

THE INDIAN PEOPLE'S TRIBUNAL REPORT

On the Alleged Environmental Pollution and Health Impacts Caused by the
Hindustan Lever Mercury Thermometer Factory at Kodaikanal

Tribunal Headed By:

Justice SN Bhargava

(Retd. Chief Justice, Sikkim High Court and State Human Rights Commission Chairperson, Manipur)

Members:

Dr. Amit Nair

Prof. Ramakrishnan

Dr Rakesh Kumar Singh

INDIAN PEOPLES'S TRIBUNAL ON ENVIRONMENT AND HUMAN RIGHTS

JUNE 2003

PANEL PROFILE

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Justice Bhargava completed his law studies at Allahabad and then practised in at various courts in Rajasthan and Supreme Court before joining the judicial services. He was elevated to the bench of the Rajasthan High Court in 1993 and retired as Chief Justice of the Sikkim High Court in 1996. Post retirement he has been the Chairperson of the Assam Human Rights Commission. Currently he is the Chairperson of the Manipur Human Rights Commission. Justice Bhargava lives in Jaipur and is actively associated with the legal aid mission and other human rights activities.

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Dr Amit Nair holds a doctoral degree from University of Delhi and is currently a Director in Development Alliance Pvt. Ltd, New Delhi. He has extensive research and teaching experience in the field of environmental health, and pollution. He is also actively involved in environmental and health management projects, especially in environmental health impact assessment and monitoring studies, research studies on trophic transfer. He has been involved in conducting impact assessment of chemical factories around human settlements. Amit has provided his services to international research organizations such as DFID India, World Bank, International Atomic Energy Agency (IAEA), Austria, HiVOs, Netherlands, Multi-Resource Centre, USA, Japanese Bank for International Corporation (JBIC) and University Grants Commission.

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Prof. Ramakrishnan has been in the teaching / research profession for the past 30 years. He has assisted the Tamil Nadu Planning Commission to evolve the 10th Plan for Education Sector. His current interests are in the areas of Corporate Social Responsibility and facilitating social change through science, technology and education. He has been a consultant to international agencies such as UNICEF and SIDA and has served in the task forces of the Central and State Governments. Prof. Ramakrishnan had his management education at IIM, Ahmedabad, University of Hawaii, Columbia University, New York and Pennsylvania State University. Currently he is teaching at the School of Management, Bharathiar University, Coimbatore.

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BACKGROUND

In 1983, a second-hand mercury thermometer factory owned by Cheseborough Ponds was imported from the US and located in the tourist and school town of Kodaikanal, (population, 30,000). The factory is situated at an altitude of 2000 meters amidst a flourishing tropical montane forest of the Western Ghats, one of the bio-diversity hotspots of the world. To the east of the factory wall, the land slopes steeply to the Pambar Shola, a largely undisturbed tropical montane forest, which was recently designated for a sanctuary by the Tamil Nadu Government. The Pambar stream drains the forests below the back wall of the factory, and runs down to the Kumbhakarai waterfalls, a popular tourist bathing site. The water from Pambar stream then continues to join the Vaigai overflow enroute to Madurai.

The thermometre factory changed hands in 1997, when Hindustan Lever acquired the factory from Ponds India Ltd. Hindustan Lever is a 51% subsidiary of Anglo-Dutch multinational UniLever. Mercury for the thermometer is imported, primarily from the United States, and finished thermometers are exported to the United States, from where they are distributed to markets in Germany, UK, Australia, Spain and Canada. About 165 million pieces of ther-

момeters were exported between 1984 and 2001.



PHOTO COURTESY: SHAILENDRA

Broken thermometers at Munjickal Scrapyard

On 7th March 2001, environmental groups Palani Hills Conservation Council (PHCC) and Greenpeace exposed mercury bearing waste glass dumped by the company at a local scrap yard. Demonstrations by local people at the factory site forced its closure, and the Tamil Nadu Pollution Control Board (TNPCB) issued a notice to the compa-

ny to refrain from carrying out any activity at the plant site. The Board also disconnected the water and electricity supply to the factory.

Formation of Hazardous Waste Monitoring Committee (HWMC) by TNPCB

In response to the demand of the community to obtain information on the functioning of the factory and its operations over 18 years, the TNPCB formed a Hazardous Waste Monitoring Committee with representatives from industry, and NGOs. In its letter of 22.05.01, (HMW/12391/01/DGL/Mercury) the Convenor of the HWM Committee, Thiru R. Ramachandran noted some salient factors that had come to their attention regarding the complaint received by the Board on the functioning of the factory and the illegal disposal of hazardous waste.

The Convenor's Note states that:

"Authorisation has been issued to the unit vide Proc No 11 HWM/33386/96 dt 17.4.2000 subject to the following condition ... v) The Unit shall handle all hazardous chemicals by adhering to safety precaution specified in Materials Safety data sheet, which shall be maintained as per schedule 9 of MSII IC Rules 1989 as amended in 1994. As the unit has disposed glass cullets ... generated from the mercury section of the manufacturing unit, in contravention of the conditions imposed in the authorisation order, a closure order was issued to the unit vide Proceeding noHWM/4280/ of 23.3.01. The Report of Analysis of the totally crushed glass sample from the scrapyards reveals the presence of mercury at levels of 346 mg/kg and 529 mg/kg respectively".

The Note mentions that the company had appointed M/s Dames and Moore as consultants to draw up a protocol for the cleanup of the scrapyards and for remediation at the factory site, and that the factory had given an assurance that no activity would take place at the factory without the permission of the TNPCB. The Board constituted the HWM Committee in order to:

1. Ensure safe disposal of mercury bearing waste and other hazardous waste generated from HLL thermometer factory in Kodaikanal.
2. Assess and suggest remediation measures if any are required on account of disposal of mercury bearing waste generated by HLL in Kodaikanal.

At the Meeting of the HWM Committee on 28th and 29th of May 2001, the company informed the committee that it would not be reviving production at the site. The committee called for a detailed remediation protocol and for details of glass scrap and stock at the site.

At the meeting HLL presented a report which was required to provide details of production activity at the plant and a breakdown of raw material used, waste generated and stored and waste recycled in-house, and an assessment of health impact on workers and the impact on the environment, along with a plan for cleaning up the scrapyards where the mercury bearing glass was dumped. The Company was requested to provide information about the quantity of mercury and glass used in manufacture, and the quantity that remaining in waste and emitted to the environment.

On preliminary reading the Committee felt that the required information was not made available, though the company would have been required to keep such records and make

them readily available. On 28 May 2001, the Committee urged the company to provide details against which the assertions of the report may be verified. The committee sought details of “quantities of various categories of glass shall be given by M/s HLL to support the material balance.” It also requested information on soil contamination around the site.

Community and the Clean Up

The community called on the Hazardous Waste Monitoring Committee to permit an appraisal of the clean up protocol produced by the company, and accepted the suggestions of the appraisal presented by the community. On 21st June the company under supervision of the community undertook the clean up of the scrapyard.

It may be noted here that in its May 2001 Report it had mentioned that their records and those of the Customs and Excise warehouse on site showed that 5.3 tons of mercury bearing waste had been inadvertently sold to the scrap dealer. However on the community’s insistence that the contaminated glass be recovered and weighed, 7.4 tons of glass was found.



Community and the IPT

After a year of reminders both from the TNPCB and the community and HLL’s failure to respond, the community, Palani Hills Conservation Council, Greenpeace and other local groups approached the Indian People’s Tribunal on Environment and Human Rights (IPT) to investigate into the

A Scene from behind the HLL Thermometer Factory, Kodaikanal

issues involved and call on HLL to furnish the information necessary to assess emissions to the environment and impact on health.

The **Terms of Reference** of the enquiry were,

- 1. To look into the health and environmental impact of mercury pollution in the area**
- 2. To look into the practices at the factory with regards to safety and effluent disposal.**

The IPT constituted an expert panel to look into the above issues. The panel consisted of Justice SN Bhargava as Chairperson, and Dr. Amit Nair, Prof. Ramakrishnan and Dr. Rakesh Kumar Singh as members of the Panel.

The enquiry was conducted on 2nd and 3rd of September 2002. The panel held public hearings on both the days and visited the factory premises. Although the Hindustan Lever Limited was invited and the panel requested them to be present for the public hearing, they declined. They did, however, come to the venue of the public hearing prior to the start of the hearing and handed over a few documents to the Tribunal.

Various sections of the community and government and NGOs made presentations to the IPT giving details of the working conditions, daily routines, health and safety practices, waste handling methods, and health effects felt by them over the years. A total of 160 ex-workers of the former thermometer factory, four members from the TNPCB, Dr. Mohan Isaac, NIMHANS, Bangalore, representatives from Community Health Centre (CHC), Bangalore, NGO representatives and hundreds of citizens of Kodaikanal attended the public hearing.

The testimonies of individual people also brought to the attention of the Tribunal that 10 young men (Average age 31) had died after working at the factory. The company has denied having any information on these deaths. The survivors of the deceased petitioned the IPT to call on HLL to furnish the health records of the deceased workers.



PHOTO COURTESY: SUNIL SCARIA

IPT Panel at the Public Hearing at the Boat Club, Kodaikanal. Seated from left: Prof Ramakrishnan, Justice SN Bhargava, Dr Amit Nair, and Dr Rakesh Kumar Singh

STATEMENTS TO THE IPT

Given below are statements and oral testimonies submitted to the IPT, followed by the observations of the panel who made personal visits to the plant, the surrounding forest and lake watersheds. The IPT also had discussions with workers, doctors, teachers and towns' people. Apart from that several doctors who have experience with dealing with the complexities of epidemiology and toxicity on neurological and physiological systems also briefed the panel on the case.

The Panel held discussions with representatives of the TNPCB who attended the hearing on 2nd September 2002 and provided records to the IPT on the functioning of the factory to the TNPCB. The Panel also met the concerned Factory Inspector who provided some records and described the department's interaction with the company.

It should be noted that the statements presented below are entirely the version of the person or group that has submitted it before the Indian People's Tribunal Panel. Therefore the IPT has no responsibility on whatever is said in the statements.

1. Location of factory site in eco-sensitive zone - Submission by PHCC

The Palani Hills Conservation Council is a group that has since its formation in 1986 has been engaged in programmes for afforestation and preserving the ecology of the hills submitted documentation on the nature of the tropical montane forest bordering the factory, and the special sensitivity of the Pambar shola to the East and south of the factory. This Shola harbours about 17 endemic species on the Red Data List of endangered plants. The Shola has been declared as a special Kurunji sanctuary for the *Strobilanthus* specie that treats the valley as a refuge.

A paper on "The Bio-diversity of the Palni Hills", by Fr K. M. Mathew, Director, Rapinat Herbarium, St. Joseph's College, Trichy, was presented to underline the ecological importance of the Pambar Shola and forest watersheds and the rivers served by them.

Pambar Shola: a Bio-diversity treasure trove under threat

The Pambar Shola, 2000-m, perched on the edge of the precipice with the Falls cascading down for several hundred metres, is a living fossil, a relic among relics. This bio-diversity treasure trove, now shrunk to less than 3 km in circumference, is witnessing the last-ditch battle for survival by a number of plant species, "absolutely the last sentinels of a long bygone age". The past had been glorious; several plant species were described as new to science from here. But the developmental activities of recent decades have depleted its species richness; a few are already extinct; at least four are now known from a single clump each for the entire Plan hills. (See Data List below). The Tamil Nadu Forest

Department fending the Shola during 1999 has been recognition of its vital importance.

Contiguous to this sanctuary is a slope, now declared as a "Kurinji Preservation Plot" by the Tamil Nadu Forest Department (Ref. No. J2/10888/99 of 26-11-1999 of the Principal Chief Conservator of Forest, Chennai), as this slope is the best preserved one for the entire Palni hills for the folklore plant Kurinji (*Strobilanthes kunthiana*) that flowers once in 12 years.

The secluded, and contiguous, location of these two treasures saved them to some extent till now, but for the future the only way is on site (in situ) conservation. Any external interference will prove lethal in this last ditch struggle of the threatened species.

In 1980s Ponds India Ltd. set up a mercury thermometer factory on the ridge of Pambar shola slope by securing special exemption form the Tamil Nadu Government on grounds that the factory is non-polluting. Over the years, the slopes leading into Pambar shola's core have been used by the factory management as a dumping ground for all kinds of wastes, including broken mercury-containing thermometers and other potentially mercury-contaminated wastes. The slopes where the wastes are dumped are part of the Pambar shola watershed, draining water through the Pambar River which eventually ends up in the plains leading up to the temple city of Madurai through a network of canals, and finally to the Bay of Bengal. This watercourse across the entire Tamil Nadu State can be our version of Chernobyl (Minamata) should the deadly mercury compounds enter it. Besides mercury poison is cumulative in our system.

Pambar Shola and Environments – Red Data List of plants

1. *Sonerila pulneyensis* : a delicate succulent herb endemic from Pambar Shola in all of the Palni hills
2. *Hoya wightii* ssp. *Pulneyensis* : a succulent vine with waxy flowers endemic to Pambar Shola'
3. *Plectranthus bourneate* : a succulent herb endemic to Pambar Shola.
4. *Trichoglottis tenera* : an epiphytic orchid. Pambar Shola is its major habitat.
5. *Phyllanthus chandrabosei* : a shrub endemic to Pambar Shola
6. *Hupezria* sp. : a fern ally endemic to Pambar Shola
7. *Selaginella* sp. : a delicate creeping fern endemic to Pambar Shola
8. *Psydrax ficiformis* : a tree, until recently throughout extinct
9. *Utleria salicifolia* : only one clump known on the Palni hills
10. *Elaeocarpus blascoi* : a tree believed extinct until this year
11. *Cyathea crinita* : tree fern, highly endangered (Botanical Survey of India)
12. *Aeschynanthus perrottetii* : known only from one other shola in the Palni hills
13. *Eulophia* sp. : a new species for the Palni hills first collected in April 2000
14. *Actinodapohne bourneae* : Laurel tree believed extinct (Botanical Survey of India). Two trees found in Pambar Shola
15. *Ceropegia thwaitesii* : vine, vulnerable, endemic to Pambar shola
16. *Pimpinella pulneyensis* : scarce
17. *Exacum anamallayannum* : gentian, only one other known location in Palni hills

2. Documentation presented by HLL

The company submitted its Report of May 2001 to the IPT. The IPT team however was taken around the factory by the company for a visit, details of which are given below.

The documentation provided by HLL comprised a Report produced by its Consultants, Dames & Moore and Van Tuenenbroek. The report was expected to disclose information on the use and disposal from the HLL thermometer factory over the past 18 years. The Hazardous Waste Committee had expected declarations on amount of mercury and glass used, in waste or off site. The company provided the IPT with its Report of May 01, without having responded to the information required by the HWC.

However, the second Report (28th June 2002) seems not to have presented the required figures, (e.g. total amount of glass imported) or explained the inconsistencies in the figures given in either Report or the company's records and statements at various times. Furthermore, the company, which had agreed to answer written questions from the Tribunal earlier, declined later to cooperate.

The IPT was therefore forced to read the total picture presented by the company bearing in mind the inconsistencies and misrepresentations which become difficult to ignore, as they concern substantial issues of quantities of mercury emitted, used or stored, and its potential impact on people and the environment of Kodaikanal hills.

3. Summary of ex-workers Testimony on Health, Safety and Precautionary Measures and Shop Floor Practices

The factory was set up in 1984 and commenced production in 1985; inception of a trade union was in 1985, with the general manager of the factory as President and one worker as Joint Secretary. The workers were provided with cotton uniforms, plastic shoes, cotton surgical gloves, cotton cap and mask. However, rubber gloves were provided only to workers involved in washing bulbs with Nitric acid.

The safety measures listed above were adhered to as long as the Pond's Cheeseborough experts from the USA provided expertise during the initial two years of the factory's inception. The relationship between workers and the Personnel Officer have been stated to have been good with basic strictures like washing of hands before consuming food and bathing before leaving premises adhered to. Once the experts would leave, it was indicated that apprentice labour who had no prior knowledge of mercury exposure or safeguards required would learn the processes from senior employees.

The workers were never informed about the dangers of working with mercury nor of the health problems related to long term exposure. The label prominently displayed on the PVC containers of Bethlehem Apparatus, suppliers of frank mercury were never shown to them and there has been no indication whether they were provided the information in Tamil, the common language. Sections like Glass Cutting section had provisions for goggles to prevent silica and glass dust exposure to workers only in the initial years. However, again these units

had the necessary rudimentary precautions only for the first few years.

Over the next 16 years, safety guidelines were hardly practised, no accidents were reported or recorded and even basic provisions like a certified First aid personnel was not provided. The workers stated that cotton, bandages, plasters and tincture were often unavailable with the security at the gate where the First Aid was kept.

In the Distilling section, only uniform and apron were provided, exposing the workers to the dangers of mercury absorption through dermal contact and through inhalation. An Injection Moulding unit was set up in the late nineties, where PVC thermometer caps and barrels were manufactured. The section was closed after two years and the TNPCB later stated that they were unaware of such an ancillary unit manufacturing PVC caps and barrels.

TNPCB is also not aware of any EMP submitted neither for the same nor of any tests done on glass dust for analyzing levels of silica, lead or other heavy metals. At this juncture, the workers were asked if anyone had given any complaints to the Inspector Factories or the Inspector, Labour when the inspection of premises took place. The workers unanimously stated that until the factory was shut down and the issue became public, they were unaware of such officers and had never seen or talked to any of these authorities. No Safety Week or Educative programmes were ever observed.

Health tests including urine tests were done at random. Some permanent employees were given medical tests prior to joining the factory to ensure health and screen communicable diseases on the grounds that they were working with a Medical product. However, many employees stated that urine tests were not carried out regularly till the factory had stopped production from March 2001 to July 2001 and urine test were then conducted every three to four days and all prior tests which were few and random during production were not done by a certified lab technician but by two employees, Thiru Srinivasan or Thiru Mani.

It has also been stated that even when workers were showing obvious symptoms of mercury poisoning, including headaches, dental caries, loss of memory, tremors and nausea, urine test results and medical test reports were suppressed, declared normal and till date no employee has seen his/ her medical files at the factory. Frequent complaints entailed a change in section and could even be between non-mercury and mercury sections, further increasing the risk of exposure.

Shop floor practices included collection of broken bulbs and glass stems containing mercury using a broom and sweeping into a plastic bucket or a drain provided for the same. Asbestos roofing used in the premises had been destroyed in a storm and the damaged sheets had even been sold to workers at a price of Rs. 25/- per sheet.

4. FEW INDIVIDUAL TESTIMONIES ABOUT HEALTH PROBLEMS:

Shri Balachandran

Worked as factory supervisor between 1984-2001 - "I have worked in the factory, in all the departments for its entire time and started to suffer giddiness. I would often go home and

experience depression, memory loss and violent behavioural changes. As the situation worsened, I requested the management to give me leave for 10 to 15 days to undergo treatment for my ailment, diagnosed as depression. I had at that time nearly 240 days of paid leave to my credit. I was refused paid leave and had to go on loss of pay to avail treatment for my condition. I continued working and one day I suffered an epileptic seizure in the premises itself. I was refused help and the management even stated that I was faking my condition! My doctor provided me with treatment in Madurai for depression and I was put on anti depressants and sleeping pills. My psychiatrist informed me that I suffered from 'brain drain'. Since my condition was poor, I was often groggy in the day and I was asked to report for night shifts, this again was impossible as I was on prescribed drugs including sleeping pills accompanied by side effects.”

Mrs. Balachandran, wife of Shri Balachandran

“My husband worked all his life for the factory and believed them entirely. I personally went and met the management and begged for a transfer on health grounds. His epileptic seizures were also a cause for worry and we suffered with his regular attacks of rage and violence. He also contracted jaundice and we begged the management to please be a little more concerned, considering that my husband had worked for so many years. The requests were all refused. As loss of pay was indicated, we provided all the medical records of treatment from Dr. Ramesh, Madurai and we were in fact told that there would be no reimbursement nor any help from the company.”

Ruby Martin, mother of deceased employee, Christopher Martin Colorant (died, aged 33 years)

“ My son started work in 1986. He soon started to experience blurring of vision, headaches, nausea and breathlessness. He would hardly eat any food and would often tell me that there were no safety precautions observed at work. His health gradually worsened and by 1989, even though he continued to go to work for the family, he started to experience body swelling and weakness. He could hardly walk and suffered a fainting spell in the factory itself. He started vomiting blood once, in the factory and was brought home by Mr. Madanagopal, Manager, of HLL. I was told that all treatment was to be had only outside Kodaikanal, not even at the local hospitals like Van Allen or the Govt. Hospital. Mr. Madanagopal also offered money to get the treatment. My son asked for a change in section from checking thermometers to non-mercury, through the worker’s union. He had to be admitted in the Govt. hospital under Dr. Balaji’ s care and the medical record states he was admitted with puffiness of face, febrile with back pain and persistent cramps. Dr. Balaji referred him to Dr. Madhuram in Tiruchirapalli. The doctor never told him or me that his illness was because of mercury. He was very ill with asthmatic attacks and severe pain and body swelling. A letter was written from Dr. Madhuram again requesting the company to give him a change in section, which was refused. The doctor also told my son that his condition was because of exposure to mercury. He also started to have problems with his vision and was prescribed glasses by Sakthi Opticals, after eye testing at AG Eye Hospital in Tiruchirapalli.”

“He was in Tiruchirapalli for nearly a month under Dr. Madhuram, at Dr. Isaac Madhuram Memorial Hospital. Our financial condition was very bad by now and we moved him to the

Christian Hospital in Oddanchatram where he was kept for nearly six months. His condition seemed better and I brought him back. But his bronchial condition deteriorated and his chest would heave with difficulty in breathing. The situation worsened and in the Govt. Hospital in Madurai, he was told that he had very limited time as his kidneys and lungs were damaged beyond repair. We brought him back and he stayed at home for the last three months with emergency medical care from various doctors here. He finally died on 12-2-97 following a wheezing attack, after suffering for nearly ten years from various health problems. He has two small children who have also suffered because of this”.

Angela Mary, wife of Edward Anthony (died aged 34 years)

“ My husband joined Pond’s in 1985 and was a very athletic person who played foot ball. After 1987, my husband started complaining of incessant backaches. He would occasionally be bed ridden for a week in a month. Later, he suddenly had an epileptic seizure in the factory itself and was brought home by Raghunathan, a colleague of his. He continued to go to work despite this and other problems including headache, giddiness, nausea and lack of appetite. Our family with two small children would have starved otherwise and I would force him to go to work. One day, he was brought home with one side of his body paralysed. The company officials immediately arranged for him to be sent to Apollo Hospital, Chennai for check up. X-rays and CT scans showed a tumour growth and immediate surgical intervention was recommended and the company bore the Rs. 80000 that this had cost. He was given medicines and brought back as we had no capacity to bear the cost of surgery too.”

“The family was now starving and I repeatedly pleaded with the company to help us with the financial cost of the surgery. Since there was a refusal, he worsened and we finally took him to the Govt. Hospital, Madurai where with the lack of even bed space he died on the hospital floor on 24-9-92. Mr. Madanagopal offered me a job in the factory as a contract labourer. I do not have any medical records or proof because some of the medical reports were taken from me by the management after I started work and the rest I burnt in my grief.”

Jennifer Nancy Rani, ex woman worker

“I started working in the factory in 1996 and resigned after a year on 15 Jan., 1996, because I had contracted jaundice and would avail leave very often. I would sometimes suffer headaches and nausea. Soon I started having cramps and violent stomach pain. One night I started having a violent attack of stomach pain and was admitted at the Van Allen Hospital. A scan was done and a tumour was detected near the uterus. The uterus was surgically removed on 17 August 2001. I would often never wash my hands before eating food, as we were never told about mercury. I also took my child to the premises. Since the past four years, my child who used to be fed by me in the factory premises has got a health problem also. She suffers from epilepsy, which started in the factory when I worked there, and the attacks occur when she physically exerts herself and plays. She also has nasal bleeds when this happens. She is now 13 years and we cannot afford to have her examined or treated, though one doctor has told us that she has a heart condition.”

Sangeetha - daughter of N Govindraj (died, aged around 40 years).

“My father started work as a Security Guard on 19-12-98. He was always a very healthy man and since we have no mother he looked after all our needs. Within two to three months of

starting work he complained of leg pain and fatigue. He went and saw Dr. Balaji who informed him that he was anaemic and administered Glucose. He was also advised to go to Madurai and get a blood transfusion. The company knew of his health problem but offered no help at all. He was admitted in Bhagavathi Hospital for an ECG. After a few more tests he was told that he had hardly any blood and given a transfusion of 5 bottles. The diagnoses record Congestive Hepatomegaly and an enlarged liver. He was also advised to stay in the plains and went to Thiruvannamalai to our relatives' house. He stayed there for a few days and then went to Bombay as he knew the city and wanted to get better. He again fell ill and the doctor he went to tell him that he had very little time left even after a transfusion and that it would be better for him to see his children, my sister and me. He came back to Thiagathurukam to a relative's house where he wanted us to come and meet him. Before we could get to Thiagathurukam, he passed away suddenly on 19-10-00. My sister and I are now all alone with only relatives to look after us."

B Joseph, employed in the Crusher Unit and Injection Moulding

"I worked in the factory for 6 months and left because I started experiencing fainting spells and have had several attacks within the factory itself. I suffer from burn injuries, skin dermatitis and intermittent chest pain. Except the bulb-washing unit where rubber gloves were provided, I have never been informed about the dangers of exposure to mercury. I also suffer from dental caries, tremors and am unable to get permanent employment anywhere due to constant fatigue."

Joseph also employed in the Crusher unit- "I resigned from the factory on 10 Noember 1995. Initially, I worked in the crusher unit where we would grind down broken and waste glass. After about four months I started getting headaches and asked for a change in section. I was sent to the Injection Moulding section where, two weeks later, I started having nosebleeds. I also had constant cough, runny nose and my eyesight deteriorated. After one year I had difficulty in reading without glasses, as my eyes would water. I left after two and a half years, as I was not feeling well and suffered from leg pain. The only safety apparel provided by the company was Khaki coat and cotton cap/ mask. I was not given goggles to protect my eyes in the crushing unit and the area of the room was around 8'x 10' with one exhaust fan. The glass dust and debris would be swept up only in the evening."

V Paulraj, worked in the Laser Cutting, Flame Cutting, Distillation sections

"I worked for nearly 14 years in the factory in the above sections. I started working initially in the generator room and was soon transferred to the Distillation Section. Soon, I started suffering joint pain and body swelling .At least once a month, I would be ill and not go to work for a week. I am one of the oldest employees who have never received an Attendance Incentive and was even told by the management that I could never get one. I told them about my health details and they only offered a good doctor's recommendation. But no financial help could be availed as giving one employee meant giving financial help to all the employees with health complaints. So I started to keep Rs. 1000 aside every month for my medical expenses. I never collected bills or showed anyone as I knew that the management didn't really care. I was soon shifted to the crusher unit and started experiencing shaky hands, chest pain and intense fatigue, so much so that I could not even carry my lunchbox. I still suffer from wheezing, chest pain and breathlessness. I receive treatment from Dr. Balaji and when I was X-rayed, he advised me to stop work as my lungs had suf-

ferred. I did not resign as I have an entire family dependant on me and continued to work. Later, I started suffering from intense attacks of panic and agitation. I would get violent with my family and even now cannot stand loud sounds as I get very aggressive. My brother who was employed (in HLL) also suffers from health problems like body swelling and pain.”

Saleth Mary, mother of Jesus Kanna (died aged 35 years)

“My son started working early in life as my husband died and we needed a breadwinner with three smaller brothers to also look after. He started working in the factory in 1991 and was a temporary employee. He cleaned scrap glass and waste from the mercury section. He would often come home with cut fingers, which would be bandaged at the factory premises. As he needed a permanent job, he applied for a change in section as an apprentice. He was transferred to the mercury/ fine air passing section in 1992. Soon he started complaining of nausea, headache, vomiting and fatigue. He was once admitted in Van Allen Hospital with violent nausea attack. He also started suffering stomach pain and would hardly eat. He married in 1995 and moved to Sivakasi. He would write to tell me that he was not in good health and it was to do with exposure to mercury. He returned in 1996 to formally resign as his health condition was very poor and his wife wrote to me that he had to take repeated blood transfusions and was under treatment from Dr. Chandravadanam, a practitioner in Sivakasi. In July- August 1996, his wife wrote to tell me that he had blood cancer and would not live very long. He passed away in Sivakasi on 18-9-96 and I only saw his body when it was brought for burial to Kodaikanal. I am now employed as a school teacher and have lost my oldest son”.

B Shankar, worked in Packing and Screening sections

“I would injure my fingers quite often due to breakage in handling finished thermometers. I recorded an injury once, which was bleeding heavily and was taken to Van Allen for First Aid. I was also taken to Dr. Padmanaban for the same. There were no safety precautions followed and one day I broke out into a skin rash and complained to the management, including the Supervisor and the Personnel Manager, to have them take me to the hospital. However, there was no factory vehicle available and I was told to go on my own. So I walked to the Govt. Hospital to take treatment. I suffer from constant headache, neck pain and back ache.”

Vijayalakshmi, Digital and Packing section

“I would often handle broken thermometers and cut my fingers in the packing section. There were no certified First Aid personnel and I would usually tie a piece of cloth on the wound and continue working. Soon, I started to experience giddy spells. I would be allowed a few minutes of rest and go back to work as my superiors expected us to work hard and concentrate on production. I soon started having nose bleeds, headache, nausea, ear bleeds and lack of appetite. My teeth also started falling out and I have very bad teeth and also have dentures. No one told us that we were in danger of exposure to mercury and we would not be allowed to wear footwear other than rubber chappals inside the digital section. Thereafter I started having irregular menses, bloody urine and a white vaginal discharge. I complained to the management but no one cared. I finally resigned and was called for a last medical check up after the factory closed. The tests were done on nearly 160 people on 25 April, 2001 and when my report came home I was surprised to find that I was recorded normal even with my obvious health problems.”

Gnanasoundari, Digital section

"I live opposite the factory and my mother was a caretaker for a house next to the factory. My brother is 12 years old and is mentally retarded. My mother also has health problems with a defective heart condition. I never used footwear or any other precautions when I worked in the factory. My health problems started with body swelling and gastric burning. I also have headache, nausea, asthma and cough. I often have difficulty in urination and cannot hear with one ear. I had a miscarriage during the first pregnancy. I now have two children, and both the children have leg deformities. None of the births were natural and because of great difficulty even during the pregnancies, I had Caesarean operations. I also suffer from dental caries and bleeding gums."

Amritraj, Grading section

"I joined the company in 1984 and started experiencing mental agitation within four months. The slightest sound would aggravate me and cause disturbance. After some time, one of my testicles started swelling painfully. At this juncture, I visited Dr. Ramnath and was prescribed medication. The symptoms subsided but I ran away from the factory and never returned as one of my colleagues, Marimuthu died suddenly in 1984. I am now sterile and having been married for 8 years has no children."

Poomari, wife of R Marimuthu (died, aged 27 years)

"My husband joined the factory in 1984 and his job involved grading of thermometers, sometimes working 14- 18 hours as we had had two small children and we needed the income. In April 1984, he started complaining of chest pain and nausea. He also developed chronic cough and breathlessness. He was admitted in the Govt. Hospital for regular check-ups, almost every Sunday. By June 1984, his condition worsened to include painful headaches, regular vomiting and nausea. After emergency care in the Govt. hospital, we moved him to the Govt. Hospital, Periakulam for better care. Here, he was diagnosed with Extensive Pulmonary Tuberculosis and died of heart failure."

Carmel, employed as painter in the factory as contract labour

"I used to often work in painting the asbestos roof of the factory, including mercury and non mercury sections. I would often be covered with fine specks and beads of mercury, which would have collected on the roof and fall on me, when I was painting. The factory management provided no precaution. I would sometimes suffer headache, memory loss, stomach burning and lack of appetite, all of which still persist. I have one child of two years who has a heart ailment. My son is unable to walk and has no co-ordination of motor skills. I have been to the Sathya Sai Baba Hospital, Bangalore for free surgery and have been told to wait. I have also done tests for my child in Madurai and Coimbatore. "

Selva Rani, employed in Digital section

"I joined the factory in 1997 and worked only for a year. My male child was born on 6-11-98 and died on 4-12-98. At birth itself my baby did not seem very well. I was also bleeding very heavily and both of us were admitted at Van Allen Hospital for three days. I had already asked Dr. Balasubramaniam and Dr. Balaji and they had refused as the baby had lumps all over his body and when they were surgically removed more cysts appeared in other parts of his body. Finally, the baby died. Later I suffered an abortion in my fifth month and now have a baby boy aged three and a half who is also unwell and suffers constant lung congestion and

I have records of all the X rays and injections he gets. I am currently pregnant and hope that at least this child is born well. In employment, I suffered constant headache and a nervous twitch above my left eye. Now I only take treatment for white discharge and anaemia.

Sunder Raj, brother of Selva Rani, Canteen section

"I worked in the canteen section in cooking and service floor. The floor of the canteen would sometimes be white with sediment where the workers placed their feet and sat. I worked from 1992-99. In the last three years, I have developed wheezing and breathing difficulty. I got married in 1999, but I have no children. I have medical records for treatment I am receiving for sterility and a low sperm count.

Rangaswamy, father of the above, in the non mercury section, packing and top chamber

"My eyes are affected and I suffer from loss of memory even now. When I worked as contract labour between 7- 12- 94 -96 to carry scrap and I used to suffer from headaches, nausea, and lack of appetite. Soon I started experiencing pain in my knee joints and giddiness. When we both started experiencing health problems we decided to leave.

Lourde Yesurajan, employed in Grading, Laser, Shakedown and Flame cutting sections

"My Token number was 118. I joined the factory in 1984. I continued working till its closure in 2001. I started having incessant headaches from 1984 onwards. My eyesight deteriorated and I wear glasses. My teeth have also rotted and fallen out, I have blue gums and have had several fainting spells, even in the factory. I often had chest pain and Dr. Balaji recommended an ECG. It has been found that I have a blocked valve and cannot exert myself physically. I was always questioned on my leave of absence by the management. I took leave in 1998 as the chest pain resumed and another ECG was done. I have to always keep tablets with me and continue with them regularly. The first time I took leave I had to go on loss of pay with no compensation. I now suffer from breathing problems, shaky hands and tremors and constant knee pain. How can I go for employment anywhere else in this condition?"

Sebastian, brother of Arokiaselva Raja (died, aged 32 years)

"My brother worked in the factory between 1985- 1997 in the grading, laser cutting and screening sections. He resigned in 1997, as he was too ill to go to work. He never smoked or drank and was always a healthy person when he developed acute coughing and lung congestion in 1985. He also suffered occasional nosebleeds and blood vomiting. Soon this worsened and he started having indigestion and nausea with no appetite. In 1995, the condition worsened and he was bed ridden with acute body swelling including testicles. He had two small children and all through 1996 even with financial difficulty we took him to several doctors. In June 1996 we were told that he had an incurable kidney disease, Early Parenchymal Disease, also had very high urea/ creatinine levels. With limited time left we finally brought him and even gave him treatment at home but his body would swell up and he would be in terrible pain. Soon he started bleeding rectally and died on 27-4-97.

Parimala, wife of Muthukrishna Angaiah (died, aged around 40 years)

"My husband joined the factory in 1990 and worked for a year. He was employed in the laundry to wash workers uniforms. All the clothes from different sections would lie together, including mercury and non-mercury uniforms. In 1992, he started having constant headaches and breathing trouble. He went to Dr. Balaji and took regular medicines. In 1993, his body

started swelling and he complained of nausea. By 1997, his health worsened and he was diagnosed with a heart ailment. As he needed better care, we went to Madurai through the offices of Mr. Nagarajan, Personnel Manager and Mr. Gopalakrishnan, Plant Manager. We were then told about JIPMER, Pondicherry and made several visits between 1998- 99. However, he had a sudden heart attack and died at home. Dr. Balaji's certificate states cause of death as Rheumatic Heart Disease- Rheumatic Mitral Stenosis with Mitral Regurgitation, Pulmonary Hypertension leading to Congestive Heart failure. My husband was an occasional smoker and drinker which was stopped after initial problems started”

P Thangaraj, uncle of M Sasikumar (died, aged 29 years)

“My nephew came as a contract labourer through Pandurangan, a labour contractor for the factory in 1998. His work involved manual labour in the packing section. Soon he was apprentice in the top cutting, chart out and fill room between 1988-91. he had no vices and was a very healthy child. The only blood test he ever got from the company was prior to his apprenticeship when he was given a test for communicable diseases. After about three months as apprentice he started suffering extreme fatigue, nausea, lack of appetite and headache. In 1992, the problem became worse and he went to various doctors. His legs started to pain and he had difficulty urinating. His testicles would also get inflamed painfully. Blood/ Urine/ Creatinine Levels records were stated as very high. We even took him to the free hospital in Puttaparathi. But the diagnosis was that he needed immediate heart surgery. Finally we sent him to his parents in Munnar and even with the pain he was finally taken to Amritha Heart Hospital in Cochin where free surgery was conducted. He lived for another eight months and was advised not to do any strenuous work. His body swelling occurred occasionally. Soon, all the old symptoms returned and he passed away on 18-6-00. His certificate records Causal Asystole, Renal failure, Sepsis Syndrome, Rheumatic Heart disease- Post Mitral Valve Replacement.”

Lily Yesudass and Jyothi Yesudass, sisters of Paneerselvam Yesudass, (died, aged 28 years)

“Our brother had no record of major health problems till he started work in the factory. In 1985, he complained of stomachache and nausea. In the beginning of 1986, he would return from work with skin rashes and burning sensation. He took skin ointments from doctors and asked for a change of section. He was transferred to sweep and clean debris from the distillation and fill room sections. He suffered injuries from handling cut glass and said he would clean glass and mercury from the factory floor and work counters. The skin worsened and the nausea increased. In 1987, he resigned, as he was too sick and unhappy with the lack of care from the company. For the next eight years, he had trouble urinating and testicular swelling. His back hurt and he had difficulty straightening his spine. He could not eat and complained of blurring vision. Alarmed, we took him to Govt. Hospital, Madurai. Finally after visiting several hospitals he was diagnosed with kidney trouble at VK Hospital and very high blood pressure and both creatinine and blood urea levels very high. Both kidneys were recorded as showing Increased Echo Texture and diagnosis was medical renal disease.

When he was discharged, blurred vision, palpitation, cough, headache, bilateral limb swelling and low urinary output are recorded. Mild Haemaptysis was also recorded. On 9-7-97, he urinated only a volume of 230 ml/day and passed away on 13-7-97.”

Selvi, wife of Shankar (died, aged 35 years)

"My husband was an active and healthy man and joined the factory in 1988 as a sweeper. He received a permanent post and work involved washing of floors and factory premises in both mercury / non-mercury sections. He sometimes worked even two shifts. By the end of 1989, he complained of throat pain, nausea and lack of appetite. He continued working hard for the permanent confirmation. He soon started having body swelling and his lower limbs would appear inflamed. He took treatment from many doctors and swelling would appear repeatedly despite medicine. I have not kept any records, as I did not know they were important. One day he came home after the second shift and died suddenly at home. Certificate of death states cause of death as massive Cardiac Arrest on 25-3-98.

5. A 'peer review' of a study presented by HLL team on workers in HLL Thermometer Factory in Kodaikanal - By Community Health Cell (CHC)

A. Background

- In August 2001, CHC organised a skill share for a number of environmental health groups that were campaigning against certain environmental hazards in different parts of India. The purpose of the skill share was to help campaigning groups study the local health problems linked to the environmental hazard in a more scientific and systematic way. The skill share was entitled Community Health Environment Survey Skillshare (CHESS).
- One of the case studies presented by a group from Kodaikanal was the problem of Mercury related human and environmental hazards in and around Kodaikanal due to improper hazard control and waste disposal process of a local mercury thermometer factory. As a preparation for the skill share a two member team from CHC (Dr. Mohan Isaac, Professor of Psychiatry, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore; and Dr. Anur Praveen, a young doctor volunteer of CHC visited Kodaikanal and interacted with some of the ex-workers to make a preliminary situation analysis. Their preliminary report was circulated which highlighted some of the findings and the need for a more rigorous scientific study.
- A few weeks later, the Medical Advisor of HLL, Dr. Rajagopal contacted CHC, and requested CHC to give them an opportunity to present the findings of a recent study done on over 250 workers at the HLL factory. As a professional resource group concerned about peoples and workers health, we welcomed this opportunity to dialogue with the industry. We appreciated this as a sign of greater accountability and transparency. This dialogue took place on 27th November 2001.

B. The Presentation

- Dr. T. Rajagopal - Corporate Medical Advisor, Dr. Premala Mascarenhas - Area Medical Officer; Dr. H.V. Ravi Mohan - Occupational Health Physician; Dr. Anil - South East Asia Business Manager; and Dr. Ashok - who deals with environmental issues formed the HLL team that visited on 27th November 2001 to make the presentation.

- The CHC team included many of our associates who are also involved in occupational and environmental issues. The team consisted of Dr. Ravi Narayan, Community Health and Occupational Health Consultant, presently Community Health Adviser of CHC; Dr. C. Francis, a physiologist - endocrinologist, also the retired Dean of St. John's Medical College and presently Consultant of CHC; Dr. Mohan Isaac, Professor of Psychiatry at National Institute of Mental Health and Neuro Sciences, Bangalore, Dr. T. Venkatesh, Professor of Biochemistry, St. John's National Academy for Health Sciences and heavy metal toxicity expert for South Asia; Mr. AS Mohammed, Asst. Professor of Statistics, Department of Community Medicine, St. John's Medical College; Dr. H.R. Rajmohan, Director of Regional Occupational Health Centre, Bangalore (branch of NIOH, Ahmedabad), Dr. Krishnamurthy, Senior Scientist of ROHC and Dr. Sampath Krishnan, Fellow-Community Health, CHC and Dr. Anur Praveen, a doctor volunteer, CHC.

In spite of a prior request, the HLL team did not send us a report of the study in advance as requested, but made a presentation at CHC, using overhead projection sheets, summarising the background, the objectives, the methodology and the findings and analysis of a survey of around 255 workers. These workers had showed up at the visit of a 3 member medical team, in response to newspaper announcement requesting them to be present for medical evaluation, a few months after the operations in the factory had been closed.

The CHC team and associates raised queries and shared comments as the presentation progressed. We again requested for a report of the study, since peer review is not adequately effective if peers are just shown slides or OHPs in presentations, which merely always has a constrain of time. However, though it was mentioned that we would get the report, so far none has been received. We therefore invited all our team members and associates to put down in writing the key issues and comments that they have to make on the study. We hope to pass this on to the study organisers and to others who wish to asses and tackle the problem of human and environmental health caused by the HLL factory.

C. Peer Review and Comments

Handicapped as we are with the absence of OHP sheets presented at CHC by Dr Rajagopal or any documented or printed report of the study - these comments listed below may be taken as issues of concern with the study design and process of analysis, that may have affected the assessment of the actual problem. A biological monitoring approach rather than an occupational health monitoring approach seems to have predominated in the study design. The HLL teams, responses to some of these points raised were either "we have that type of analysis" or "we shall look into the matter".

But in the absence of a printed, circulated report it is difficult to say whether the comment or criticism has been adequately responded to in the study or subsequent analysis thereof.

1. The Sample - 'Opportunistic'

Any sample of workers that are based on those who show up on invitation of a medical team visit - announced by letter or newspaper or whatever method is what in epidemiological terms is called an 'opportunistic' or 'grab' sample. Extreme caution has to be taken to make any sort of judgement about the whole population of HLL workers, past and present because

extrapolation from an 'opportunistic sample', which has self-selection bias, is usually invalid.

2. Occupational History - an important parametre not adequately considered

A more rigorous sampling method may have to be used or else using detailed occupational health history the available sample may need to be subdivided into 'internal controls' for enhancing the comparisons. The 'opportunistic sample' may have workers with different years of work experience in the factory and different jobs or sections as well and these differences can be used to evolve subgroups. Clubbing them together by age or any other parametre, disregarding the occupational history, especially when the exposure is occupational, is again not a rational method of analysis. Clubbing previous employees, recent current employees and temporary employees is also not a good procedure.

3. Lack of clarity in study objectives:

- It was not clear whether the study was based on any hypothesis e.g., exposed vs. control or more exposed vs. less exposed. All the data was clubbed together which seemed to confuse the situation.
- There was no attempt to link the biochemical parameters with clinical examination. These were presented as different tables. So, whether there are correlation between clinical findings and investigations or between exposure and health effects were not clear.

4. Inadequate use of data on health from Company records

Too much emphasis was put on the study conducted without adequate use of supplementary information available with the industry, e.g., Periodical monthly monitoring, and annual medical check up, occupational data. The data from the periodical medical examination and the monthly urine examination for protein urea, mercury level, etc., were presented but not correlated. These need to be reviewed in greater detail.

5. Absence of Exit interviews

Even though the 'turnover' of workers seemed to have been large, the management does not seem to have had 'exit interviews' which would have helped to determine whether 'health reasons' were an important component of the decision to leave the job.

6. Averages highlighted without range

The significance of the results especially values of urinary mercury were given without any indication of standard deviations or 95% confidence limits. The significance of the results could therefore have been assessed if standard deviations are also shown. Averages are important but range of data within averages is also crucial.

7. Further analysis of individuals with higher urinary mercury levels needed

- The presentation highlighted the urinary mercury levels of ex employees, present employees as well as other workers. Some levels did exceed the prescribed levels. Who were these? What was the exposure? What were the effects? What action was taken? This was not clear.
- A close follow up of employees (who showed higher levels) and their levels analysed separately would have indicated pattern of reduction. A meaningful occupational break up

like exposure versus urinary levels; or experiences vs. urinary concentrations of mercury, levels vs. sex distribution (male / female workers and distribution of Hg levels), age vs. Hg distributions: job processes vs. Hg urine distribution - would have provided clearer occupational health status of employers.

8. Quality control of Lab Tests not undertaken

The study does not seem to have followed external and internal quality control methods. The same laboratory did all tests.

9. Data to be analysed against all guidelines

The data should be looked at by existing recommended health based biological exposure limits like WHO/ACGIH, EPA and NIOSH on an individual and group basis. This study compared only WHO guidelines. The biological monitoring centred on urinary mercury level prescribed by WHO / OSHA Indian Factory Act adopting OSHA prescribed limit. Lower limits are nowadays used and this must be considered.

10. Personal environmental monitoring rather than area sampling

Finally, in the monitoring of work environment, rather than area sampling representing background mercury pollution, it would have been better to have attempted personal monitoring as a better indication of concentrations in the breathing zone of the workers. Also the details of job processes covered for air monitoring; levels existing at mercury / non mercury areas and / or environmental mercury at production / non production sections - would provide meaningful comparisons and facilitate understanding subjective concentration of airborne mercury levels at different job processes and / or sections of the factory.

Also, as factory involves glass - processing (which generally involves heat), a picture of work environmental heat parameters like DB, EB, WBGT would have provided not only the extent of heat stress (if present) but also would have given an idea of work environment air temperature which could be a crucial factor for mercury to get airborne in the environment.

Finally, while there are many other minor points that can be included in a spirit of peer review and dialogue, we concluded that,

The study seems to have been undertaken is somewhat of a hurry; without adequate focus in planning and analysis to the occupational health principles involved in such a study.

While it may have been a good beginning the analysis of the data must be done more carefully, perhaps with some involvement of external peers and advisers who can help this process - so that a more sound analysis of the problem can be made to help get further clarity on the situation.

To begin with a circulation of detailed report of the study including objectives, materials and methods, efforts at standardisation, findings and analysis and discussion of findings should be done immediately in a true spirit of transparency and accountability.

Occupational health hazards are not uncommon even with the best of efforts. The only way forward to improve and protect workers health is to begin to look at the evidence in a more interactive, participatory and holistic way so that there is:

- Clarity of the problem,
- Careful monitoring of evidence, and
- Evidence based evolution of solutions.
- HLL need to set an example of corporate social responsibility in this matter.

HLL needs to set an example of corporate social responsibility in this matter.

[A summary based on notes provided by Dr. T. Venkatesh, Dr. H.R. Rajamohan, Dr. Krishna Murthy and Dr. Ravi Narayan and Dr. C.M. Francis] Community Health Cell, 367, Srinivasa Nilaya, Jakkasandra 1st Main, Koramangala 1st Block, Bangalore - 560034

6. Preliminary assessment Done by Community Health Cell, Bangalore of persons exposed to mercury in Kodaikanal

Dr. Mohan Isaac and Dr. Praveen of Community Health Cell visited Kodaikanal on 22nd July 2001 to make a preliminary assessment of health effects of mercury amongst current and past workers of Ponds factory. 30 persons who were either current workers or ex workers of the Hindustan Lever’s thermometer factory (Ponds factory) were examined from around 9 a.m. till 5:30 p.m. on 22nd July 2001. The history taking and physical/mental examinations were focussed to assess if there were neurological/psychiatric sequelae of mercury poisoning amongst these workers. However, the specific aspects about work history, duration of exposure, previous consultation patterns for health related problems, current occupational history, etc. were obtained as part of the general history and the general examination was done on all the persons. The following are the findings of this preliminary assessment. Although specific neurological problems such as tremors of the hand, tongue and eyelids,

Total subjects examined - 30	
Males	25
Female	5
Age range: 24 - 49 years	
Prominent health problems found	No. of persons
Gum & teeth problems (such as bleeding gums, inflammation of gums shaking and falling of teeth)	9
Skin problems (especially in the lower and upper extremities)	5
Non-specific functional (Psychiatric) symptoms	9
Infertility problems	2
Renal problems	2
Gastrointestinal tract disorders	3
Recurrent depression	1
White discharge p/v (non-organic)	1

difficulty in balancing and walking, etc. and psychiatric symptoms such as mood fluctuations, irritability, memory loss, hallucinations, etc. were looked for specifically, none in this

group of 30 subjects were found to have major neuro-psychiatric problems. One person who had suffered from recurrent depression appeared to have a unipolar depressive disorder perhaps not related to mercury exposure. However, many people were found to have gum and skin allergy-related problems that appeared to be due to exposure to mercury. Few persons with infertility and renal problems also were detected. What is most interesting is that most of the 30 subjects interviewed reported to frequent taking of leave due to a variety of health problems while they were regularly working in the Ponds factory. Of the 30 subjects examined 12 persons had resigned from their job after varying periods of work in the Ponds factory and all of them attributed their resignations to health factors.

The preliminary assessment of a random number of 30 workers exposed to mercury at the Ponds factory indicates that there is a need to assess all the exposed workers in greater detail for health effects of mercury. It is suggested that all the workers (past and present) be assessed for health effects of mercury initially and if there is any evidence for the need for further assessment a more detailed community survey of the population around the Ponds factory be carried out.

7. Greenpeace statement on Health and environment assessment (Summary)

Mercury use

The HLL Report itself demonstrates mercury contamination at the factory site as well as outside it. Contamination Levels outside the factory in the environment of the shola forest were measured at 600-800 times permissible limits of .01mg/kg in soil. (No readings were provided for any tests from inside the factory!). HLL estimates the loss to environment from the site at 559 kg of mercury lost by vapour or effluent and leaching (over 18 years). The company's contention that this has no impact on human or environmental well being places the burden of proof on the affected community, even though the community was denied information that may establish its case.

The Report of May 01 claims that 110 tons of mercury was used to produce 165 million thermometers. After a year of persistent queries by the community, the company in its report of June '02 admits that it had failed to declare 10 tons of mercury used in the production. This 10 tons was a part of 16 tons purchased locally, in addition to 120 tons of mercury that was imported largely from the US or Spain. At the submission of the first Report the Consultants could not have been ignorant of the 10 tons as 5 tons of the same lot of locally purchased mercury had been declared as used.

This would imply an addition of 10 tons lost to the environment. However, the Consultants who had in the first Report assured us that after "an exhaustive review and collation of the recorded number and types of thermometers dispatched from the site and their contained mercury", they reported that 110 tons of mercury was exported in finished thermometers. Now with the new "discovery" of 10 tons more mercury used than earlier declared, the Consultants have also discovered that the actual content of mercury in exported thermometers was about 10 tons more than earlier estimated. This discovery, as pointed out above were not an inadvertent oversight but a calculated attempt to falsify critical infor-

mation, compounded by a feeble attempt to cover up an original lie.

Waste

In the first Report the company says that 146 tons of broken waste glass (with 6% mercury) was recycled onsite recovering 10 tons of mercury. The remnant glass contains between 1-0.15 mg/kg of mercury.

The report also mentions that 40 tons of this recovered glass was buried by the company on the slope leading into Pambar shola and has been recovered and stored at the factory. The Report also admits to 98 tons of this partially recovered glass had been sold to recycling units in the past.

The second Report however admits that only 68 tons of broken glass was processed. Therefore of the 98 tons sold across the South, only 28 tons was recycled glass with 1-0.15 mg/kg of mercury and the balance 70 tons contained 6% mercury. Thus the amount of mercury sent offsite contains not 461 kg of mercury, but about 4 tons.

Another anomaly noticed between the two Reports is that whereas there was only 20 kg of mercury reported in sludge in May '01, the June '02 Report claims there was 593 kg of mercury in the sludge.

Mercury dispersal at site

The Reports calculate mercury emission at the factory with a measure of vapour readings, which they claim were maintained below .03mg/m³. The reading (one) is according to the workers taken once a day after closure of shift and from any point within the factory. As such it cannot represent a true picture of mercury emitted during the work process. This aspect of emission estimation is dealt with in the section on the Medical Report.

It is curious that this reading is taken as a basis of calculation, when a much more direct and reliable method exists.

There is 288 tons of broken glass with mercury, measured at 6%. However a mercury thermometer contains 13.5% of mercury. If 6% remains, the remaining 7% needs to be accounted for.

This would imply that 288 tons of broken glass contained 13.50% mercury, but 7.5% of the mercury has been lost in collection, handling and storage over 18 years. This calculation indicates a loss to environment of over 20 tons from this part of the production process.

Medical Surveillance

This section describes vapour levels measured, on the basis of which emission levels are estimated, as also impact on worker's health. At the outset it must be noted that the company's claims of having a functional Health Officer and Safety Committee are false. Not a single minute of the Safety Committee describing safety measures to be taken exists. The Safety Committee met on occasion, and the subject of discussion was methods of increasing production. The requirements of the functioning of such a committee under the Factory Act for a unit using hazardous material were not observed.

According to the workers, a reading was taken at the end of a day from sections neither of the factory but neither from the specific points, nor at the time of maximum potential exposure during each shift. The readings recorded therefore do not reflect exposure actually

received by workers during shift. In this respect a study provided to the company by the supplier of mercury, Bethlehem Apparatus Co., on " Safety and Health Practices for working with Metallic Mercury" has this to say:

"Work Environment Monitoring: There has always been a difficulty in correlating measured exposure levels to mercury vapour with biological measurements of mercury absorption except where data is analysed on a group basis. Most studies that correlate biological levels with air levels are based on area vapour measurements. However, when there is a potential exposure to metallic mercury, personal contamination can result with the formation of a micro-environment of mercury vapour around a worker's breathing zone which is several times higher than that of the general work environment."

The Report bases its entire estimate of emission on measurements said to be lower than 0.05 mg/m³, collected once a day, after the shift is over, from any corner of the facility.

It is not at all clear that the necessary formalities for detection of effects on health were undertaken other than urine/blood readings, which in themselves are an inadequate guide to the nature of contamination. The EU Review of Mercury provides the following caution:

"The poisoning nature of mercury is well acknowledged (IPCS 1991; Ishihara and Urushiyama, 1994). But less known are the effects of mercury on humans as a consequence of long term exposure to low concentrations. In many cases the use of biomarkers, such as Hg concentrations blood and urine, are not sufficient to assess the internal doses and potential effects on the central nervous system, kidney, the immune system, and other possible effects. Therefore, better scientific understanding of risks to human health, especially to those citizens living close to potentially dangerous sites, is needed. Therefore other biomarkers than mercury measurements alone should be used. An example is N-acetyl-glucose-aminidase (NAG) and other low molecular weight proteins in urine, which seem to reflect effects at low-level exposure to Hg. There is a need for continuous research, and for example, markers of oxidative damage could be tested." (EU Review of Mercury, Chapter: 5 Page: 8)

and,

"At low-level elemental Hg exposure, blood Hg poorly represent information on current and past Hg exposure. A separation of whole blood into its plasma and erythrocytes fractions permits better discrimination will, of course, be more correct using speciation of mercury in blood." (EU Review, Ch 5 p. 5-6).

There is no evidence that any such examinations were conducted by the company or the Public Health Officer, whose responsibility it is to monitor health and environmental impacts from industrial units.

The company could not have been ignorant of symptoms reported by workers, many of which are recorded as known symptoms of mercury poisoning in the document supplied to the factory from its supplier of mercury, Bethlehem Apparatus Co., ("Safety and Health Practices for working with Metallic Mercury") which note the following symptoms among others (p. 3):

"Inhalation: Inhalation of high levels of mercury vapour may cause almost immediate dyspnea, cough, fever, nausea, vomiting, diarrhoea, headache, ... Symptoms may resolve or may progress to necrotizing bronchiolitis, pneumonitis, pulmonary edema... Acidosis and renal damage may also occur ...Concentrations as low as .03mg/m³ have induced psychiatric symptoms in humans. ...Other effects may include salivation, gingivitis, stomatitis, loosening of the teeth, blue lines on the gums, ...speech and sensory disorders, unsteady gait, chronic pneumonitis, and mild anemia. ..."

It may be noted that according to the workers health effects noted by them during medical examinations was not recorded. The reports of health checks received by some workers demonstrates that persistent and visible problems such as bleeding gums, skin patches, eye irritations etc were not noted in the histories of their medical records, indicating that the records would not be very helpful in arriving at an understanding of the extent of impact.

Issues arising from 1) Vacuuming broken glass, 2) Scrubbing of floor with water, 3) absence of safety masks or gloves, 4) urine tests raise further issues regarding safety measures in practice, and these must be read in conjunction with the account provided by workers of standard shop floor practices followed by the company, especially the level of information imparted on safety requirements and procedures.

It may also be noted here that the company had no accident preparedness plan, or had given no intimation of such a plan to the town authorities.

Impact on forest

This section describes the location on the crest of the hill with Pambar Shola to the East and Kodi Lake and town to the West and North. Both vapour blown out by the fans and natural drainage of water make these areas recipients of mercury. The nature of the forest, a tropical montane forest maintains a moist layer of humus all year. The potential for this layer to be host to methylation of mercury has not been examined. In this respect it would be useful to note the observations offered by the EU Mercury Review.

"Contaminated sediments at the bottom of surface waters can serve as an important mercury reservoir, with sediment-bound mercury recycling back into the aquatic ecosystem for decades or longer. Mercury has a long retention time in soil and as a result, the mercury accumulated in soil may continue to be released to surface waters and other media for long periods of time, possibly hundreds years." (EU Review, Ch. 1, p. 3)

The document describes the role of organic matter in binding and releasing mercury over long periods of time:

"Increased concentrations of metals in forest soils, especially in the mor layer, imply risks of adverse effect on vital microbial processes and indirectly, of disturbance of ecosystem functioning. Most of the decomposition of organic matter takes place in the mor layer, including the release of nutrients important for maintaining the productivity of forests. Most plant roots are also found in the mor, which moreover is the most important soil layer for organisms that form the base for food chains ending in mammals and birds. Disturbance of the functioning of the mor may therefore have considerable eco-

logical consequences that may be difficult to prognosticate without a thorough knowledge of the entire system. Preliminary critical limits to prevent ecological effects for mercury in organic soils has been set to 0.07 - 0.3 mg/kg for the total content in soil by an international expert group on effect-based critical limits for heavy metals working within the framework of UN ECE Convention on Long-range Transboundary Air Pollution (CLRTAP), (Curlic et al.2000).” (EU Review, Ch. 1, p.7}

Therefore, the HLL Report’s suggestion (sec 3.2) for use of limits set for industrial urban areas of Europe of 10 mg/kg and above in soil requiring a cleanup, may not be appropriate in this situation.

Mercury distribution offsite

The Report observes that “There are slightly elevated concentrations of mercury, up to 2.5mg/kg, over the whole site...” Average soil concentrations of mercury in soil are generally 0.02-0.625 mg/kg (Alloway 1990, WHO 1989). Levels of 2.5mg/kg are 4 times the upper ends of this range. Soil values within the site have been found as low as 0.1 mg/kg (BS-2), and if this is assumed to be uncontaminated then the 2.5mg/kg limit is a 25 times elevation over the lowest reading, and 250 times permissible limits.

It must be noted that this contamination is the result of mercury carried by vapour forcefully blown out by fans, and there is no reason to suppose that these levels did not carry to the surrounding environment.

The sediments LP5 and DFE (samples) are highly contaminated, indicating significant discharges of mercury from the site via this runoff point. 110mg/kg are over 300 times the upper limit of typical uncontaminated sediments (0.35mg/kg). As these levels are in the top layer of soil, carryover of mercury containing particles from this location into the Pambar forest area would be expected.

The samples from the edge of the lake contain low levels of mercury, but sediment from the lake bottom was not analysed. If the lake receives mercury via runoff or deposits from air they would be expected to end up in the lake sediments (a prime location for methylation to occur). The low level of mercury in the water (<0.0003mg/l) are no indication of the amount of mercury that the lake has received as mercury will tend to bind to sediment particles and settle to the lake bottom.

For background comparison, uncontaminated freshwater typically contains less than 0.005ug/l = 0.000005 mg/l (ATSDR 1997), so the detection limit of 0.0003 mg/l (60 times the background value) is too high to give a helpful result. These arguments also apply to the samples from the Kumbakarai Falls. It is also curious that no samples were collected from other parts of Kodi town such as the opposite hills of Observatory Rd to the West, or Vattacanal to the East, to examine the extent of dispersal.

Methyl mercury results

The results strongly suggest that methylation of released mercury is occurring. Sample DFE-05 has 85mg/kg total mercury and 0.126-mg/kg methyl mercury, compared with DFNE-05 has 6mg/kg total mercury and 0.0008-mg/kg methyl mercury. These samples are from the same

area and both described as surface sediments.

The report claims that,

“All methyl mercury analyses indicate concentrations so low that they do not constitute either a health or ecological risk”.

If the lowest value obtained for this report is used as a background figure (surface sediment SRA; 0.0001mg/kg) then sample DFE-05 is elevated by a factor of 1260!

The Report’s contention that methylation is not a serious risk is highly questionable, and in view of the forest and lake ecology described above, it is apparent that the process of methylation is well underway, and presents a persistent danger to this sensitive watershed.

Conclusion:

The first observation that must be emphasized is the lack of transparency and basic integrity displayed by the company in a series of lies, misrepresentation of facts, and deliberate falsification of critical information. Here is a clear instance where reliance on Voluntary Disclosure by corporations is taken by industry as an assurance against discovery, and a license to pollute, with no consequent responsibility for damage caused to the workers, communities, and the environment.

This is also a clear instance where lack of public awareness engendered by the failure of the company and statutory bodies to inform the public of the nature of the toxics to which they have been exposed. It is also a reflection of the ineffectiveness of statutory bodies concerned with monitoring toxic emissions in discharging their duties; much less demonstrate a concern for impacts on public health and environment. Mandatory public declarations of toxics used or generated by industry are an essential tool for the community’s right to protect its own health and environment.

Evidence largely gathered from sampling by the company, from information given or omitted by the company and testimonies of community members, indicates that there has been significantly higher contamination emanating from the plant than the company would have us believe. It is also obvious that the workers were in the pathway of that contamination, and according to the company records, significantly enough affected to require shifting to non-mercury areas of work, and that the environment was inevitably the recipient of both vapour and effluent bearing mercury emitted from the factory.

The company must therefore be held responsible for damage to the health of the workers and community, and lasting damage to the environment, and must be held liable for costs of discovery of health and environmental impact, including long term monitoring of both, their remediation, and compensation for loss of quality of life for all those affected.

OBSERVATIONS OF THE PANEL

A total of 160 ex-workers of the former thermometer factory, four members from the TNPCB, Dr. Mohan Isaac, NIMHANS, Bangalore, representatives from Community Health Centre (CHC), Bangalore, NGO representatives and hundreds of other citizens of Kodaikanal attended the public hearing.

OBSERVATIONS ON FACTORY WORKERS' HEALTH CONCERNS

Interacting with the 160 ex-workers who attended the public hearing, the Panel learnt that among them 65 served in HLL as well as Ponds Limited, 48 workers served only in Ponds and, 47 served in only HLL. In the meeting, each worker was given time to present his/her health problems. The ex-factory workers brought with them medical records, prescriptions, X-rays, and MRI scans.

The panel noticed that many workers still had tremors and showed slow responses unlike normal individuals.

Surprisingly, most workers were unaware of the hazards of mercury while they were working. According to the workers, the supervisory staff of HLL at no point in time discussed the hazards of mercury. Also, the workers could never imagine that the place where they earned their bread and butter was also the place that was detrimentally affecting their health. It is understood that the supervisory staff showed apathy to the health problems of workers. Many workers carried home mercury in their shoes, clothes and in their bodies. Most workers said that they have never been medically examined by HLL doctors at all while very a few said at times they were removed from the mercury areas for a while after a medical examination and re-shifted after a few days.

OBSERVATIONS ON WORKERS TESTIMONIES

The panel had the opportunity to question workers and even in some instances take a hand count on health issues so as to collate some of the information that was being provided by individuals. The oral testimonies collected from dependant members of the 10 deceased workers have clearly displayed a pattern including the following details:

The average age of the deceased was 32 years. Only 5 of the deceased had minor vices including occasional consumption of alcohol and tobacco. All of them were in good health till their employment in the thermometer factory and subsequent exposure to mercury in both vaporised and frank form.

Symptoms of poisoning:

Persistent Headaches	6
Nausea	8
Oedema	6
Respiratory disorders	3
Lack of appetite	8
Stomach disorders	9

Final prognosis and disease, including cause of death medically recorded: (several of the victims suffered multiple diseases and disorders leading to death):

Liver disorders/ Blood disorders	2
Brain disorders	1
Kidney dysfunction	6
Breathing / respiratory disorders	5
Cardiac disorders	4

Several workers have also related on camera, details about the clothing being contaminated and going home after work hours taking the contamination home on their person and even in pockets to their families, seriously endangering the health of the family and the community. Medical assistance to workers has not been consistent and till date none of the workers appear to have received any consistent health information, medical reports of either tests or financial help from the management. This includes women workers who were also exposed to high levels of mercury and record several health problems related to conception and menstruation. Several male workers have also been declared sterile, including a canteen worker who had to undergo fertility treatment. Oral accounts of workers children being born to both sexes with severe health and birth defects and problems including mental retardation, mutations, heart disorders, poor health and respiratory disorders have been recorded.

Oral testimonies given by head count and raising of hands at the IPT hearing provided the following details of worker health and common symptoms displayed by them:

Dental/ gum problems	100
Have headaches (then and now)	100
Memory loss	83
Vision	78
Spinal problems	111
Stomatitis/ ulcers	76
Nasal bleeding	13
Skin diseases	45

The Panel visited the HLL Thermometer Factory on September 2nd 2002, after reading the report that was provided to IPT by Mr. John George, the current factory manager. We made a second visit on September 3rd 2002, to check facts directly from the factory. We inspected the factory premises even though it had been shut for 2 years. Apart from what we

observed at the factory premises and what we learnt from the people present at the public hearing, we would like to comment on the two reports that HLL handed over to us, namely,

1. Report on Environmental Analysis
2. Report on Medical Surveillance

1. OBSERVATIONS ON HLL REPORT ON ENVIRONMENTAL ANALYSIS

The environment assessment report entitled "Health and Safety Plan - Site Remediation HLL Thermometer Factory Site, Kodaikanal, Tamil Nadu" provided by Mr. John George, Manager, HLL Thermometre Factory, Kodaikanal to the Panel minutes prior to commencement of the public hearing on the 2nd September 2002, at Boat Club.

Mercury: Fate and Behaviour in the Environment

Before discussing the HLL report it becomes essential to know about the behaviour of mercury and its impact on the health and the environment so as to understand the long-term implications of mercury in the environment. Mercury is an extremely toxic, non-essential metal having no biochemical or nutritional function. Mercury is the only metal that can exist as both liquid and vapour at ambient temperatures. In the atmosphere, elemental mercury is the most common form and it is in this vapour form that it is responsible for a long-range global transport. Mercury enters aquatic and terrestrial systems from the atmosphere primarily in an organic form. However, under conditions that favour bacterial sulfate reduction, inorganic mercury is methylated to methyl mercury, a potent neurotoxin that accumulates in fish. In the aquatic environment mercury gets bound to particulate organic material. Hence, bottom dwellers in fresh and marine aquatic systems get readily exposed to mercury contamination. Those organisms that depend on the bottom dwellers get exposed to mercury. Once it enters the living body, the biological mechanisms for its removal are extremely poor. Furthermore, unfortunately, mercury is the only metal known to accumulate and biomagnify in the food chain. When inorganic mercury is released in the environment, microorganisms present in soil, water and sediments can convert in to methyl mercury through a process of methylation. Wetlands, Lake Sediments and bottom waters that have depleted oxygen levels are three locations where methyl mercury is rapidly formed as a by-product of bacterial sulfate reduction. The methyl mercury is highly soluble, mobile and toxic, and it can readily enter the food chains. In comparison to mercury, methyl mercury bioaccumulates more rapidly since it is more liposoluble, has long biological half-life and increased longevity in top predators.

Toxic effects of Mercury to human health

The toxic manifestations of mercury depend on the mode of exposure. Acute inhalation of mercury vapours, which generally happens in occupational exposure causes a number of health problems. These include nausea, vomiting, skin allergies, increased blood pressure, bronchitis, pneumonitis and effects the central nervous system causing tremors, spasms, loss of memory, depression, hallucinations and personality changes. Chronic exposure to workers results in kidney damage. Methyl mercury is more toxic than mercury in its elemental form. The Minamata disease in Japan was due to the ingestion of methyl mercury contaminated seafoods at the Minamata Bay. The poisoning led to 111 deaths. The second incident occurred

in Nigata, Japan where 120 people were poisoned. In Iraq, 459 people died due to methyl mercury poisoning in 1971-72. Methyl mercury is highly lipophilic and readily crosses the blood-brain and placenta-foetal barrier. The exposure to methyl mercury results in permanent damage to the central nervous system, kidney and developing foetus. During prenatal life, human beings are susceptible to the toxic effects of high methyl mercury exposure because of the sensitivity of the developing nervous system. Methyl mercury easily crosses the placenta and the mercury concentrations rise to 30% higher in foetal red blood cells than in those of the mother. Methyl mercury appears to show strong teratogenic, carcinogenic and mutagenic activity. (For more details see the fact sheet on mercury, annexure no.3, page no.42).

Coming to the report,

In addition to the report submitted to us on the day of public hearing, we came across another HLL report on environmental analysis that had far more depth than the report it had provided to IPT. It is intriguing why HLL had two reports on the same issue and why it chose to provide IPT a report that had fewer samples analysed. Nevertheless, it becomes the Panel's prerogative to examine deviations and make comparisons of both reports and arrive at logical conclusions.

A.1. Disproportionate onsite and offsite sampling

The report primarily focuses upon mercury contamination around the HLL factory premises. As said earlier the HLL has prepared at least two reports on the environmental assessment of mercury. In the report provided to IPT the total number of onsite samples were 79 while the offsite samples amounted to 28, which indicated 73.8 % and 26.2%, onsite and offsite respectively, of the percent analysed samples. The other report that was prepared by HLL showed 77% onsite samples and 23% offsite samples, however the total number of samples was 476 with 367 onsite and 109 offsite. Sample size mentioned in both the reports suggests that less efforts have been made to investigate the mercury contamination around the factory. We find that the sample size is very low in offsite areas (larger area) which is statistically wrong in conducting any scientific assessment. It appeared that there was no planning in collecting offsite samples so that results obtained could be inter operated to draw conclusions about the status of mercury contamination around HLL factory in Kodaikanal. In fact more intensive sampling should be done offsite to know about environmental contamination.

There is very little to suggest that an environmental impact assessment was carried out to ascertain mercury contamination offsite, since both the type and number of samples including soil samples (inconsistency in depth profile) mentioned in the report, are insufficient to indicate that the report represents an environmental assessment of mercury pollution around Kodaikanal.

A.2. Discrepancy of test results between laboratories

The report shows very significant inter-laboratory variations in the test results of similar sample types. The question that arises here is which laboratory's values are authentic and why has there been so much variation between the two "reputed laboratories".

Interestingly, the report provided to IPT had most of the analytical test results of MGT Environmental Laboratories, Melbourne, Australia while very few results were mentioned in the Hindustan Lever Research Centre (HLRC), Mumbai and most HLRC test result columns were blank. In Contrast, the other report that HLL prepared indicated test results from both laboratories - HLRC and MGT. In most instances, in the test results there were several differences between the test results of similar sample types in the HLL report provided to IPT. A comparison of both the test results from the two reports indicates manifold differences between the analytical test results of the two laboratories in similar samples tested. It becomes very difficult to ascertain the exact amounts of mercury since the two laboratories indicate mercury concentrations that were very different from each other.

A.3. Soil samples

In the HLL report provided to IPT, a total of 66 onsite and 13 offsite soil samples were analyzed, which represents 83% onsite and 17% offsite soil samples. With such a disproportionate ratio in the sampling, the report cannot conclusively state that the offsite areas around HLL factory are not contaminated with mercury. In the report provided to IPT it was observed that the soil sample CD-05A showed 14mg/kg mercury from the MGT laboratory testing while the column was blank for the HLRC test results. However, in the other report, test figures of HLRC and MGT laboratories are available; the figures in the report indicates 67.8mg/kg mercury from HLRC laboratory and 14mg/kg mercury from the MGT laboratory in the soil sample CD-05A. There is factor of 4.8 fold difference between both the laboratories. Similarly, such a disparity was observed for a number of soil samples. There are also no details of depth profile about the exact site from which the soil was collected. Almost no samples were collected from the Pambar Shola forest. The locations of offsite sampling location were not well planned based on the wind rose diagram (refer figure 3 & 5-6). No sampling points are located in NW-NNW and SE directions where the maximum wind speed is shown in the wind rose diagram of Kodaikanal. There is also inconsistency in the depth profile about where the various soil samples have been collected from for analysis of mercury.

A.4. Sediment samples

A total of 15 surface sediment sample analyses are mentioned in the report, 8 onsite and 7 offsite samples. The sample DD shows 73mg/kg mercury from HLRC laboratory while 270 mg/kg from MGT laboratory, which is 3.7 times more than HLRC laboratory. The results of the sediment sample analyses from the two laboratories varied between 2.6 to 4.4 times. Thus it becomes very difficult to decide which result to consider.

The analysis of bottom sediments would be more appropriate to ascertain mercury contamination. Mercury has a strong tendency to settle below and associate strongly with bottom sediments. In water bodies that have depleted dissolved oxygen concentration, mercury gets transformed to methyl mercury by bacterial action. Bottom dwelling organisms (benthos) are exposed to mercury and methyl mercury contamination. A food chain involving these bottom dwellers would result in contamination of the entire ecosystem.

A.5. Water samples

The report indicates a total of 11 water samples, which includes 5 onsite and 6 offsite water samples. However, table 3 in the report indicate results of the analyses of 15 water samples. Except for two samples, the remaining 13 water samples do not show precise quanti-

ties of mercury concentrations, but only approximations. The report does not mention the name of the laboratory that conducted the tests. In the other HLL report, the water sample BRW shows 0.085mg/L mercury in the MGT laboratory analysis while the same sample showed 24mg/L mercury in HLRC analysis. There is a 282 times difference between the analytical results obtained from the two laboratories. With just one sample from the Kodai Lake taken for examination, it is statistically incorrect to suggest that the lake is free from mercury pollution.

A.6. Lichens

The report indicates a total of 2-offsite lichen samples tested for mercury contamination. Lichens are good indicators for ambient air mercury pollution. It would have been more appropriate if onsite lichen samples were analysed to ascertain mercury contamination and make a comparison with offsite lichen mercury concentrations. No information is available about the height at which the sample was collected and what was the age and species of lichen species as these factors are very important. Further, the outcome of testing two samples does not hold any meaning or is statistically insignificant to suggest that there has been/not been any sort of mercury contamination in the vicinity.

A.7. Methyl Mercury Analysis

The analysis of methyl mercury has been downplayed in the HLL project report. Lake bottom sediments and benthos organisms have not been analysed for this deadly neurotoxin compound. The bottom sediments, bottom dwellers and fish would be ideal choice for methyl mercury analysis rather than surface sediments and a few soil samples in the vicinity of the factory. There is no mention of analysis of fish samples for either the elemental mercury or organic methyl mercury. Further, the methodology employed for methyl mercury analysis has not been mentioned in the report.

Conclusions:

In general, the report as such seems to be very ambiguous, unprofessional and lacks seriousness in its approach to analyse mercury pollution. HLL survey has been done without any proper thought process going into its making and its usefulness in the future. The survey lacks both planning and authenticity. The type and number samples collected hold the key for an assessment study. The number of samples too few and there is a huge variation in the test results between laboratories. We would like to put down the following drawbacks of the study.

The drawbacks of the HLL report are: -

1. Sample size, especially for sediments, water and lichens is inadequate to suggest a relatively low or moderate mercury contamination in the vicinity.
2. Samples have been mentioned in an abbreviated form and one cannot ascertain its relation to onsite location with context to mercury and non-mercury areas.
3. There is no mention of the name, model or sensitivity of the instrument used in the analyses.

4. The methodology that the laboratories adopted for testing mercury and methyl mercury is not disclosed in the report. Report also does not disclose the % recovery of mercury from standardized method.
5. There are significant inter-laboratory variations in the test result values of the same sample type in most instances.
6. On the whole, the study is incapable of assessing mercury pollution. More offsite samples like fish, and benthos organisms, lake-water, lichens (onsite and offsite samples) and other soil indicators of mercury pollution have to be considered to assess mercury pollution. Methyl mercury analysis has been downplayed in the report.

Recommendation:

We recommend that the survey to be commissioned to some other laboratory with adequate expertise in the principles of environmental pollution monitoring and assessment. Sample type, size and specific site go to making of an authentic report. The HLL could commission the environmental assessment part of the work to IICT, Hyderabad or ITRC, Lucknow as they have the expertise in monitoring heavy metals, VOCs and pesticides in the environment. More important than the laboratory is the importance of doing an authentic study.

2. OBSERVATIONS ON HLL REPORT ON HEALTH SURVEILLANCE

The health data presented in the report presented to IPT mentions 129 employees have been tested for mercury concentration in blood and urine and the report results indicate that employees are free from mercury contamination.

However, the medical surveillance does not indicate the basis of sample selection. The following lacunae are observed in the report: -

1. **Sampling procedure:** It is difficult to ascertain from the report whether the tests were mandatory to all factory workers or only those who volunteered which in epidemiological parlance can be referred to as "grab" sample.
2. **Absence of occupational record:** one cannot ascertain the length the employee worked in the factory, as the report makes no mention of it. Quite understandably, employees who worked for a longer period would be more affected by the longer exposure period than those who worked for a shorter period. Therefore, the record on the period of occupation is very significant in such an analysis.
3. **Methodology:** The medical surveillance part of the HLL report provided to IPT does not indicate methodology, the make of the instrument, model and sensitivity of the ICP employed to carry out each of the tests to monitor mercury. Further, there is no mention of the method employed to test blood and urine mercury levels. Also, the methodology and frequency of ambient mercury monitoring is absent.

4. **Statistical Analysis and Tables:** The report does not show any specific tables indicating the range, standard deviation and standard error for mercury values in blood and urine. The results of the employees are merely summed up to a conclusion that no employee has been affected by mercury contamination. The results without showing the range can not be said to be authentic. A summary table of the employees' medical surveillance is essential to interpret and conclude whether there was a health problem.

We had asked the HLL factory manager for a few documents pertaining to medical check-ups, environmental survey and customs import document for mercury over the years. Initially, the HLL factory agreed to provide these documents **but at a later stage, the company declined to provide these documents to the IPT panel.**

We wish to add that doctors of the Community Health Centre (CHC), Bangalore, too have had similar experience as IPT members. The team of HLL doctors, who represented the HLL factory with the "peer review" of a study on workers in HLL Thermometre factory in Kodaikanal were unwilling even to send the copy of the slide presentation made at CHC on mercury exposure to employees. They initially agreed to send to them a copy of the slides. But despite constant reminders, no slides were sent to them. Usually a presentation with slide projection involves presentation of an unlimited number of slides in a short period of time. For a careful scrutiny and understanding of the presentation, normally the presenter obliges interested audience members to have a closer look at the slides. It's a normal practise in scientific presentations. It is intriguing why the HLL doctors were unwilling to part with photocopies of projected slides that were requested by the CHC team.

Environment and Health Linkage

The health impact of elemental mercury is a reflection of the environmental study. The results of the HLL environmental study are filled with blanks. This sort of a result cannot be used to conclude that people have not been exposed to mercury contamination. The two laboratories (HLRC and MGT) that were involved in testing samples give divergent data. The MGT laboratory shows extremely high levels of mercury in most cases while HLRC shows moderately low levels of mercury in the same sample types. Considering these, we find that the study done by HLL is incapable of assessing the health impact of elemental mercury in Kodaikanal.

Ambient Air Monitoring

The HLL report indicates ambient mercury monitoring in the mercury area using a gold film called **mercury vapour analyser**. This methodology adopted for monitoring ambient mercury and the sensitivity of the instrument used is not mentioned in the report. The report mentions that the intention for monitoring ambient mercury is to control mercury in the atmosphere to 0.05 mg/m³. This value is equivalent to 50 $\frac{1}{4}$ g/m³. Furthermore, the report mentions that spot reading indicates 0.480 mg/m³, which is equivalent to 480 $\frac{1}{4}$ g/m³. This value is more than 9.6 times higher than 0.05mg/m³ and 4.8 times more exposure than 100 $\frac{1}{4}$ g/m³ that affects CNS. Hence, the interpretation of the HLL suggests that the ambient mercury is exceedingly higher than what the company had desired to maintain. It is quite clear from this that the **employees were exposed to severe ambient mercury levels that are known to have severe health implications.**

In a review by the United States Environmental Protection Agency (1997), accidental exposures to high concentrations of mercury vapour (Fagala and Wigg 1992) as well as chronically exposed to potentially high concentration (Ehrenberg et al 1991) have shown effects on a wide variety of cognitive, sensory, personality and motor functions. In general symptoms have been observed to subside after removal of exposure. However, persistent effects like tremors and cognitive deficits have been observed in occupationally exposed subjects between 10 to 30 years after exposure (Letz et al, 2000; Mathiesen et al. 1999). Studies of workers exposed to elemental mercury vapour have reported a clear increase in symptoms from the CNS at exposure levels greater than 0.1 mg/m³ (100 µg/m³) of mercury poisoning at levels. Self-reported memory disturbance, sleep disorders, anger, fatigue and /or hand tremors were increased in workers chronically exposed to an estimated 0.025 mg/m³ (urinary and blood levels mercury levels of 25 µg/g and 10 µg/L (0.010 mg/L, Langworth et al. 1992). Tremors were reported in long-term exposure relatively low concentration of mercury vapour. (For more information on health effects, please refer to annexure no.3,page no.42)

Conclusion

The medical surveillance mentioned in the report is far from complete. The analysis of whatever little information that HLL has provided to IPT indicates moderate to severe exposure of employees to ambient mercury. The former workers' claims of poor health are not baseless. The evidence from researches carried out from the developed countries on health effects of ambient mercury levels corresponds with the health problems of occupationally exposed populations of HLL factory. The Panel found that the ex-workers of HLL thermometre factory suffer from occupational health problems.

CONCLUSIONS OF THE IPT PANEL ON KEY ISSUES

It may be noted with regret that M/s HLL were not present at the Hearing in order to clarify some questions that arose out of their Reports and correspondences, that have a direct bearing on critical matters of emission of mercury and affect on people and the environment over a long period of time. The company had been given the opportunity to explain these issues subsequent to the Hearing and they refused to be present at the Hearing.

There are three major points that arise out of the current investigation, which may have an immediate impact on public health and environment and are therefore brought into focus at the outset.

The first issue relates to the attitude of the company towards statutory authorities, and its admission in the June 2002 Report that its earlier (May 2001) declaration on the total quantum of mercury used over 18 years was understated by 10 tons. Given the figures mentioned in the May 2001 Report, this would imply an additional release to the environment of 10 tons. Customs, import, annual declarations etc need to be studied to arrive at an accurate estimate of the amount of mercury emitted from this site, though the true figures may never be known. However, from the material at hand it is apparent that there was scant regard for the dangers involved in the dispersal of mercury from this site.

The second issue is the amount of mercury dispersed through the South to recycling merchants. There may be about 4 tons of mercury in such glass instead of the 461 kg estimated by the company and the impact may need to be re-evaluated at points of sale or destinations of broken glass.

The above two points, combined with a number of other lacunae in the presentation of information to the Hazardous Waste Committee of the TNPCB, or the former workers or the community, show that the company has not been candid in its revelation of information.

In this regard it would be remiss of the Panel to refrain from noting that the manner in which information has been presented, the contradictions in the statements and subsequent reworkings of the mercury balance, indicate a concerted attempt to misrepresent with incorrect declarations the true facts in this matter.

RECOMMENDATIONS

The government must ensure that in view of the seriousness of the issue and to uphold the integrity of statutory authorities, the company is held responsible for the false declarations made by them before the PCB in matters of substance that affect public health and environmental security.

An independent assessment to be made of the documentation with the company regarding practices in the plant and the impact on health of workers, permanent and temporary to verify the company's claim that no worker has ever been affected. The panel also recommends that the affected community raise the issue with the State Human Rights Commission to

ensure that their rights regarding information, records, health and loss of quality of life may be addressed.

An independent assessment may be made of the spread of mercury in the Kodaikanal area as well as sites in the South to which waste had been sent in the past for recycling.

Ensure that the remediation of the site is undertaken keeping in mind the sensitive nature of the surroundings in this important watershed.

The Panel recommends that in order to emphasise the highly dangerous and persistent nature of mercury toxicity, and the lack of adequate regulation in its use throughout the country, the company be refused permission to sell any mercury or mercury product from the plant including machinery, and be called upon to retire the same to a safe storage or recycling facility in the USA.

Dr Amit Nair
Prof. Ramakrishnan
Dr Rakesh Kumar Singh



Justice SN Bhargava

ANNEXURE I

LIST OF QUERIES MADE TO THE HLL BY THE PANEL MEMBERS

After the public hearings, factory visits, the panel found that there were many things that were still unclear. The documents submitted by HLL were not sufficient to explain these things. Therefore, the panel was forced to make some queries to the company officials. The following is the list of queries that were sent to the HLL office in Kodaikanal. They had promised the panel that they would furnish us with all documents and reply to our queries. However, at a later stage they declined to cooperate.

1. Record of visit of Factory Inspector from 1997 to 2001 and certificate issued by him and report by the company to the factory inspector regarding the recordable injury during the period 1997 to 2001.
2. Sample copy of any worker's medical report of April 2001.
3. Record of Custom department showing how much mercury in stock today, total how much received and used how much exported or sold in thermometres and how much to be accounted for.
4. Agreement between Ponds and HLL while take over particularly regarding liability if any, health hazard due to mercury use of the period before HLL took over the thermometre factory.
5. Name of the 12 ex-workers allegedly died and their medical records showing health status, illness and cause of death.
6. Whether form No. 17,18 and 27 under Factories Act 1948, of all workers are being maintained, if so copy of at least some workers.
7. Copy of periodical medical examination as per Annexe VI of your submission before the panel.
8. Copy of the Safety guideline booklet, which was to be provided to every worker as per letter, dated 15.06.200 to kodaikanal HLL employees' Union.
9. Name and qualification of the technician
10. Name and qualification (post-graduate in what area/specialist) of the doctor.
11. Record to show commissioning to URS
12. Letter from URS showing type of samples and number of samples given for analysis at the Australian lab.
13. Letter showing URS Commission to the lab at Australia.
14. Letter from URS showing addresses, email, and fax number of the Australian lab.
15. Letter from URS of the methodology adopted including models of all the equipment used.
16. Letter from URS to show payment made to the analytical firm at Australia where it is conducted.
17. Receipt of the payment from the company to URS
18. Description of sample, transport of sample, the weight of the sample and date of collection of samples. Please indicate the weight of soil, water and plant sample.
 - Soil: number and weight
 - Water: number and litre
 - Sediment: number and weight
 - Plant sample: number and species (Barch and Lichens)
19. Mercury analyser: procedure adopted for analysis of mercury in urine and sensitivity of the equipment.
20. Principle and detection limit of both the instruments that were used for urine mercury and ambient mercury analysis
21. The report which was given to CPCB
22. Location of sample stations on toposheets map (minimum scale 1:50,000)
23. Minutes of the constitution of the safety committee and any minutes of the meetings of the safety committee.
24. Records like tender, supply order and purchase receipts etc. pertaining to purchase of safety equipments.
25. Pathological reports for the last medical examination report as in the prescribed form along with the pathological report.
26. Organisational chart along with manufacturing process flow chart.
27. The total number of ALL people who have been employed for at least 2 months as casual or permanent employees anytime during the period of operation of the plant; similar number employed in the mercury section; and whether the records of medical examination exists for all of them.
28. Minutes of the meetings of the Safety committee (which is supposed to include a worker representative) that is expected to meet periodically as per the guidelines of plants engaged in hazardous materials.

ANNEXURE II

MINUTES OF THE MEETING OF THE WORKING COMMITTEE

on Mercury Contamination due to M/s. Hindustan Lever Ltd. (Thermometre Factory), Kodaikanal, Dindigul District.

Date: 11.10.2002

Venue: Environmental Training Institute class room, Tamilnadu Pollution Control Board, Chennai

Present:

Thiruvallargal G.Rengasamy	Former Member Secretary, TNPCB - Chairman
R. Ramachandran	Addl Chief Env.Engineer, TNPCB - Convenor
R. Gnanasekaran	Revenue Divl.Officer (rep. Dist. Collector, Dindigul).
G.S. Ganapathy	Chemical Industries Association - Member
M.S. Srinivasan	Vice President, Manufacturing - Member M/s.EID Parry (India) Ltd
L. Sabarathinam	Past President, Member, Madras Chamber of Commerce
Navroz Mody	Greenpeace, Member
A.R. Krishna Ram	District Environmental Engineer, Member, TNPCB, Dindigul
Selvi Meenakshi	Palani Hills Conservation Council, Member

Invitees

Thiruvallargal A.Krishnamoorthy	Environmental Engineer (i/c), TNPCB
V. Rohit Kumar	Asst. Engineer, TNPCB
Rajesh Rangarajan	Toxics Link (Citizen Civic Action Group)

Representatives of M/s. Hindustan Lever Ltd.

Thiruvallargal Gurdeep Singh	Hindustan Lever Ltd. Mumbai
M.K. Sharma	Hindustan Lever Ltd. Mumbai
Ashok Gupta	Hindustan Lever Ltd. Mumbai
Anil Baskar	Hindustan Lever Ltd. Mumbai
Dr. Rajagopal	Hindustan Lever Ltd. Mumbai
Dr. P. Mascarenhaas	Hindustan Lever Ltd. Mumbai
R. John George	Factory Manager, HLL (Thermometre Factory) Kodaikanal
M. Paul Whincup	ERM Consultant, Hindustan Lever Ltd. Mumbai
Tom Van Tuenbroek	TNO Consultant Hindustan Lever Ltd. Mumbai
Damika Wickremasinghe	URS Dames & Moore, Consultant, HLL Mumbai

Representatives of Employees

Thiruvallargal S. Raja Mohamed	Secretary, Ex-Ponds-HLL Employees Association
K. Gopala Krishnan	Ex-Ponds-HLL Employees Association
P. Pandey	Ex-Ponds-HLL Employees Association

At the outset the Chairman of the Working Committee, welcomed the members, representatives of M/s. Hindustan Lever Ltd and other participants. He recalled briefly the incidents that had occurred and the various reports furnished by M/s. Hindustan Lever Limited towards Environmental Assessment of the site and Risk Assessment due to Mercury contamination in the environs of the Thermometer Factory of M/s. Hindustan Lever Limited which functioned at Kodaikanal. The representatives of M/s. Hindustan Lever Limited were requested to make a presentation on the following reports:

- i) Environmental Impact and Risk Assessment for Mercury
- ii) Health and Safety Plan - Site Remediation
- iii) Remedial Action Plan

Mr. Paul Whincup (ERM), Mr. Damika Wickrema Singhe (URS Dames & Moore) and Mr. Tom Van Tuenbroek (TNO - Netherlands) made a presentation on the above said reports and on the field investigation undertaken by them. After the presentation the committee members expressed their concern over the variations in the material balance in respect of mercury and pointed out that the loss of mercury into the environment which appeared to be sub-

stantially higher than permissible levels would require a more precise determination. The Committee called on HLL to furnish documented data on material use and disposal as reported to statutory authorities during the functioning of the plant, as well as an inventory of all materials and machineries on site so that the committee may verify the information prior to the removal of material from site.

The committee members also stressed that the mercury levels at the site be reassessed while carrying out the remediation works and the impact of both upper limit and lower limit of unaccounted mercury to be investigated while the remedial works are in progress. However, the committee members were of the unanimous view that the entire plant & machinery which had come into contact with mercury should be scrapped and that the entire stock of mercury at the site should be exported to authorized recycling facility abroad. Committee members were also of the view that the remediation measures at the site should not be initiated unless the entire stock of mercury available at the site as elemental mercury, mercury in finished and semi-finished thermometers and in broken or crushed glass is packed, labeled, recorded and sent for reclamation to the facility identified by M/s. Hindustan Lever Limited in USA with prior approval of all concerned authorities. After detailed discussions the following decisions were arrived at.

- i) The mercury balance information presently submitted by the consultant is considered preliminary. Mercury balance shall be reworked and finalized by the Tamilnadu Pollution Control Board after obtaining additional data input requested from HLL and verification of the same against the stock and from sampling and resurveying of the site prior to the commencement of remediation work.
- ii) The remediation work at the site shall be initiated with the approval of TNPCB only when the Hindustan Lever Limited (Thermometer Factory), site is cleared of all accumulated stocks of mercury in various forms namely elemental mercury, mercury in finished and semi-finished thermometers, in broken or crushed glass and ETP sludge. Till such time no drilling, digging or demolition at the site shall be carried out without prior permission of Tamilnadu Pollution Control Board. Initially, hot spots containing elevated levels of mercury shall be prioritized for remediation after assessing the exact number of such hot spots. The mercury bearing material shall be removed from the site and transported by adhering to the Protocol which is to be approved by the Tamilnadu Pollution Control Board. Till such time, one person from the Inspectorate of Factories may be posted at the site to ensure that there is no tampering at the site and Tamilnadu Pollution Control Board may address the Chief Inspector of Factories. It may be mentioned that HLL informed the Committee that around Feb-March they had without permission excavated the flooring of the factory and removed highly contaminated soil from below.
- iii) In case it is possible to obtain necessary approval within four months to export the mercury and mercury bearing waste indicated in item above to the USA, the material may be transported directly to the concerned ports for further export. In case it extends beyond four months, the mercury and mercury bearing waste lying on site shall be transported to plains and stored in a transit storage facility approved by Tamilnadu Pollution Control Board by following all relevant protocols till the mercury and mercury bearing glass scrap is exported to the country of origin.
- iv) Though the consultants M/s. URS Dames and Moore & TNO Netherlands, engaged by M/s. Hindustan Lever had recommended that the site be remedied up to a level of 10 mg/kg of mercury as per Dutch Standards of Urban Residential areas. It was suggested that after the remediation is over, one more survey would be conducted by Hindustan Lever Ltd, to ensure that all soil containing more than 10mg/kg of mercury is removed.
- v) As informed Thiru Navroz Mody will furnish details of supportive documents related to limits for mercury namely 0.03 mg/kg to decide the limit to be specified for remediation considering the ecological sensitivity of the site and will furnish details of inconsistencies felt or observed if any in the report furnished by the consultant. To help expedite matter, Mr. Mody was requested to furnish the above before March 2003.
- vi) Unused, uncontaminated stem glass and broken glass from non mercury section shall be isolated after proper listing, inspected, monitored and returned back preferably to the

original supplier with the approval of concerned authorities. In case the thermometer stem glass cannot be returned to the original supplier the stem glass shall be crushed defaced and sold as scrap. Hindustan Lever Limited shall also work out the material balance for glass consumption.

- vii) The entire plant and machinery which had come into contact with mercury shall be destroyed rendered unusable and scrapped after decontamination with the approval of the Tamilnadu Pollution Control Board.
- viii) HLL have agreed to provide records pertaining to all ex-workers whoever asks for them in writing, including to families of those who expired after employment at the factory. The Committee suggests that the findings of the company on health impacts be reviewed by an appropriate authority.
- ix) Regarding the medical surveillance and occupational health aspects Thiru Navroz Mody, Committee member suggested that the Board make an independent review of the health records and medical examination carried out by the unit for the employees by an outside competent agency. However, other committee members suggested that the aggrieved employees prefer an appeal against the orders by which they are aggrieved and suggested that the Tamilnadu Pollution Control Board may ask the Factory Inspectorate to investigate the health records and review the medical examination carried out by the unit for its employees. However, it was once again advised that the Government in the Labour Department might be approached regarding occupational health related issues.

Signed By

Thiruvallargal G. Rengasamy - Chairman Working Committee
R. Ramachandran - Convenor Working Committee
R. Gnanasekaran - Member
Revenue Divisional Officer, Kodaikanal
G. S. Ganapathy - Member
M.S. Srinivasan - Member
L. Sabarathinam - Member
Navroz Mody - Member
A.R. Krishna Ram - Member
Meenakshi Subramaniam - Representative of PHCC

ANNEXURE III

NEW JERSEY DEPARTMENT OF HEALTH AND SENIOR SERVICES HAZARDOUS SUBSTANCE FACTSHEET

Common Name : MERCURY
CAS Number : 7439-97-6
DOT Number : UN 2809
RTK Substance number : 1183
Date : August 1992
Revision : August 1998

HAZARD SUMMARY

- Mercury can affect you when breathed in and by passing through your skin.
- Mercury can irritate the skin and eyes.
- Exposure to high levels of Mercury vapor can irritate the lungs, causing cough, chest pain, and shortness of breath.
- Mercury may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.
- Repeated exposure can cause Mercury poisoning. Symptoms include tremors, trouble remembering and concentrating, gum problems and changes in mood.
- Repeated exposure may cause clouding of the eyes.
- Exposure may cause kidney damage.

IDENTIFICATION

Mercury is a silvery, heavy, odorless liquid. It is used in thermometers, barometers, vapor lamps, mirror coatings, and amalgams, and in making chemicals and electrical equipment.

REASON FOR CITATION

Mercury is on the Hazardous Substance List because it is regulated by OSHA and cited by ACGIH, DOT, NIOSH, EPA, DEP and HHAG.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information and training concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard, 1910.1200, requires private employers to provide similar training and information to their employees.

- Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal

right to this information under OSHA 1910.20.

- If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.

WORKPLACE EXPOSURE LIMITS

The following exposure limits are for Mercury vapor:

OSHA: The legal airborne permissible exposure limit (PEL) is 0.1 mg/m³, not to be exceeded at anytime.

NIOSH: The recommended airborne exposure limit is 0.05 mg/m³ averaged over a 10-hour workshift and 0.1 mg/m³, not to be exceeded during any 15 minute work period.

ACGIH: The recommended airborne exposure limit is 0.025 mg/m³ averaged over an 8-hour workshift.

The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

WAYS OF REDUCING EXPOSURE

- Where possible, enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
- Wear protective work clothing.
- Wash thoroughly immediately after exposure to Mercury and at the end of the workshift.
- Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of Mercury to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to Mercury:

- Mercury can irritate the skin and eyes.

- Exposure to high levels of Mercury vapor can irritate the lungs, causing cough, chest pain, and shortness of breath.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to Mercury and can last for months or years:

Cancer Hazard

According to the information presently available to the New Jersey Department of Health and Senior Services, Mercury has been tested and has not been shown to cause cancer in animals.

Reproductive Hazard

There is limited evidence that Mercury may cause an increase in spontaneous abortions in exposed women.

Other Long-Term Effects

- Mercury may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.
- Repeated low exposure or a very high single exposure can cause Mercury poisoning. Symptoms include tremors (shaking), trouble remembering and concentrating, gum problems, increased salivation, loss of appetite and weight, and changes in mood and personality. These can be severe and cause hallucinating and psychosis.
- Repeated exposure (usually more than five years) may cause clouding of the eyes.
- Repeated contact may cause a gray skin color.
- Exposure may cause kidney damage.

MEDICAL

Medical Testing

- For those with frequent or potentially high exposure (half the TLV or greater, or significant skin contact), the following are recommended before beginning work and at regular times after that:
- Exam of the nervous system (including handwriting test to detect early hand tremor).
- Urine Mercury level (usually less than 0.02 mg/liter).
- Kidney function tests.

If symptoms develop or overexposure is suspected, the following may be useful:

- Consider chest x-ray after acute overexposure.
- Evaluation by a qualified allergist, including careful exposure history and special testing, may help diagnose skin allergy.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, ENGINEERING CONTROLS are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider:

- how hazardous the substance is,
 - how much of the substance is released into the workplace and
 - whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.
- In addition, the following control is recommended:
- Where possible, automatically pump liquid Mercury from drums or other storage containers to process containers.

Good **WORK PRACTICES** can help to reduce hazardous exposures. The following work practices are recommended:

- Workers whose clothing has been contaminated by Mercury should change into clean clothing promptly.
- Do not take contaminated work clothes home. Family members could be exposed.
- Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to Mercury.
- Eye wash fountains should be provided in the immediate work area for emergency use.
- If there is the possibility of skin exposure, emergency shower facilities should be provided.
- On skin contact with Mercury, immediately wash or shower to remove the chemical. At the end of the workshift, wash any areas of the body that may have contacted Mercury, whether or not known skin contact has occurred.
- Do not eat, smoke, or drink where Mercury is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating or smoking.
- For clean-up use a specialized charcoal-filtered vacuum or suction pump to avoid generating Mercury vapor. Care should be taken not to disturb spilled material.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only

once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

OSHA 1910.132 requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Clothing

- Avoid skin contact with Mercury. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.
- There is no quantitative information available at the present time on what types of gloves or chemical protective clothing offer protection from permeation or degradation by Mercury and its compounds.

Eye Protection

Wear chemical goggles and face shield when working with liquid, unless full facepiece respiratory protection is worn.

Respiratory Protection

IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA

1910.134.

- Where the potential exists for exposure to Mercury vapor over 0.05 mg/m³ (8-hour average airborne exposure), but less than 0.5 mg/m³, use a NIOSH/MSHA approved halfmask respirator with cartridges specific for Mercury. These cartridges have end of service life indicators which visually indicate when filters must be changed.
- If while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect Mercury, or if while wearing particulate filters abnormal resistance to breathing is experienced, or eye irritation occurs while wearing a full facepiece respirator, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Be sure to consider all potential exposures in your workplace. You may need a combination of filters, prefilters, cartridges, or canisters to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Where the potential exists for exposure over 0.5 mg/m³, use a MSHA/NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to 10 mg/m³ is immediately dangerous to life and health. If the possibility of exposure above 10 mg/m³ exists, use a MSHA/NIOSH approved self-contained breathing apparatus with a full facepiece operated in continuous flow or other positive pressure mode.

EMERGENCY INFORMATION

Common Name : MERCURY
DOT Number : UN 2809
NAERG Code : 172
CAS Number : 7439-97-6

Hazard rating NJDHS NFPA
FLAMMABILITY 0 -
REACTIVITY 0 -
POISONOUS GASES ARE PRODUCED IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

FIRE HAZARDS

- Extinguish fire using an agent suitable for type of surrounding fire. Mercury itself does not burn but may initiate fires of other COMBUSTIBLES.

- POISONOUS GASES ARE PRODUCED IN FIRE.
- Use water to keep fire-exposed containers cool.
- If employees are expected to fight fires, they must be trained and equipped as stated in OSHA 1910.156.

SPILLS AND EMERGENCIES

If Mercury is spilled or leaked, take the following steps:

- Evacuate persons not wearing protective equipment from area of spill or leak until clean-up is complete.
- Spills should be collected with special Mercury vapor suppressants or special vacuums. Kits specific for clean-up of Mercury spills are available.
- Decontaminate and ventilate the area after clean-up is complete.
- It may be necessary to contain and dispose of Mercury as a HAZARDOUS WASTE. Contact your Department of Environmental Protection (DEP) or

your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

- If employees are required to clean-up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

HANDLING AND STORAGE

- Prior to working with Mercury you should be trained on its proper handling and storage.
- Mixtures of Mercury with ACETYLENE, AMMONIA, CHLORINE DIOXIDE, METHYL AZIDE, CHLORATES, NITRATES, and HOT SULFURIC ACID can be EXPLOSIVE.
- Store in tightly closed containers in a cool, well-ventilated area away from NICKEL, CALCIUM, SODIUM, CARBIDE, LITHIUM, RUBIDIUM, COPPER, and COMBUSTIBLES.

FIRST AID

Eye Contact

Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids.

Skin Contact

Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Breathing

Remove the person from exposure.

Begin rescue breathing if breathing has stopped and CPR if heart action has stopped.

Transfer promptly to a medical facility.

PHYSICAL DATA

Vapor Pressure: 0.0012 mm Hg at 68oF (20oC)

Water Solubility: Insoluble

OTHER COMMONLY USED NAMES

Chemical Name: Mercury

Other Names: Colloidal Mercury; Quick Silver

ANNEXURE IV

EXTRACTS FROM EU REVIEW OF MERCURY

Chapter 1: Page 2

The chemical and physical form of mercury in air affects the mechanisms by which it is transferred to the earth surface and ultimately influence the depositional fluxes.

Wet deposition is the primary mechanism for transferring mercury and its compounds from the atmosphere to aquatic and terrestrial receptors, though in dry regions, particle dry deposition fluxes may be significant.

Once in aquatic ecosystems, mercury can exist in dissolved and/or particulate forms and can undergo chemical/microbial transformation to methylmercury.

Chapter 1: Page 3

Contaminated sediments at the bottom of surface waters can serve as an important mercury reservoir, with sediment-bound mercury recycling back into the aquatic ecosystem for decades or longer.

Mercury has a long retention time in soil and as a result, the mercury accumulated in soil may continue to be released to surface waters and other media for long periods of time, possibly hundreds years.

Chapter 1: Page 6

Forest soils and other natural soils with a surface layer rich in organic matter, e.g. Podsollic soils with a more or less well-developed mor horizon, are especially sensitive to anthropogenic deposition of heavy metals. The organic matter in the topsoil layer absorbs mercury and other heavy metals very effectively and can therefore be regarded as a filter between the supply from the atmospheric deposition and soil layers at deeper depths.

Chapter 1: Page 7

Increased concentrations of metals in forest soils, especially in the mor layer, imply risks of adverse effect on vital microbial processes and indirectly, of disturbance of ecosystem functioning. Most of the decomposition of organic matter takes place in the mor layer, including the release of nutrients important for maintaining the productivity of forests. Most plant roots are also found in the mor, which moreover is the most important soil layer for organisms that form the base for food chains ending in mammals and birds. Disturbance of the functioning of the mor may therefore have considerable ecological consequences that may be difficult to prognosticate without a thorough knowledge of the entire system.

Preliminary critical limits to prevent ecological effects for mercury in organic soils has been set to 0.07 - 0.3 mg/kg for the total content in soil by an international expert group on effect-based critical limits for heavy metals working within the framework of UN ECE Convention on Long-range Transboundary Air Pollution (CLRTAP), (Curlic et al. 2000).

Chapter 1: Page 11

Mercury deposited from the atmosphere is accumulated in soils and transported to watercourses and lakes in increased amounts. The risks for adverse effects in the environment and for human health are mainly related to the accumulation of mercury in top layers of forest soils and to the bioaccumulation in aquatic ecosystems.

Chapter 1: Page 10

The distribution of absorbed elemental mercury is limited primarily by the oxidation of elemental mercury to the mercuric ion as the mercuric ion has a limited ability to cross the placental and blood-brain barriers. Once elemental mercury crosses these barriers and is oxidised to mercuric ion, return to the general circulation is impeded, and mercury can be retained in brain tissue. The elimination of elemental mercury occurs via urine, faeces,

exhaled air, sweat and saliva. The pattern of excretion is dependent on the extent to which elemental mercury has been oxidised to mercuric mercury (WHO, 1990; US-EPA, 1997).

Chapter 1: Page 12

The accumulation of heavy metals in forest soils is also a long-term environmental problem. The present ongoing accumulation of mercury in soils is difficult to reverse. Only 0.1% of the Hg present in the mor layer is released annually from the drainage areas (Aastrup et al., 1991). Therefore, reduced emissions have only significant effects on the pools in the perspective of decades or centuries. The strategy of environmental protection has to be based on precautionary principles and continuous assessment.

Chapter 5: Page 6

At low level elements Hg exposure, blood Hg poorly represent information on current and past Hg exposure. A separation of whole blood into its plasma and erythrocytes fractions permits better discrimination will, of course, be more correct using speciation of mercury in blood.

Chapter 5: Page 5-6

In case of exposure to elemental mercury blood and urinary mercury are commonly used to assess occupational exposure. Elemental Hg in exhaled air and urine has also been used to assess the level of recent exposure to elemental Hg. One should note that inhaled vapour of Hg is oxidised to Hg (II) and both species are present (elemental and divalent Hg). The elemental Hg is highly mobile, readily crossed the placenta, cell membranes, and the blood-brain barrier. The Hg (II) ions are much less mobile, crossing the above barriers at a much slower rate. The usefulness of blood as a bioindicators of exposure to elemental Hg depends on time elapsed since exposure and the level of exposure. The whole blood analysis may be used to assess the exposure. Mercury in blood increase rapidly with the exposure, and decreases with an initial half-life of approximately two to four days, and a slower phase of a couple of weeks (Barregard et al. 1992, Sallsten et al. 1993). This means, that the usefulness of the blood is of limited value, in particular, if it is taken several weeks after exposure. It is, however, valuable for assessment of peak exposures (Barregard 1993).

At low levels of elemental Hg exposure, individual differences in total Hg in blood could be explained by current exposure to Hg due to the number of amalgams fillings, fish consumption and other possible exposure routes (e.g. Living environment in Hg mining area).

At low-level elemental Hg exposure, blood Hg poorly represent information on current and past Hg exposure. A separation of whole blood into its plasma and erythrocytes fractions permits better discrimination will, of course, be more correct using speciation of mercury in blood.

Chapter 5: Page 8

The poisoning nature of mercury is well acknowledged (IPCS 1991; Ishihara and Urushiyama, 1994). But less known are the effects of mercury on humans as a consequence of long term exposure to low concentrations. In many cases the use of biomarkers, such as Hg concentrations blood and urine, are not sufficient to assess the internal doses and potential effects on the central nervous system, kidney, the immune system, and other possible effects. Therefore, better scientific understanding of risks to human health, especially to those citizens living close to potentially dangerous sites, is needed. Therefore other biomarkers than mercury measurements alone should be used. An example is N-acetyl-glucose-aminidase (NAG) and other low molecular weight proteins in urine, that seem to reflect effects at low level exposure to Hg. There is a need for continuous research, and for example, markers of oxidative damage could be tested.

Chapter 6: Page 3

Vapour of elemental mercury is rapidly absorbed via the lungs. In humans 75-85% of an inhaled dose is absorbed (Hursh et al., 1985, WHO 1991). Elemental mercury in liquid or vapour form is not well absorbed from the gastrointestinal tract (possibly less than 0.01%) (Bornmann et al. 1970).

Chapter 6: Pages 9, 10 and 11

Effects on the renal tubules, as demonstrated by increased excretion of low molecular proteins like the proximal

tubular enzyme NAG (N-acetyl-beta-D-glucosaminidase) have been shown at low-level exposure, and may constitute the earliest biological effect. This effect was previously shown at occupational exposure with urinary mercury of about 35 ug/g creatinine, equivalent to long term exposure to air levels of 25-30 ug/m³ (Barregard et al., 1988) , Longworth et al., 1992, Cardenas et al., 1993). In a recent report by Ellingsen et al.(2000), such an effect was, however, shown also in workers with urinary mercury of about 10 ug/g creatinine.

The most common sign of frank mercury poisoning is stomatitis, which is usually reported following acute, high concentration exposure to elemental mercury vapours (Bluhm et al., 1992a; Snodgrass et al. 1981). Other commonly reported gastrointestinal effects include nausea, vomiting, diarrhea and abdominal cramps (Bluhm et al. 1992A; Lilis et al. 1985; Sexton et al. 1978, Snodgrass et al. 1981, Vroom and Greer 1972). No increased mortality from the digestive system was observed in European mercury miners (Boffetta et al. 2001).

The thyroid may accumulate mercury at exposure to Hg (Kosta et al. 1975, WHO 1991, Falnoga 2000). It has recently been shown (Barregard et al. 1994, Ellingsen et al. 2000b) that moderate occupational exposure affects the deiodinase responsible for the deiodination of thyroxine (T4) to triiodothyronine (T3), a seleno-enzyme. This tends to increase T4 and reverse T3 levels, and increase the T4/T3 ratio. The effects were seen at current urinary Hg levels of 15-30 ug/g creatinine (Barregard 1994, Ellingsen 2000b), thus at levels as low as the those where the first minor effects on the CNS and the kidneys were reported.

ANNEXURE V

BILL IN THE U.S.A SENATE TO PHASE OUT MERCURY IN THERMOMETERS AND WITHDRAW EXISTING THERMOMETRES FROM THE MARKET

S.351 Bill Summary

6-26-02 Draft

IN THE SENATE OF THE UNITED STATES. 107 TH Congress, 2d Session

To amend the Solid Waste Disposal Act to reduce the quantity of mercury to the environment by limiting the use of mercury fever thermometers and improving the collection and proper management of mercury, and for other purposes.

Brief Description: S.351 would ban the sale of mercury fever thermometers, except by prescription, within 180 days after enactment. The bill would also authorize funds for a grant program to states and other appropriate parties for a thermometer exchange program. S.351 also requires the Environmental Protection Agency (EPA) to keep the mercury collected from thermometers out of commerce. It creates a Federal interagency task force to make recommendations regarding the cost-effective, long term management of surplus mercury and authorizes EPA to spend \$1 million per year to carry out these recommendations. As discussed, the bill contains four provisions:

1. Prohibition on the sale of mercury containing fever thermometers

Six months after the effective date of the legislation, a person shall not sell or supply mercury fever thermometers to consumers and patients, except by prescription.

2. Thermometer exchange

Directs the EPA to make grants to states, municipalities, nonprofit organizations, or other suitable entities for implementation of a national program for the collection of mercury fever thermometers from households and their exchange for non-mercury containing substitutes. Of the \$20 million authorization in the bill to fulfill this task, \$19 million is provided for the thermometer exchange program, which is expected to make about 6 million non-mercury thermometers available for exchange.

3. Management of collected mercury

Requires EPA to A) take title to the mercury collected in the above thermometer exchange program and ensure no release to the environment or reintroduction into commerce of said mercury; B) allows EPA to purchase or otherwise take title to mercury collected from others sources; and C.) requires EPA to conduct research and development on the management of surplus mercury. Authorization is provided in this section of the bill for \$1 million per year for EPA to purchase or otherwise take title to the mercury collected under the thermometer exchange program or collected from any other source to ensure its proper, long-term management.

4. Federal Interagency Task Force on Mercury

Creates a Federal interagency task force to be chaired by the Administrator of the Environmental Protection Agency with one member each to be appointed by the Secretaries of State, Defense, Energy, and the National Institute of Environmental Health Sciences. The Task Force is required to consult with States, industries, and health, environmental, and consumer organizations and not later than 1 year after the formation, the Task Force shall submit to Congress a report containing recommendations regarding means of reducing the total mercury threat to humans and the environment, including:

- the long term management of mercury from thermometers and other sources;
- collection of mercury from industrial or other sources in the U.S. where mercury is no longer needed; and
- effective means of reducing the total amount of mercury produced, used and released on a global basis.

THE INDIAN PEOPLE'S TRIBUNAL ON ENVIRONMENT AND HUMAN RIGHTS

In June 1993, at the National Conference on 'Human Rights, Environment and the Law', 400 people comprising lawyers, judges, human rights activists and non-governmental organisations (NGOs) met to share their experiences. Disillusioned with the apathy of the judiciary towards human rights and the environment they decided to campaign for changes in the system. The conference culminated with the setting up of the Indian People's Tribunal on Environment and Human Rights (IPT) on June 5, 1993. The IPT is positioned as an alternative 'People's Court'.

Retired Supreme Court and High Court judges associated with the IPT investigate crucial human rights violations and cases of environmental degradation. These reports are then used by local groups to further the campaign and strengthen their struggle. In some cases, a public interest litigation is filed on the basis of these reports to obtain relief for the victims.

OBJECTIVES

- To highlight environment and human rights issues and provide an alternative vision for both, the judiciary and the public.
- To investigate cases of gross human rights violations and environmental degradation and to report, campaign and litigate.
- To highlight the plight of the oppressed, in particular children, women, tribal people, slum dwellers, labourers and prisoners, and encourage victim communities to fight for their rights.

KIND OF INVESTIGATIONS UNDERTAKEN BY THE IPT

- Forced evictions due to mega-projects, urbanisation and natural disasters
- People's rights in protected areas
- Atrocities against women
- Attacks on minorities
- Atrocities against Dalits
- Impact of industrialisation/ Mega projects
- State Repression and Police Atrocities
- Environmental Pollution/ Degradation

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