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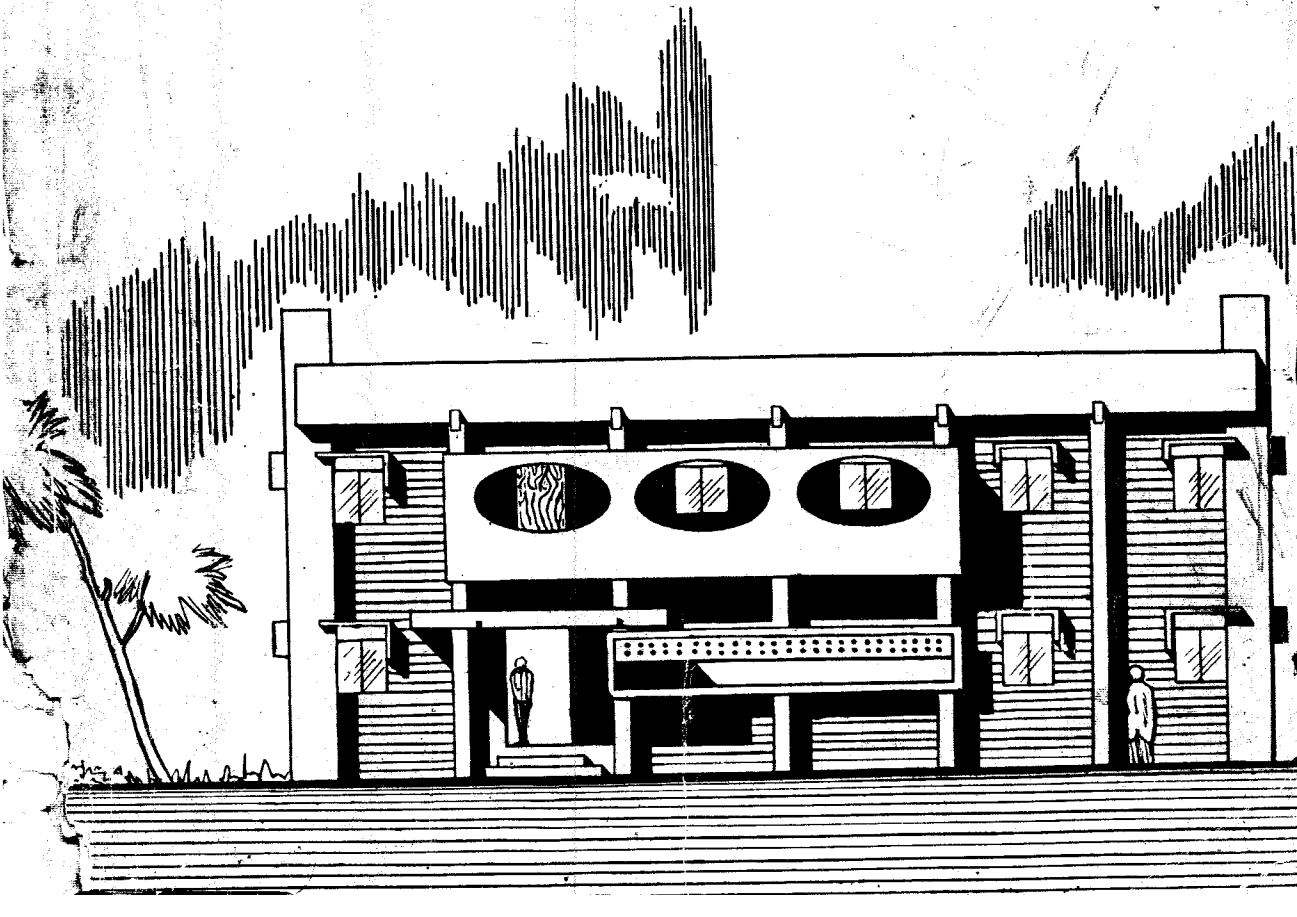

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MERCURY CONCENTRATION IN FISH

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Some time ago an American housewife, who went on a weight-reduction diet, started developing symptoms of loss of memory, giddiness, hypersensitivity to light and a number of other ailments. It was diagnosed that she had been suffering from 'psychosomatic complaints', for which she took psychiatric treatment for more than two years but with no obvious improvement. Later, an expert from the State Health Department, after testing a sample of her hair, found that she was suffering from mercury poisoning. In fact, the source of this mercury poisoning was traced to the swordfish meat which she had been eating as the staple food for over nineteen months.

But the most tragic case of mercury poisoning occurred in Japan in 1953. In Minamata, a coastal fishing town where the population lived largely on fish, people began to suffer convulsion and emotional distress. According to the latest count, about 75 people have died, and another 500 are dying — with their retarded brains, crippled limbs and ruined vision. These people had been eating fish and shellfish which had accumulated mercury from the water highly polluted by the industrial effluents discharged into the Minamata Bay from a nearby vinyl chloride factory.

These incidents have generated among scientists the world over, immense awareness and concern about this impending danger, and they started investigating the various aspects of mercury concentration in fish. Indeed, the presence of many toxic elements like lead, nickel, arsenic, copper, antimony, cadmium, zinc, uranium, mercury, manganese, chromium, tin, etc. have been detected in fish, but with the exception of mercury, in no other instance the concentration did exceed safe levels set for arsenic, copper and zinc, the most lethel elements. High concentration of mercury was found not only in fish and shellfish but also in some fish-eating birds, seals and porpoises.

The concentration of mercury is expressed as "parts per million" (ppm) on a wet weight or a dry weight basis. Fish with 1 ppm mercury wet weight means, for example, that one million kilograms of fish as eaten would contain one kilogram of mercury; or more simply, one milligram of mercury per kilogram of fish, or one microgram per gram. On the other hand, the fishmeal which we use as cattle and poultry feed is in dry solid state and it has its mercury content expressed on a dry weight basis. As regards fish as human food the value

is always expressed as parts per million wet weight, unless otherwise specified.

The standards set for safe levels of mercury concentration varies from country to country, since there is no absolute measure of what concentration is dangerous to man. Studies carried out in Japan since the Minamata tragedy, where the concentration was as incredibly high as 102 ppm wet weight, indicated that fish containing 10 ppm of mercury could be dangerous. The Food and Drugs Administration, U.S.A., divided this value by a factor of 20, and thus established safe level at 0.5 ppm (wet weight). In countries like Canada and Australia also the 0.5 ppm value is adopted as the maximum permissible level of mercury at which fish for human consumption can legally be marketed, but Sweden and Japan permit twice this level.

Man has used mercury from time immemorial; today it has myriads of industrial use — in thermometers, flourescent lights, paper making, skin creams, dental preparations, fungicides etc. The mercury-containing effluents from some of the industrial plants are believed to be an important source of mercury pollution in fish, but there are reports (from Sweden) that significant concentrations of this liquid metal were found in fish from apparently uncontaminated waters. Yet another recent report from Australia says that although some fish caught in Tasmanian waters contained excess mercury, there is no evidence that these excess levels can be attributed to man-made sources. It is suggested that as a result of complex natural biological processes, most marine animals accumulate mercury many hundred times the level of concentration in sea water. One possibility is that the concentration could be due to the mercury in the bed rock and bottom sediments being mobilized by bacteria and other micro-organisms and passed on to the smaller and predator fishes through the food chain. These facts not withstanding, however, there is substantial evidence, as in the case of Minamata disaster, to suggest that the industrial source is a major contributor to the mercury contamination of fish and shell fish.

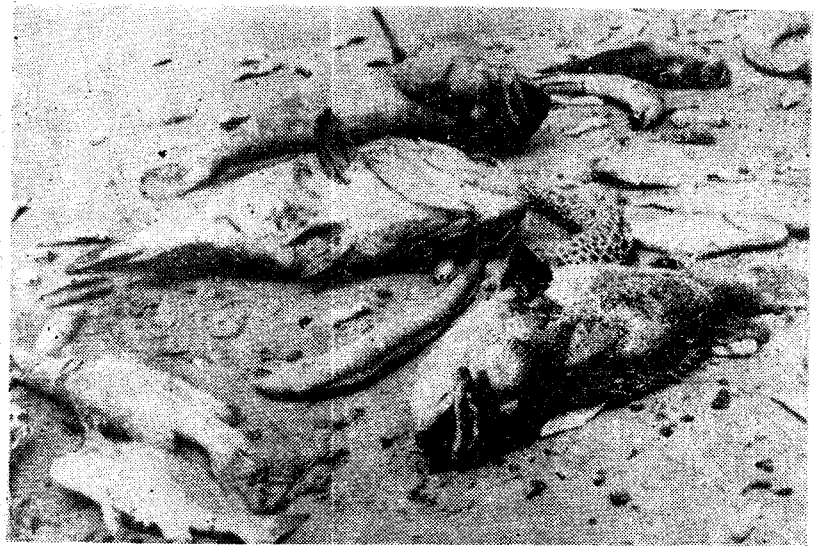
In nature, mercury occurs in many forms but among them methyl mercury is more toxic than all other mercury compounds. Fish tend to accumulate mercury mostly in the methyl form, and the toxicity of the fish depends upon the methyl mercury content in the total mercury. The accumulation of mercury can be rapid but elimination is very slow; this accounts for its greater concentration in the body of the fish than in the surrounding water. It is observed that in some species of fish the concentration is different in the male and the female of the same length, and that the concentration is cumulative with age, which facts prompted the authorities to prevent the capture of these fish above a certain length. The amount of mercury accumulated in various organs of the same fish may also vary, and the organs heavily contaminated are kidneys, liver and intestine. It is very interesting that "even though mercury compounds are highly toxic, there are no reports of fish kills due to mercury pollution".

The economic implications of the findings of high mercury concentration in fish have been tremendous. Many nations had either to close down the fishery in some localities or to prohibit the sale of processed fish, thereby putting the fishing community and the industry to considerable difficulties. In 1971 a shipment of spiny dogfish captured from the Strait of Georgia, British

Columbia, was withdrawn, as the fish contained mercury in excess of 0.5 ppm. The same year much of the eel fishery in Canada was stopped Sweden has prohibited capture of fish from some freshwater areas. The U.S. Foood and Drug Administration has urged that "Swordfish be crossed off the national menu" because of mercury contamination. High concentrations were found

fishermen had to be provided alternate jobs and financial subsidy.

It is reported recently that the Coleman Instruments, U.S A., has devised a Mercury Analyser, which operates by atomic absorption spectrophotometry, and it is claimed to be the first complete self-contained unit for analysing the mercury levels in fish. Results can be



A view of the deadfish washed ashore on Goa coast in September 1973.
(Photo by courtesy of BLITZ)

also in some tunas, halibut, bass and northern pike. But the people to suffer the worst were the Australia's traditional shark-fishermen, who were thrown out of employment last year when the Goverment of Victoria, following a finding of mercury concetration upto 2 ppm in school sharks over 70 centimeters, prohibited their capture and sale above that length. A consignment of one and a half tonnes of sharks from South Australia, found to contain excess mercury, was dumped. The affected

read directly in terms of micrograms of mercury which can be converted by simple calculation into parts per million mercury (wet weight). Many U.S. purse seiners catching tuna are equipped with this device.

In India there is no report so far of any investigation in regard to concentration of mercury or any other toxic elements in fish, but some recent newspaper reports are a pointer towards the necessity and urgency of undertaking

such an investigation. Some time ago, heaps of deadfish have been washed ashore on a 16-kilometer coastline between Dabolim and Velsao in Goa. Though the preliminary investigation by experts shows that the fish mortality may be due to coastal upwelling, another opinion still persists that the arsenic pollution by effluents from a nearby fertilizer plant may be an important factor. The second report is from Baripada in Orissa, where some 60 hostelers took ill after consuming fried fish. In this case also the exact cause is not known. Recently the Union Minister for Petrolium and Chemicals is reported to have said that the oysters have disappeared from the Bombay coast because of pollution by the industrial effluents. In all these there is enough warning that we must view the problem in all its seriousness, as it is the health of the people that is mainly involved.

Since the industrialization of the country is progressing at a rapid pace and the industrial effluents and domestic sewages are discharged into the rivers, estuaries and the sea, and since the sea is the ultimate receptacle, the chances of polluting the marine environment are also on the increase. This is bound to affect the fisheries of coastal waters especially in such localised areas as directly influenced by the industrial discharge. It is, therefore, all the more imperative to initiate investigations into the various aspects of aquatic pollution, particularly the concentration of mercury and other toxic elements in the living resources, especially fish. ●