An old problem, mercury pollution of freshwater fish, re-emerged during the late 1980s in a form much more widespread and much more difficult to control than previously seen.

Federal and state governments have done little to attack the problem, partly because much of the bad news is recent, and partly because government policies created much of the problem in the first place.

Mercury contamination first became known in 1932 when fish from the Great Lakes were discovered to be so laced with mercury that they were poisonous to humans. The source was thought to be industrial dumping of mercury directly into waterways.[1] After various industries reduced their mercury dumping into streams and lakes, pollution control officials assumed the problem was under control and basically went to sleep.

However, throughout the 1970s, Swedish researchers continued to report high mercury levels in fish taken from remote lakes, far from any industrial polluters. In the early 1980s, Minnesota officials began examining fish from remote lakes and they too found fish with dangerously high mercury concentrations. Then officials in Wisconsin and Michigan made similar discoveries. In the Canadian province of Ontario, researchers found high levels of mercury in 95% of all the lakes tested.[2]

Scientists assumed the source of the mercury was natural geologic deposits until recently when careful measurements of rainwater revealed that the mercury is coming from the atmosphere, carried to earth by rain. Mercury enters the atmosphere from two main sources: 65% from combustion of coal, and 25% from solid waste incineration.[3]

Recent measurements of mercury in the atmosphere over the oceans indicate that total mercury in the atmosphere has doubled since the 19th century. Nature moves mercury into the atmosphere by various means, such as volcanoes, but human sources are now three times as large as all other natural sources of mercury. That is, humans activities (chiefly burning coal and garbage) account for 75% of the mercury entering the atmosphere today, whereas all non-human sources account for only 25%. This new data has come as something of a shock to scientists, who had thought humans were a rather puny actor on this particular stage.

Economic projections by the Washington think tank, Resources for the Future, indicate that humans are likely to double their mercury releases during the next 50 years.[4] If that should occur, some scientists say freshwater fish in acidic waters everywhere will become toxic to humans.

The mercury in the atmosphere is 97% elemental mercury, but the mercury in fish is 95% to 99% methylmercury, which is elemental mercury with a carbon atom and three hydrogen atoms attached. Methylmercury is much more toxic than elemental mercury. Scientists now know that mercury becomes methyalted when it enters a body of water, especially an acidic body of water, though the exact role of the acid is still unclear.

Big fish taken from acid waters are dangerous to humans already. And, as other sources of protein become more expensive or come to be regarded as unhealthful, such as red meat, eating fish becomes more popular. The combination of more mercury entering the atmosphere, increasing acidity of many waters because of acid precipitation (rain, snow, and even acid fog), plus increasing consumption of freshwater fish adds up to a growing threat to humans.

Fish are relatively insensitive to mercury, so they can build up a level in their tissues that is toxic to humans and other fish eaters. Mercury mainly attacks the central nervous system, chiefly the brain. In adults, the first symptoms of serious exposure are loss of sensation in the extremities of the hands and around the mouth. If exposure continues, an unsteady gait, slurred speech, tunnel vision (concentric constriction of vision), loss of hearing, convulsions, madness and death follow.

The effect of mercury on humans began to be understood during the 1970s. The Chisso Corporation dumped tons of mercury into Minamata Bay, a relatively small body of water in southern Japan, heavily contaminating local fish. Some 2900 humans were severely injured, a third of them killed outright. Recent court cases indicate that an additional 10,000 individuals were permanently harmed.[5]

Based on studies of adults contaminated at Minamata in the period 1953-1968, the World Health Organization [WHO] in 1972 established 4300 nanograms per kilogram of body weight per day (ng/kg-day) as the dose that caused poisoning; they applied a "safety factor" of 10 and concluded that a "safe" dose would be 430 ng/kg-day.[6] (A nanogram is a billionth of a gram; a kilogram is 1000 grams or 2.2 pounds; a gram is 1/28th of an ounce.)

However, since that time, much new data has become available. In northern Iraq during the winter of 1971-72, some 6530 patients were admitted to hospital with mercury poisoning. The death of 459 of them was attributed to mercury. Careful follow-up studies of mercury levels in hair and blood of adults, children, and infants allowed medical researchers to establish that infants are 5 to 10 times more sensitive to mercury than adults are. Infants exposed before birth showed severe brain damage whereas their mothers had mild or no symptoms. The fetus is thought to be particularly sensitive to mercury in the first months of pregnancy when cell migration and cell division are occurring at a fast pace. Thus the WHO "safe" level is perilously close to a mercury level known to harm fetuses and infants.

Dr. Thomas Clarkson at University of Rochester points out that Iraqi infants exposed before birth showed symptoms when their pregnant mothers had daily intakes of 600 to 1100 nanograms per kilogram. Applying the standard "safety factor" of 10, Dr. Clarkson says the new "safe" dose should be 60 to 110 nanograms per kilogram.[7] Roughly 40% of the American people already eat enough freshwater fish to exceed a mercury intake of 60 ng/kg-day.

A careful survey of fish consumption (and therefore mercury intake) of 4864 Americans by the U.S. Department of Commerce showed that 0.1% of the American people (250,000 individuals) exceed the WHO "safe" dose of 430 ng/kg-day. But if we accept Clarkson's new "safe" dose, we can calculate that roughly 40% of the American people (100 million individuals) are today eating levels of mercury in fish that would have to be called unsafe.[8]

Is anyone really being affected? Humans who eat a lot of freshwater fish seem to be, and so do fish-eating birds and mammals. In 1978 a neurological study of 592 Cree Indian people from three bands living along James Bay in Quebec province revealed tremors, incoordination and abnormal reflexes were prevalent neurological abnormalities, and other major manifestations of mercury poisoning were seen occasionally, including astereognosis (loss of the ability to judge the form of an object by touch) and tunnel vision (concentric constriction of visual field).[9] Since that time, mercury in the blood of Cree people has been cut in half by modifying their traditional diet to reduce intake of freshwater fish, particularly big fish.

Ocean fish seem not so susceptible to mercury buildup in their tissues, perhaps because the oceans are not acidic. Freshwater fish are the problem.

Bass in the Florida Everglades have 4.4 parts per million of mercury; U.S. Food and Drug Administration forbids interstate shipment of fish containing more than 1 ppm mercury, and the state of Minnesota has set a "safe" level in fish at 0.16 ppm, the strictest standard of any state. Bass and other fish in the Everglades are definitely toxic enough to pose a real threat to predators such as ospreys, eagles and humans. Mercury has been confirmed as the
cause of death in loons and panthers in the Everglades. Furthermore, mercury is suspected as an important cause of the reproductive failure being witnessed now among eagles, mink, otter and other wildlife in the Great Lakes.

The mercury problem is heavily damaging the sport fishing industry in at least 22 states and at least two Canadian provinces, where warnings have been issued against eating certain species of fish from certain waters. And, as we have seen, the problem shows every sign of growing worse.

Given that the problem is atmospheric and international, it is not one that states can completely solve alone, though each state could make strides by banning garbage incineration and phasing out the burning of coal. It will take an international accord to stem mercury poisoning. This will require leadership from the federal government, which so far has shown no interest.

Federal energy policy officially encourages coal-burning power plants and incineration of municipal trash, for generation of electricity. The Edison Electric Institute estimates it would cost $5 billion to capture mercury from the nation’s coal-burning plants, and it might cost $10 to $30 million to fit an incinerator with mercury-capturing gear. (Coal combustion provides a double whammy, acidifying waters while releasing mercury.)

Against those costs, we must weigh loss of the sport fishing industry and damage to the central nervous systems of large numbers of Americans, especially infants and children.

--Peter Montague

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