

MERCURY IN BERRY'S CREEK -- HEALTH SURVEY

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MERCURY IN BERRY'S CREEK ECOSYSTEM CONFERENCE
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INTRODUCTION:

THE DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) HAD DETERMINED THAT THE OLD WOOD SITE, ALSO KNOWN AS THE VENTRON SITE IN WOOD-RIDGE, BERGEN COUNTY. RIDGE CHEMICAL CORPORATION WAS HEAVILY CONTAMINATED WITH MERCURY. MERCURY HAD BEEN DETECTED IN HIGH LEVELS IN THE SOILS, SEDIMENTS AND WATER SAMPLES COLLECTED FROM THE SITE AND IN SURROUNDING AREAS. THE MERCURY CONTAMINATION WAS DETERMINED TO HAVE EXTENDED SOUTHWARDS TO BERRY'S CREEK.

THE PROGRAM ON ENVIRONMENTAL CANCER AND TOXIC SUBSTANCES AT DEP REQUESTED THE ASSISTANCE OF THE STATE DEPARTMENT OF HEALTH FOR INVESTIGATING THE EXTENT OF EXPOSURE TO MERCURY AND THE POTENTIAL HEALTH HAZARDS TO THE RESIDENTS IN THE COMMUNITY NEIGHBORING THE VENTRON SITE.

BACKGROUND:

A MERCURY PROCESSING PLANT HAS BEEN OPERATED AT THE VENTRON SITE SINCE 1930 UNTIL 1974. IN 1970 THE U.S.E.P.A. AS PART OF THEIR INITIAL ENVIRONMENTAL POLLUTION ASSESSMENT PROGRAMS DECIDED TO INVESTIGATE THE USES AND DISCHARGES OF MERCURY INTO THE ENVIRONMENT. AMONGST THEIR NATIONAL SURVEYS THEY REALIZED THE POTENTIAL PROBLEMS AT THE WOOD-RIDGE PLANT AND IN 1972 REQUIRED THE COMPANY TO MONITOR SOIL AND GROUNDWATER FOR MERCURY. THESE TESTS CONDUCTED FOR THE COMPANY BY A CONTRACTOR CONFIRMED THAT BOTH SOIL AND GROUNDWATER WERE HIGHLY CONTAMINATED BY MERCURY. IN 1974 THE COMPANY DECIDED TO CLOSE THE PLANT AND SELL THE PROPERTY.

THE PLANT WAS LOCATED ON A 40 ACRE TRACT, A MAJOR PORTION OF WHICH WAS MARSHLAND. ABOUT 19 ACRES OF THIS SITE BETWEEN THE PLANT AND BERRY'S CREEK WAS USED AS A DUMPING SITE FOR THE PLANTS CHEMICAL WASTES.

THE STATE DEPARTMENT OF HEALTH UPON SURVEYING THE NEIGHBORHOOD DECIDED TO INVESTIGATE MERCURY EXPOSURE RESIDENTS IN THE COMMUNITIES OF MOONACHIE AND WOOD-RIDGE WHICH ABUT THE FORMER VENTRON SITE. THE TARGET AREA WAS A COMMUNITY AT THE NORTHWESTERN CORNER OF THE VENTRON SITE. IT INCLUDED A RESIDENTIAL AREA BORDERED BY ROUTE 17 ON THE WEST, MOONACHIE AVENUE ON THE NORTH, BERRY'S CREEK ON THE EAST AND BLUM AVENUE ON THE SOUTH. IT ALSO INCLUDED TEN OCCUPATIONAL GROUPS, EIGHT OF WHICH WERE PRIVATE INDUSTRIES AND TWO STATE AND COUNTY FACILITIES WHOSE WORK SITES WERE SITUATED ON OR IMMEDIATELY ADJACENT TO THE CONTAMINATED AREA.

METHODS:

TWO VOLUNTARY CLINICS WERE HELD ON FEBRUARY 15 AND FEBRUARY 21, 1979. INDIVIDUALS WHO ATTENDED FILLED OUT A QUESTIONNAIRE AND SUBMITTED SAMPLES OF BLOOD, URINE, AND/OR HAIR FOR ANALYSIS. BLOOD WAS COLLECTED BY VENIPUNCTURE IN METAL-FREE COLLECTION TUBES. THE URINES WERE FIRST-MORNING SPECIMENS DELIVERED THE DAY FOLLOWING THE CLINICS. THE HAIR SAMPLES WERE CUT CLOSE TO THE SCALP FROM THE CROWN AREA AND FIXED IN NORMAL ALIGNMENT, FOR SEQUENTIAL ANALYSIS.

PARTICIPATION IN THE SCREENING CLINIC WAS EXCELLENT. 138 WORKERS, APPROXIMATELY 47%, AND 160 RESIDENTS PARTICIPATED. EXACT POPULATION DATA FOR THE RESIDENTIAL AREA DOES NOT EXIST,

BUT A NEIGHBORHOOD SURVEY TEAM COUNTED 90 MAILBOXES. ASSUMING THAT EACH MAILBOX REPRESENTED ONE HOUSEHOLD IN THE STUDY AREA, 55% OF HOUSEHOLDS WERE REPRESENTED BY ONE OR MORE FAMILY MEMBERS. THE SAMPLE POPULATION THUS APPEARED SUFFICIENTLY REPRESENTATIVE AND ADEQUATE IN SIZE FOR OUR PURPOSES.

BLOOD AND URINE SAMPLES WERE SUBMITTED TO THE STATE HEALTH DEPARTMENT LABORATORY. 0.55 CC BLOOD ALIQUOTS WERE ANALYZED BY FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY AFTER PROTEOLYSIS WITH A 1:2 NITRIC-SULFURIC ACID MIXTURE, OXIDATION WITH 5% POTASSIUM PERMANGANATE, LIBERATION OF ORGANIC MERCURY WITH POTASSIUM PERSULFATE, PURIFICATION WITH HYDROXYLAMINE, AND DILUTION TO 100 CC WITH DISTILLED WATER. A SATURATED SOLUTION OF STANNOUS SULFATE WAS USED TO VAPORIZE THE MERCURY BEFORE ANALYSIS. 2 CC ALIQUOTS OF URINE WERE ANALYZED BY A SIMILAR PROTOCOL.

RESULTS

TABLE 1 SHOWS THE NUMBER OF BLOOD SAMPLES SUBMITTED AND RESULTS IN PARTS PER BILLION.

THE VALUES ARE RECORDED AS < 10 PPB (BELOW THE LABORATORY'S LEVEL OF DETECTION), OR ≥ 10 PPB. SAMPLES WERE ANALYZED THREE SEPARATE TIMES OVER A THREE-WEEK INTERVAL. THE VALUES BELIEVED MOST ACCURATE WERE THOSE OF THE SECOND TWO ANALYSES, WHICH ARE RECORDED HERE. OF THESE VALUES, THE HIGHEST LEVELS WERE 15 PPB IN THE EMPLOYEES.

INTERPRETATION OF THE ABSOLUTE VALUES OF THE BLOOD MERCURY RESULTS WAS MADE MORE DIFFICULT BY LACK OF REPRODUCIBILITY OF THE LABORATORY REPORTS. TABLE II DISPLAYS BLOOD MERCURY VALUES BY DATE OF THE LABORATORY ANALYSIS. IT IS EVIDENT THAT THE LEVELS AMONG BOTH EMPLOYEES AND RESIDENTS WERE LOWER ON THE REPEAT ANALYSIS THAN THEY WERE INITIALLY.

THE DECREASING VALUES WERE FELT TO BE DUE TO CHANGES IN LABORATORY TECHNIQUE RATHER THAN SIMPLY FROM LOSS OF MERCURY DUE TO VAPORIZATION OR ABSORPTION TO THE GLASS CONTAINERS.

THE DATA ON URINE SAMPLES IS PRESENTED IN TABLE III.

THE HEALTH DEPARTMENT LABORATORY LEVEL OF DETECTION FOR URINE WAS 5 PPB. IN CONTRAST WITH THE BLOOD REPRODUCIBILITY OF MERCURY LEVELS IN THE URINE WAS EXCELLENT, THE LEVELS OF URINE MERCURY ARE PRESENTED IN TABLE IV.

THE FOUR URINE MERCURY LEVELS EXCEEDING 30 PPB WERE 38, 80, 82 AND 160 PPB. OF NOTE WAS THAT ALL OF THESE INDIVIDUALS BELONGED TO A SINGLE FAMILY.

ANALYSIS OF THE QUESTIONNAIRES YIELDED THE FOLLOWING EPIDEMIOLOGIC DATA. THERE WAS NO CORRELATION BETWEEN BLOOD POSITIVITY (BLOOD MERCURY ≥ 10 PPB) AND URINE POSITIVITY (URINE MERCURY ≥ 5 PPB). SIMILARLY, NO CORRELATION EXISTED BETWEEN HAVING A POSITIVE BLOOD MERCURY AND ENGAGING IN ANY ACTIVITIES THAT WOULD CAUSE EXPOSURE TO THE SITE, SUCH AS VISITING THE SITE, EATING LOCAL FISH OR WILDLIFE, ALLOWING ONE'S PET TO ROAM FREE, LIVING IN A HOUSE WITH A BASEMENT WHICH FLOODED, ETC. NOR WAS THERE A DEMONSTRABLE ASSOCIATION BETWEEN A POSITIVE BLOOD MERCURY AND NON-SITE RELATED MERCURY EXPOSURE, SUCH AS OCCUPATIONAL EXPOSURE, OR FREQUENT CONSUMPTION OF TUNA FISH. AS STATED PREVIOUSLY, THERE WAS GRAVE DOUBT ABOUT THE VALIDITY OF BLOOD "POSITIVITY" AS A RELIABLE CASE DEFINITION. TABLE V DEMONSTRATES THE DECREASING LEVELS OF BLOOD MERCURY ON SEQUENTIAL ANALYSIS OF 13 SAMPLES WHICH WERE INITIALLY "POSITIVE," BUT ULTIMATELY DEEMED "NEGATIVE" AFTER THE ROCHESTER ANALYSIS.

BECAUSE OF THE UNCERTAIN RELIABILITY OF THE BLOOD MERCURY LEVELS, LITTLE IMPORTANCE WAS PLACED ON THE APPARENT EXCESS OF "POSITIVES" AMONG EMPLOYEES AS OPPOSED TO RESIDENTS.

THE URINE MERCURY LEVELS SEEMED MORE RELIABLE AS AN INDEX OF GROUP EXPOSURE. AS STATED PREVIOUSLY, THE FOUR HIGHEST URINE MERCURY VALUES ALL BELONGED TO INDIVIDUALS IN A SINGLE FAMILY. A VISIT TO THEIR HOUSE REVEALED THAT ONE OF THE

CHILDREN IN THE FAMILY HAD BROUGHT A BOTTLE OF MERCURY HOME FROM SCHOOL AS A PLAYTHING. AIR MONITORING IN THE HOME WITH A BACHARACH PORTABLE ULTRAVIOLET LIGHT MERCURY SNIFFER DETECTED MERCURY CONCENTRATIONS OF $35 \mu\text{G}/\text{M}^3$ IN THE CHILDREN'S BEDROOMS, AND $1000 \text{ MG}/\text{M}^3$ IN THE NOZZLE OF THE VACUUM CLEANER. NO FAMILY MEMBERS WERE SYMPTOMATIC. FURTHER FOLLOW-UP ON THIS FAMILY WILL BE DESCRIBED LATER. ANALYSIS OF BEHAVIORAL VARIABLES IN RELATION TO URINE POSITIVITY REVEALED ONLY AN ASSOCIATION BETWEEN "SITE EXPOSURE," I.E. LIVING IN A HOUSEHOLD WITH A CHILD, PET OR INDIVIDUAL WHO VISITED THE SITE, AND HAVING A URINE MERCURY ≥ 5 PPB. TABLE VI DEPICTS THIS ASSOCIATION.

THE ABOVE DATA AND INTERPRETATIONS WERE COMPLETED IN EARLY APRIL. HOWEVER, THE TIME CONSUMING ANALYSIS OF THE HAIR SAMPLES HAD NOT BEGUN, PARTLY BECAUSE THE TECHNICAL DIFFICULTIES OF PERFORMING SEQUENTIAL SEGMENT HAIR ANALYSIS MADE IT IMPRACTICAL FOR THE STATE HEALTH LAB TO PERFORM, AND PARTLY BECAUSE THE HAIR WAS INTENDED TO REFLECT EXPOSURE TO MERCURY OVER TIME. BLOOD AND URINE SAMPLES HAD ALREADY DEMONSTRATED THE ABSENCE OF AN IMMEDIATE HEALTH HAZARD FROM THE SITE. THE HAIR COULD BE ANALYZED AT LEISURE.

WITH THE ASSISTANCE OF DR. THOMAS CLARKSON, OF THE UNIVERSITY OF ROCHESTER, TWO GROUPS OF SPLIT LABORATORY SAMPLES WERE TESTED. THE FIRST GROUP INCLUDED 24 ORIGINAL BLOODS FROM

FEBRUARY, 18 OF WHICH HAD BEEN ANALYZED BY OUR LABORATORY AS CONTAINING ≥ 10 PPB. ALL 24 WERE REPORTED BY DR. CLARKSON AS < 10 PPB. THE SECOND GROUP INCLUDED FRESH BLOOD SAMPLES ON THE SIX FAMILY MEMBERS WITH KNOWN EXTRANEIOUS MERCURY EXPOSURE. TABLE VII DEPICTS THE RESULTS.

THE AVAILABLE EVIDENCE SUGGESTED THAT THE NEW JERSEY RESULTS WERE REASONABLY CLOSE TO THOSE OF DR. CLARKSON AND, EXCEPT IN ONE SAMPLE, HIGH RATHER THAN LOW.

STEPS WERE TAKEN TO ELIMINATE MERCURY EXPOSURE IN THE ONE FAMILY WITH ELEVATED VALUES. THE SOUVENIR BOTTLE AND CONTAMINATED VACUUM CLEANER BAGS WERE REMOVED FROM THEIR HOUSE.

A COMMUNITY MEETING WAS HELD ON APRIL 26 TO ANNOUNCE THE RESULTS OF THE STUDY. THE CONCLUSIONS PRESENTED AT THAT TIME WERE:

- 1) NO EVIDENCE EXISTED OF AN IMMEDIATE HEALTH HAZARD FROM MERCURY EXPOSURE ARISING FROM THE SITE.
- 2) SUGGESTIVE EVIDENCE EXISTED THAT LOW LEVEL EXPOSURE TO MERCURY, AS EVIDENCED BY THE URINE VALUES, MIGHT BE OCCURRING BY EXPOSURE TO THE SITE.
- 3) THE SITE NEEDED A FENCE TO MINIMIZE UNNECESSARY AND UNAUTHORIZED EXPOSURE TO CONTAMINATED SOIL.

- 4) FURTHER TESTING OF SELECTED INDIVIDUALS WITH EXTENSIVE CONTACT WITH THE SITE SHOULD BE CONDUCTED IN SUMMER, WHEN THE TEMPERATURE, AND VAPORIZATION OF MERCURY, WOULD BE INCREASED.
- 5) ADDITIONAL FOLLOW-UP OF THE INDIVIDUAL FAMILY WAS NEEDED.

FOLLOW-UP AUGUST, 1979

AT A JULY 26 MEETING OF THE SELIKOFF ADVISORY COMMITTEE TO GOVERNOR BYRNE ON THE PROBLEM OF MERCURY IN THE MEADOWLANDS, THE FOLLOWING PLANS WERE ESTABLISHED. HUMAN MONITORING WOULD BE LIMITED TO A SMALL GROUP OF INDIVIDUALS POTENTIALLY MOST HEAVILY EXPOSED TO THE SITE. THESE INCLUDED THE BERGEN COUNTY MOSQUITO CONTROL COMMISSION PERSONNEL, CHILDREN WHO CONTINUED TO PLAY ON THE SITE, AND THE WOOD-RIDGE FIREMEN WHO WERE FREQUENTLY CALLED OUT TO EXTINGUISH BRUSH FIRES OF BURNING PHRAGMITES. THE FAMILY WITH UNRELATED MERCURY EXPOSURE WOULD ALSO BE RETESTED, ESPECIALLY SINCE THE FOUR CHILDREN CONTINUED TO BE THE MOST FREQUENT VISITORS TO THE SITE, DESPITE CONSTRUCTION OF AN EIGHT FOOT CYCLONE FENCE.

ON AUGUST 7, QUESTIONNAIRES AND SAMPLES OF BLOOD, URINE AND HAIR WERE OBTAINED FROM THE WOOD-RIDGE FIREMEN. IDENTICAL INFORMATION, EXCLUDING HAIR SAMPLES, WAS OBTAINED FROM THE OTHER GROUPS. THE RESULTS ARE PRESENTED BELOW.

ONLY THE THREE FAMILY MEMBERS PREVIOUSLY SHOWING INCREASED MERCURY ABSORPTION EVIDENCED SIGNIFICANT EXPOSURE. THAT THEIR EXPOSURE SEEMS ATTRIBUTABLE TO PAST, RATHER THAN ONGOING EXPOSURE, MAY BE SEEN FROM THE FOLLOWING FLOW-SHEET.

FINALLY, THE HAIR SAMPLES OF ALL 15 FIREMEN WERE ANALYZED IN SEQUENTIAL CENTIMETERS FOR TOTAL MERCURY BY THE LABORATORY OF DR. CLARKSON. ALL OF THE HAIR SAMPLES WERE WELL WITHIN THE NORMAL "NON-EXPOSED" RANGE. THERE WAS NO EVIDENCE OF A "PEAK" MERCURY EXPOSURE CORRESPONDING IN TIME WITH THE APRIL FIRE WHICH THESE MEN HAD ATTENDED.

PRESENT DATA INDICATES THAT NO SIGNIFICANT EXPOSURE TO MERCURY IS OCCURRING VIA MERCURY VAPOR OR DUST BLOWING OFF THE BERRY'S CREEK SITE. THE POTENTIAL FOR FUTURE HAZARD CERTAINLY EXISTS, SHOULD ACCUMULATION OF MERCURY IN THE FOOD CHAIN BECOME A SIGNIFICANT SOURCE OF TRANSMISSION TO PEOPLE. HOWEVER, NO PRESENT HAZARD HAS BEEN DEMONSTRATED.

TABLE I

RESULTS (IN PARTS PER BILLION)

	<u><10</u>	<u>≥10</u>	<u>TOTAL</u>
RESIDENTS	147 (94.8%)	8 (5.2%)	155
EMPLOYEES	110 (82.1%)	24 (17.9%)	134
TOTAL	257 (88.9%)	32 (11.1%)	289

TABLE II

LEVEL OF BLOOD MERCURY BY DATE OF ANALYSIS

<u>EMPLOYEE</u>	<10	10	<u>LEVEL IN PPB</u>		30	40
			15	20		
INITIAL	106	11	2	12	0	3
REPEAT	110	22	2			
<u>RESIDENTS</u>						
INITIAL	146	5	3	1		
REPEAT	147	8				

TABLE III

URINE MERCURY RESULTS (IN PARTS PER BILLION)

	<u><5</u>	<u>≥5</u>	<u>TOTAL</u>
RESIDENTS	106 (76.8%)	32 (32.2%)	138
EMPLOYEES	96 (81.4%)	22 (18.6%)	118
TOTAL	202 (78.9%)	54 (21.1%)	256

TABLE IV
URINE MERCURY LEADS IN PPB

	NO. URINE	0-4		5-9		10-14		15-19		20-24		25-30		>30	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%
EMPLOYEES	20	96	(81.4)	15	(12.7)	7	(5.9)								
RESIDENTS	22	106	(78.8)	18	(13)	4	(2.9)	4	(2.9)	1	(.7)	1	(.7)	4	(2.9)
TOTAL	42	202	(78.9)	33	(12.9)	11	(4.3)	4	(1.6)	1	(.4)	1	(.4)	4	(1.6)

TABLE V

LEVEL OF BLOOD MERCURY IN 13 SPLIT SAMPLES
BY TIME AND PLACE OF ANALYSIS

		<10	10	15	20	30	40	<u>LEVEL IN PPB</u>
NJDH	INITIAL		2		8		3	
	REPEAT	3	10					
ROCHESTER ANALYSIS		13						

TABLE VI

RELATION BETWEEN HAVING A PET, CHILD, OR INDIVIDUAL WHO VISITS
THE SITE IN ONE'S FAMILY AND HAVING A URINE MERCURY \geq 5 PPB

	<u>URINE \geq5</u>
ALL INDIVIDUALS IN HOUSEHOLDS WITH SITE EXPOSURE	22/71 (30.8%)
INDIVIDUALS IN HOUSEHOLDS WITH SITE EXPOSURE, EXCLUDING SPECIAL FAMILY	16/65 (24.6%)
INDIVIDUALS IN HOUSEHOLDS WITHOUT SITE EXPOSURE	10/67 (14.9%)

TABLE VII

BLOOD MERCURY (IN PPB) BY LABORATORY

	<u>FATHER</u>	<u>MOTHER</u>	<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>#4</u>
NEW JERSEY	<10.0	<10	20	10.0	20	10
ROCHESTER	2.5	10	18	7.1	14	16

<u>AUGUST MERCURY LEVELS IN PPB</u>	<u>NUMBER</u>	<u>BLOOD</u>	<u>URINE</u>
WOOD-RIDGE FIREMEN	15	<10	<5
MOSQUITO CONTROL COMMISSION	4	<10	<5
FAMILY	6	<10	*
OTHER CHILDREN WITH CONTINUING EXPOSURE	1	<10	<5

*FAMILY MEMBERS 3/6 \geq 5 ppb: 20, 20, 25

SPECIMEN

BLOOD

URINE

DATE

2/15

4/25

8/8

2/15

4/25

8/7

LAB

N.J.

N.J.

ROCH.

N.J.

ROCH.

N.J.

N.J.

N.J.

FATHER

<10

<10

2.5

<10

3.4

8

16

<5

MOTHER

<10

<10

10

<10

6.2

20

33

<5

1

<10

20

18

<10

7.9

82

80

20

2

<10

10

7.1

<10

4.5

38

30

5

3

<10

20

14

<10

9.1

80

94

20

4

<10

10

16

<10

5.7

164

172

25

Water

Mercury levels found in streams and rivers in the U.S. range from 0.01-1.0 ppb with a mean concentration of about 0.03 ppb. Most mercury compounds have low water solubility and have a high affinity for suspended solids especially suspended organic matter. In fact, it is thought that suspended sediment exerts the greatest influence on the concentration of various forms of dissolved mercury in water. For example, the water data collected by HMDC in 1977 and 1978 showed that dissolved mercury levels commonly were below the detection limit of 0.10 ppb in and around the vicinity of Berry's Creek. Therefore all the data presented about mercury levels in the Berry's Creek system is for mercury on suspended particles. The DEP has a minimum allowable mercury concentration for fresh water of 5 ppb. The EPA has proposed a water quality ceiling level of 3.2 ppb inorganic Hg, 8.8 ppb organic Hg for freshwater and 1.0 ppb inorganic mercury and 2.6 ppb organic mercury for saltwater to adequately protect aquatic life.

The next slides compares mercury concentrations in water samples in Berry's Creek and in the Hackensack river system at low tide. There are two points that can be made about these slides. First mercury levels in the Berry's Creek area waterways vary seasonally and secondly, the levels of mercury in the water of Berry's Creek exceeds both state and federal water standards. The next slide compares mercury levels in water in the Northeastern part of New Jersey, the Hackensack river and Berry's Creek at high and low tide. The samples were taken by the DEP in Northern NJ and were analyzed by Rutgers University and can be compared with information collected by HMDC in Berry's Creek and the Hackensack river. Approximately 50% of the samples in Berry's Creek exceed 1.0 ppb, as compared to about 7% in the Hackensack river and none in Northern NJ. It is obvious from this information that the water in Berry's Creek is heavily contaminated by mercury. In a recent water sampling project with Rutgers University, samples were taken in the vicinity of Berry's Creek and this information essentially confirmed earlier reports.

It is obvious that a more dynamic sampling approach is needed to study mercury in the waters of Berry's Creek and vicinity. Specifically we need information on methyl mercury levels, size fractionation of mercury contaminated suspended sediments and we need to study the influence of environmental changes on mercury levels in the water system.

Air

Mercury levels in ambient air over continental regions varies from 10 ng/m³ in pristine areas to 60 ng/m³ in urban areas. Mercury occurs in ambient air both in vapor and particle forms, however the vapor form is thought to account for more than 90% of the total amount of mercury in ambient air. All things being equal, the temperature of the substrate the mercury is stored in has the most significant effect on it's vaporization rate. At 15°C or above the effect of temperature on mercury vaporization is significant and this fact has much relevance to the mercury problem in Berry's Creek.

Two sampling campaigns were conducted by the US EPA on the Ventron site at the DEP's request. The preliminary results from the sampling in 1977 showed that mercury vapor concentrations behind the warehouse buildings on Wolf's property ranged from 100-400 ng/m³. In August 1978, the US EPA Environmental Monitoring and Surveillance Laboratory from Research Triangle Park, North Carolina, monitored mercury on the Ventron site over a 5 day period. There were a number of problems during this sampling program. For example, two samplers were used for the monitoring effort and they measured either inorganic and organic mercury or just inorganic mercury vapor, however an adequate number of side-by-side sampling periods to determine organic mercury levels was lacking. In addition, there were only a few times when simultaneous sampling was conducted by the EPA staff at the various sites; the sampling calibration method used by EPA was inaccurate and EPA reported that there were rather high analytical errors in the analytical procedure. Never the less, this sampling campaign represents our best knowledge of atmospheric mercury levels in the vicinity of the Ventron site. Mercury levels varied from 3300 ng/m³ to about 200 ng/m³. These values are 500x average mercury levels found in urban areas in the US and 1000x particulate mercury levels found in five urban areas in New Jersey.

For comparative purposes NIOSH recommends that the 8 hr. TWA exposure for a five day work week should not exceed 50,000 ng/m³ and US EPA recommends that 1000 ng/m³ in ambient air is safe for the general populace. Thus ambient mercury levels at the Ventron site appear to warrant further monitoring in this area, but do not seem to pose an immediate health threat to the nearby populace.

Another approach to looking at atmospheric mercury levels in the Berry's Creek local would be to determine the rate of loss to the atmosphere of mercury contained in the landfill and marsh soils. For example, in a recent study in Northwestern Quebec workers have reported soil degassing rates for elemental mercury of 0.2 ug/m²/hr. and other workers have reported levels from 0.02-1.7 ug/m²/hr. in other areas of North America. In a recent study completed by Oak Ridge National Laboratory around an abandoned chloralkali plant in Virginia, it was found that at a soil temperature of 33°C the degassing rate of contaminated chloralkali wastes was 120-170 ug/m²/hr., which is substantially higher than rates previously reported. These workers also reported that mercury contaminated soils at a temperature of 33°C had a degassing rate of 0.5-0.7 ug/m²/hr. The

primary reason for the differences in degassing rates is due to the chemical form of the mercury. In mineral soils mercury is typically in the sulfide (HgS) or oxide forms (HgO), whereas in the chloralkali wastes the mercury was thought to exist as either elemental mercury or possibly HgCl_2 or HgCO_3 . In addition, mercury in the chloralkali leachate exists as HgCl_4 , HgCl_3 , HgCl_2 or Hg(OH)_2 .

In any event, it should be remembered that the degassing rate of a soil is directly related to the soil temperature. I used the following information and assumptions and calculated the amount of mercury lost to the atmosphere for one month at three locations near Berry's Creek if the soil temperature is 33°C . On the Velsicol property (33 Acres) this amounted to a loss of approximately 50 gm, for the Eight Day Swamp (65 Acres) 98 gm, and for the Walden Swamp (135 Acres) 203 gm or for all three sites about 351 gm. The concentration of mercury in the soil, the nature of the soil, the depth the mercury is buried and the degree of soil water saturation will have a significant effect on the mercury emission rates.

To conclude, based on a limited amount of data, atmospheric mercury levels around the Ventron site are relatively high, but do not at the present time pose a threat to the nearby populace. Finally we plan to conduct an in depth atmospheric monitoring program for mercury in the local of Berry's Creek in the next year.

The issues to be addressed by the conference include:

- What are the rate controlling mechanisms governing the movement of mercury through the different environmental compartments of Berry's Creek and the Hackensack Meadowlands. Particular emphasis will be placed upon the factors controlling the movement of mercury through the marshes.
- Can a model be developed for predicting the way in which expected changes in biological and physiochemical parameters will affect the distribution and rate of movement of mercury in the different environment compartments.
- What types of "short-term" events effect the distribution and movement of mercury in this ecosystem. How should these events be studied.
- Developing and evaluating proposals for containing and cleaning up the contaminated marshes adjacent to Berry's Creek.
- What types of monitoring should be performed during the implementation of a large scale dredging program.
- What types of future monitoring effects should be undertaken in the region.