devised by science."

Instead of permitting salesmen stimulated by commissions and bonuses to sell pesticides to the ultimate user, van den Bosch proposes that they be replaced by professional pest-control advisers who would be subject to examination, licensing and a code of conduct similar to physicians. This done, van den Bosch says, "The company-affiliated salesman, with his built-in conflict of interest and sales motivation, can be phased out of pest-control advisement. Direct contact between the salesman and the lay user of insecticides can be eliminated. Just as the drug salesman deals only with the physician, not with the patient, the salesman of toxic pesticides can be required to deal only with the pest-control adviser."

Sources of harmful pollution—mercury, PCBs or pesticides—must be identified and stopped. Monitoring and source identification must also be conducted on other probable contaminants, including heat from power plants, radioactive wastes or heavy metals. Testifying last August before the U.S. Senate subcommittee on environmental pollution, Dr. Henry Schroeder of Dartmouth dealt with mercury, cadmium, lead, nickel, beryllium and antimony. "I must emphasize that environmental pollution by toxic metals is a much more serious and much more insidious problem than is pollution by organic substances, such as pesticides, weed killers, sulphur dioxide, oxides of nitrogen, carbon monoxide and other gross contaminants of air and water. . . . Most organic substances are degradable by natural processes. Once we control their use, they will leave little or no residue, but no metal is degradable. Once dug from the earth, metals stay with us and what we are now accumulating will be around as long as we are."

Government officials must enforce antipollution laws and be on guard against the spread of possible contaminants. There have been all too many instances of cover-up. Last month there was a ruckus when the Canadian government banned woodcock hunting in the province of New Brunswick because the birds were saturated with DDT. The fact is that this danger was known five years ago when Bruce Wright, director of the Northeastern Wildlife Station in Frederickton, published a paper about DDT and woodcock. Wright says he was told then that publication of his study was "not in the best interests of the province." Wright says government funds for support of the station were later cut. Last year the provincial government finally abandoned using DDT, but New Brunswick will have the legacy for years to come. Soil scientists report that DDT is at least eight inches deep in the forest floor.

Much indiscriminate pollution of U.S. waters could be stopped by enforcement of the Federal Refuse Act passed back in 1899 by Congress. This act, in part, makes it illegal "to throw, discharge, or deposit, or cause, suffer, or procure to be thrown, discharged or deposited either from or out of any ship, barge, or other floating craft of any kind, or from the shore, wharf, manufacturing establishment or mill, any refuse matter of any kind or description whatever other than that flowing from streets and sewers and passing therefrom in a liquid state, into any navigable water of the U.S."

Laws may be passed and laws may be broken. In the end, the enforcement and abatement depend upon public opinion. If one lesson is to be learned it is that we cannot release wide-ranging persistent poisons into the air or water. As Ovid wrote 2,000 years ago: "Ill habits gather by unseen degrees. As brooks make rivers, rivers run to seas." END

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