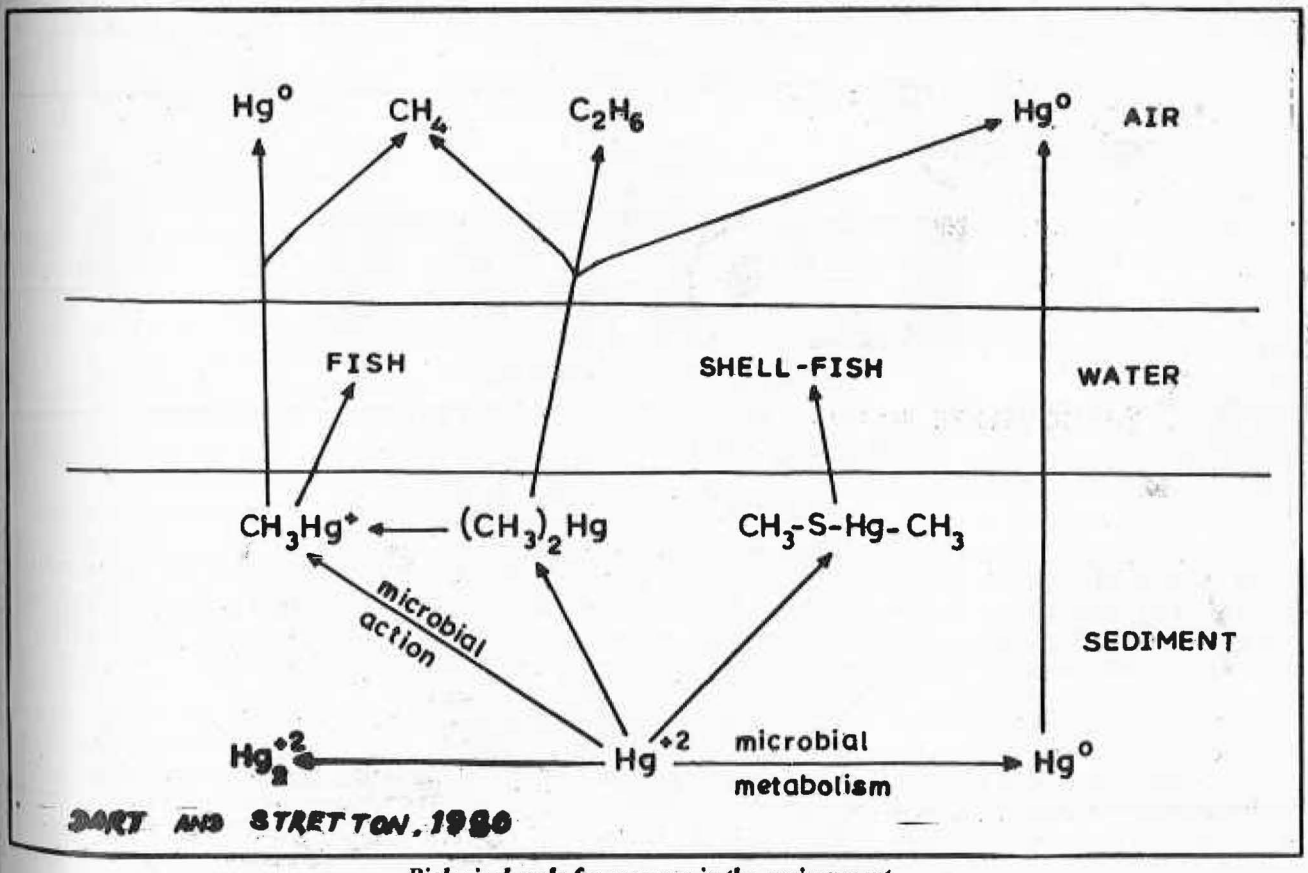
Abatement of Mercury Pollution in Aquatic Systems: A Bio technological Approach

Mercury has been in use since time immemorial for medicinal, agricultural and industrial purposes. It is widely used in the manufacture of thermometers, fungicides, insecticides, batteries, caustic soda, pulp and paper, urethane plastics and many other purposes. During 1953 to 1961, 43 people died and about 113 were affected with mercury poisoning after consuming mercury contaminated fish in Minamata, Japan. In 1960, in Sweden, methyl mercury accumulation in fish and decrease in the population of birds was noticed. This was attributed to the use of methyl mercury dicyanide.

Of late in India also, certain hot spots of pollution with high levels of mercury in aquatic environments, viz., Thana Creek of Bombay and coastal waters of Cochin and Tuticorin has been identified. The coastal waters of Karwar are also known to contain high levels of mercury, possibly due to mercury containing discharges from a caustic soda manufacturing factory. It is yet not too late to control the possible mercury pollution of our environment to enable people to have access to healthy seafood, free from mercury contamination. Fish, shellfish and other aquatic animals bioaccumulate mercury mainly in the form of methyl mercury through their food web. The amount of mercury present in the environment gets biomagnified through various organisms at different trophic levels in the aquatic ecosystem, before it gets accumulated in fish and shellfish.

Though mercury is toxic to biota, certain bacteria and algae have been found to have evolved mechanisms to resist this metal and bring about its transformation (Fig.1). The bacteria have gained this resistance property to mercury through aquisition of plasmids (extra chromasomal DNA), and the mechanism of resistance exhibited by the algae remains to be understood. Some bacteria and algae by virtue of their enzymes and metabolic pathways, can transform mercury and its compounds, although plants and abiotic factors also contribute in the transformation. Formation of volatile mercury (Hg) is an important step, which is considered as the process of detoxification, because (1) this zero valent form is less toxic than the other forms of mercury especially the organic ones, and (ii) it can escape into the atmosphere (later to enter its geochemical cycle).

The property of volatilisation of mercury by bacteria and the algae can be harnessed to control mercury pollution. In our laboratory, we tested a unicellular marine micro-algae, *Isochrysis galbana* Parke for removal of ➔



Biological cycle for mercury in the environment

mercury from the culture broth. This algae had a high degree of resistance to mercury, the LC 50 being 25 micro grams per litre. A fresh culture of this algae was given a dose of sub-lethal concentration of 20 micrograms per litre of inorganic mercury in the form of mercuric chloride. The system was continuously aerated and the amount of mercury remaining in the culture system was periodically analysed by cold vapour atomic absorption spectrophotometry. A similar experiment with filtered seawater was conducted to examine the effect of aeration. The presence of the algae, *Isochrysis galbana*, brought about rapid removal of mercury to as much as 86% in just 4 hours, compared only to 21% in the filtered seawater

A number of bacteria, *viz.*, *Pseudomonas, Vibrio, Enterobacter, Azotobacter lwoffi, Moraxella* etc., have been found to volatilise various forms of mercury. Use of these bacteria and the micro algae like *Isochrysis galbana* Parke with the capacity to volatilise mercury would be of immense importance in the abatement of mercury pollution of the aquatic systems in short duration and at a very low cost without further deteriorating the environment.

Table to show loss of Mercury from aquatic system

Time in hours	Percentage removal of mercury from	
	Culture broth *I. galbana*	Filtered seawater
2	22.7	4.5
4	85.9	21.4
8	90.5	21.4
24	93.6	39.1
48	95.5	45.7

Further Reading

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