

Mortality Studies – “C”

This is a continuation of *DioxinSpin.com*, Mortality Studies “C”.

Let’s examine each one of the Dow studies on the Midland and Bay City employees in greater detail.

A. Cause-Specific Mortality Among Male Chemical Workers, BB Bond, *et al*, 1987

This study evaluated the mortality of the 37,682 male Dow employees that worked at the Midland and Bay City sites from **1940 to 1982**. For some reason, this study excluded 6,250 male employees that had worked in the Bay City Magnesium Foundry from 1940 to 1961. The foundry was sold to Magnesium Aerospace Products in 1961 and was subsequently shut down. This case of employee exclusion was subsequently reported 15 years later in a follow-up study, Burns, 2002.

There is a possibility that the Bond, 1987 study may have included approximately 2,100 of the Dow male foundry workers in the 1940 to 1982 study. However, both Bond, 1987 and Burns, 2002 are a little vague about this. The Burns, 2002 study corrected the “exclusion” and reported the mortality experience of the male and female foundry workers. The “mortality experience” was not good. Since Dow’s Industrial Hygiene Department was identified as having written reports about the foundry, it is doubtful if Dow’s Epidemiology Department was ignorant of the foundry. More information about the “forgotten” foundry workers will be provided in the discussion of the Burns, 2002 study later in this commentary.

Excluding almost 14% of the total Midland and Bay City workforce seems a little odd and, perhaps, a little speculation as to why this exclusion was made is appropriate. Table 1 shows the potential impact of adding the foundry workers to Mortality from All Cancers.

Table 1
Dow Midland and Bay City Sites
 (Worker Mortality with >20 Years of Employment)
 (1940 – 1982)

<u>All Cancers</u>	<u>Obs.</u>	<u>Exp.</u>	<u>SMR</u>	<u>95% CI</u>
1940-1982 Study (1), as published	1501	1577.7	95	90-100
Magnesium Foundry (2), workers	941	847	111	<u>104-116</u>
Total	2442	2425.4	<u>101</u>	? - ?

- (1) GG Bond, *et al*, 1987
- (2) CJ Burns, *et al*, 2002

As can be seen from the table, the cohort mortality from All Cancers increases from a SMR 95 to a SMR 101; unfortunately, the overall 95% CI is unknown. These are only estimates since Dow did not provide any 1982 mortality data on the foundry workers. I believe that the reader gets the general idea... the addition of the foundry workers increased mortality in the extremely important All Cancers category.

In the 1980's, Dow was promoting its "chemistries of fire" theory on dioxin formation and was publishing mortality studies that indicated that its workers were healthier than the US population. An All Cancer Mortality greater than 100 in a large employee study would not have been good news. Only the most cynical readers would question whether Dow deleted the foundry workers to "cook the epidemiology books" so as to be able to continue to claim that its workers were healthier than the US average.

However, this unusual exclusion notwithstanding, other portions of Bond, 1987 are excellent. One of the more interesting aspects of the Bond, 1987 study is that the study provided detailed mortality data for the three main pay categories: (1) hourly, (2) salaried nonexempt (plant clerks, clerical, secretarial) employees and (3) salaried exempt (management, technical, professional) employees.

Although the study did not focus on any specific chemical exposure, it must be recognized that the hourly employees, working in a chemical manufacturing

environment, would be more heavily exposed to chemicals than would be the salaried employees in the same plant. It should also be noted that a portion of the salaried nonexempt workers had probably been hourly workers prior to accepting employment in a salaried position. On average, the salaried exempt employees would have had the lowest amount of chemical exposure of the three groups of Dow workers.

Table 2, **Mortality of Male Chemical Workers – Dow Midland and Bay City**, presents a comparison of various mortality ratio's between the three groups of Dow workers. In the general category of mortality from All Causes, the hourly employees' mortality ratio of 95 was a 73% increase over that of the Salaried exempt employees' mortality ratio of 55. The hourly cohort of 21,437 employees (4,071 foundry workers excluded) had statistically significant increased mortality from **liver cancer** (SMR 140), **cancer of the lymphatic-hematopolietic tissues** (SMR 140) and cancer from rare **Other and Unspecified sites** (SMR 141). As can be seen from the table, mortality from lymphatic-hematopolietic cancers, lymphosarcoma-reticulosarcoma, and leukemia-aleukemia was elevated for all employees.

Table 2
Mortality of Male Chemical Workers – Dow Midland and Bay City
(1940 – 1982)

	<u>Hourly</u>	<u>Salaried Non-Exempt</u>	<u>Salaried</u>
Number of Employees	21,437	4,819	11,364
<u>Cause of Death</u>	<u>SMR</u>	<u>SMR</u>	<u>SMR (2)</u>
All causes (000-999)	95	71	55
All malignant neoplasms (140-209)	98	88	73
Liver & biliary passages (155-156) cancers	140	115	64
Cancer of skin (172-173)	63	136	136
Cancer of prostate (185)	82	116	99
Cancer of testis (186)	128	92	29
Cancer of brain & CNS (191-192)	118	83	82
Lymphatic-hematopolietic cancer (200-209)	110	134	104
Lymphosarcoma& reticulosarcoma (200)	106	145	128
Hodgkin's disease (201)	83	173	32
Leukemia - aleukemia (204-207)	108	176	119
Cancer-other lymphatic tissue (202-203,208)	140	43	115
Cancers of Other and Unspecified sites	141	213	100

Outlined SMR: 95% CI lower level >100

The 1987 study provided information that indicated that All Malignant Neoplasms for hourly workers increased with duration of employment and that the mortality of the workers with more than 20 years of employment increased to SMR 109, a level that is statistically significant. Table 3, **Mortality of Hourly Chemical Workers – Dow Midland and Bay City Locations**, summarizes the mortality from specific cancers for three sub-groups of hourly employees differentiated by years of employment.

Table 3
Mortality of Hourly Chemical Workers – Dow Midland and Bay City Locations
 (Standardized Mortality Ratio)

<u>Duration of Employment:</u>	<u>SMR</u> <u>< 5 Yr</u>	<u>SMR</u> <u>5-19.9 Yr</u>	<u>SMR</u> <u>>20 Yr</u>
<u>Cancer Site</u>			
All Malignant Neoplasms	91	97	109
Digestive Organs	77	95	100
Stomach	66	107	123
Large Intestine	70	90	108
Liver -***	126	162	138
Respiratory System	94	99	114
Lung	95	100	118
Prostrate	59	53	123
Leukemia - Aleukemia	70	148	126
Lymphatic and Hematopoietic	95	115	130
Lymphosarcoma - Reticulosarcoma	81	100	139
Hodgkin's Disease	86	58	118
Other Lymphatic Tissue - ***	157	118	135
Other/Unspecified - ***	134	157	137

Outlined SMR's are statistically significant, lower 95% CL > 100
***** Statistically significant for all employment durations**

Even though other Dow mortality studies have previously reported that the Midland location had significant (but unexplained) elevation of Cancers from Other/Unspecified

Sites, it was somewhat surprising that the salaried nonexempt employees had the highest mortality (SMR 213) from these types of cancers of the three groups of workers that were studied. The 1987 study did not provide any information on the salaried nonexempt workers that would allow analysis if these cancers are more predominant in the Midland plant workers or in the Bay City plant workers.

Over the years, Dow's Midland plant site manufactured an extensive line of chemical products from a wide variety of chemical synthesis. With the exception of the Magnesium foundry, the Bay City site was primarily a petroleum refinery and a plastics fabrication site. In all likelihood, the unusual elevation of Cancers from Other/Unspecified Sites was found at the Midland site and not at the Bay City site.

The 1987 study provided information that indicated that All Malignant Neoplasms for hourly workers increased with length of employment and that the mortality of the hourly workers with more than 20 years of employment increased to SMR 109, a level that is statistically significant.

Hourly employees for all lengths of employment had significant increases in certain cancers. Employees with less than 5 years of employment had elevated mortalities in liver cancer, other lymphatic tissue cancers and cancers of the rare Other/Unspecified sites. The hourly employees with 5 to 19.9 years of employment had significantly increased mortality in four cancer categories (liver, leukemia-aleukemia, other lymphatic tissues and other/unspecified sites). The hourly employees with more than 20 years of employment had significantly elevated increases in 9 categories of cancer, including the very important, All Malignant Neoplasms (SMR 109). Evidently, even the "healthy worker effect" that Dow has described in other studies can be overcome with a high enough exposure to toxic chemicals for a sufficiently long enough time.

A number years ago, I worked in the same plant with a salaried employee that had been an hourly employee in Dow's Organic Chemicals Department during the 1940's and 1950's. When I knew him, Jack's health had deteriorated to the point that unexpected blackouts were becoming more and more common. He firmly believed that his health had been adversely affected by working around open top vessels that were emitting large amounts of visible and foul-smelling chemical vapors without any personnel

protective equipment when he was a younger hourly employee. At the time, his heavy smoking detracted somewhat for his credibility.

I left the department and he died perhaps a year later when he was in his late 50's. Unfortunately, I do not know the cause of his death. At the time before his death, I really did not believe him when he said that the company did not care a great deal about the effect of chemical exposure to its employees. However, after reviewing the mortality data on Dow's hourly employees, I now realize that he might have been correct in his opinion.

The Bond, 1987 study presented some additional information of the mortality of male workers exposed to known carcinogens, such as arsenic, asbestos, benzene, etc.. The study indicated that **611 Dow employees** had been exposed to **arsenic** and that their mortality was significantly elevated with SMR = 225 (95% CL 157-313). More information can be found in Table XIII of the actual report and I refer the readers to this table.

The Bond, 1987 study acknowledges that arsenic is a “**known human carcinogen**”. As I reading this study, I wondered if Dow would have so willingly agreed that arsenic was a known carcinogen if high levels of arsenic had been found in large areas of Midland downwind from Dow and in river sediments downstream from the Dow discharge.

B. Cause-Specific Mortality Among Michigan Employees of a Chemical Company: 1940 to 1994, CJ Burns, *et al*, 2002

Dow's *Overview* summarized the Burns, 2002 study in the following manner:

“In this study, the investigators evaluated all-cause mortality experience of more than 50,000 employees of a major chemical manufacturing company. All causes of death were observed, including diabetes, heart disease, etc., and higher rates were observed in men for non-specific categories such as cancer of other digestive organs and other respiratory cancers. However, these patterns may have resulted from regional certification practices, changes in coding rules, etc. It has been pointed out that since

the facility mentioned in the study has not been used for more than 40 years, further study of this cohort is not recommended. The investigators of the study did not identify any disease or process area that warrants additional focused study.”

This might be a little tangential but how many readers inferred from this PR summary that the facility that employed more than 50,000 employees has not been used in 40 years and that further study of the 50,000 employee cohort is not recommended? How many readers also inferred that the evaluation of the 50,000 employees did not indicate any disease or other reason for additional study? Just wondering.

Actually the facility referred to in Dow’s summary was the Bay City Magnesium Foundry that employed approximately 6,250 male employees from 1940 to 1961 and not the 50,000 identified in the summary. For a Public Relations Department that may pride itself on conveying its messages in an easy to understand manner, this Dow summary seems to be a little confusing.

Dow’s *Overview* statement, “However, these patterns may have resulted from regional certification practices, changes in coding rules, **etc.**” really does not convey the full impact of what the study found. Burns, 2002 actually stated, “Such practices may result from regional certification practices, vagaries of coding rules over time, **or several deaths connected to mesothelioma.**” Not much difference between “ETC.” and the actual statement, is there?

In fact, the language used in Burns, 2002 to describe mesothelioma is even more informative, “Among men, we observed more deaths than expected in the residual categories of other respiratory and other digestive cancers, regardless of the comparison population used. This elevation was statistically significant (SMR=174; 95% CI 103 to 276) for other respiratory cancers when compared with the State of Michigan. Contributing to the higher rates of nonspecific respiratory cancer were 15 men with mesothelioma. Overall, we identified **54 men and 3 women** from the entire cohort who died with **mesothelioma.**”

Mesothelioma is a very rare type of cancer that is most often, but not always, caused by exposure to asbestos. The tumors are associated with mucus producing cells that line the body's abdominal cavity and the internal sacs that contain the body's organs.

The previous Bond, 1987 study reported that, from 1940 to 1982, 12 deaths from respiratory system cancers had been detected in those male workers that were exposed to asbestos. Although, the Burns, 2002 study did not report the number of deaths that were related to asbestos exposure, with extrapolation, the number should be approximately 15 to 16 deaths from 1940 to 1994. Let's be generous and estimate that the male mesothelioma deaths totaled 20 from 1940 to 1994. Burns, 2002 reported a total of 54 male deaths; 54 minus 20 equals **34 mesothelioma deaths** in male workers that may not have been related to asbestos exposure. Burns, 2002 also indicated that, for the 3 female workers who died with mesothelioma, "The women did not hold jobs indicative of asbestos exposure, nor were their occupations listed on the death certificates as congruous with asbestos exposure."

A history of asbestos exposure is reported in approximately 70% to 80% of all mesothelioma cases. Based on the earlier Bond, 1987 study ratio's, only **approximately 12%** of the male mesothelioma deaths reported in the Burns, 2002 study are associated with asbestos and **none** of the female mesothelioma deaths are related to asbestos. Obviously, the deaths of Dow employees with mesothelioma must be associated with other factors... perhaps widespread chemical or dioxin exposure.

The Burns, 2002 study resolved the issue of 57 mesothelioma-related deaths in a very unusual manner, "Within this population, the 57 mesothelioma deaths were classified into eight different sites." Rather than reporting these 57 deaths in a single category, the deaths were spread out into eight categories ... a somewhat odd epidemiology approach.

The 2002 study is not really an update of the earlier 1987 study. Based on how the composition of the original 1940 to 1982 cohort was changed, it is extremely difficult to compare one study against the other.

The term *cohort* is used to describe a group of people who have something in common when they were first assembled and who are then observed for a period of time to see what happens to them. A few cohort “givens”: (1) cohorts should be observed over a meaningful period of time in the natural history of the disease in question and (2) (*this is important*) all members of the cohort should be observed over the full period of follow-up. When employees are dropped from the study, the information provided by an incomplete cohort can be a distortion of the true state of affairs. Not quite garbage in-garbage out, but close. Table 4 provides some additional information on the changes that were made to the Midland-Bay City cohort.

Table 4
Changes in Original 1940 to 1982 Cohort
 (CJ Burns, *et al*, 2002)

	<u>No. of Male Employees</u>
Original 1940 – 1982 Cohort	37,682
Delete 5,492 employees dropped from Dow’s Epidemiology Surveillance Database	- 1,864 (est.)
Delete 1,657 employees that died between 1940 – 1959 (More details later in section)	- 1,657
Add 4,012 male employees from Bay City Magnesium Foundry	+ 4,012
Add 4,012 employees hired after 1/1/83 less 168 employees that were part-time employees prior to 1/1/83	+ 3,844
Total 1940 – 1994 Cohort	42,076

The 2002 study revised the original cohort of 37,682 employees by 7,533 employees (1804 + 1657 + 4012) or approximately 20%. It may be kosher for an “open” cohort to add new members, such as new hires or the Bay City Foundry employees, but

dropping some members, for whatever reason, is an epidemiological flaw. A few more “interesting” approaches used in the 1994 “revision”:

1. The Bond, 1987 study was able to determine the number of expected deaths for all the cohort despite the large number of employees. The number of expected deaths was based on the US national population. Burns, 2002 encountered a few problems in developing the number of expected deaths. The “revised” 2002 study used a University of Pittsburgh database for non-cancer deaths. Unfortunately, this database is limited to the period 1960 to 1994. As a result, and I quote, “This strategy essentially excluded the non-malignant deaths and person-years that occurred from 1940 through 1959.” In another part of the study, in very fine print, “The 1,657 non-malignant deaths that occurred before 1960 are not included in ‘All Causes’”. The impact on using the University of Pittsburgh database in the Burns, 2002 study: the deaths from the All Causes category were understated by 12.4% and the deaths from all non-malignant diseases were understated by 18.6%

A significant unknown is the mortality ratio (Obs. 1,657, Exp. ???, SMR ???) associated with these deaths and how these deleted deaths would have influenced the overall mortality of the Burns, 2002 study. The other unknown is which of the non-malignant disease categories were under-reported.

2. In the 1940-1994 time period, there were three major military conflicts: World War II, the Korean War and the Vietnam War. Some of the 1940 - 1994 cohort were “killed in action”. The Burns, 2002 study included these military deaths in the All Causes category. However, the study did not indicate the number of actual deaths nor did the study provide any information as to the number of “expected” deaths that were associated with the military deaths. As a result, it is impossible to determine the impact that the military service deaths had on overall mortality.
3. Burns, 2002 had a small problem keeping track of pay status of the 1940 to 1994 cohort. Table 5 provides additional information on difficulty.

Table 5
Pay Status of Cohort Members

	<u>Bond, 1987</u> (1940 – 1982)	<u>Burns, 2002</u> (1940 – 1994)
Hourly	21,437	23,400
Salaried, Exempt	11,364	12,375
Salaried, Nonexempt	4,819	2,925 ⇐
Unknown	62	3,376 ⇐
Total	37,682	42,076

I would think that it might be a little difficult to do any type of hourly vs. salaried mortality comparison when the pay status of 8% (3,376 employees) of the cohort is unknown. Perhaps, this is the reason why the Burns, 2002 study did not report mortality by Pay Status. As can be seen, the number of Salaried Nonexempt employees dropped from 4,819 to 2,925. Evidently, reducing the number of the salaried non-exempt employees that had a statistically significant elevation of Cancer of Other and Unspecified Sites (Obs. 14, Exp. 6.6, SMR 213, 95% CL **116** – 356) in the earlier study must be an acceptable epidemiology practice. Since the Burns, 2002 study did not report mortality from this category, it is difficult to determine if the reduction in salaried NE employees made any difference.

As long as the topic of reporting has been mentioned, there is another difference between the Bond, 1987 study and the Burns, 2002 study. Bond, 1987 reported that 1,666 employees died from cancer from 1940 to 1982. The Bond study provided specific information on **100%** of the cancer related deaths. The Burns, 2002 study reported 3,615 deaths from cancer but only provided specific information on **89% of the cancer deaths**. Why a 100% accounting was not provided in the Burns, 2002 study remains an unknown.

It's also interesting to note that, with all the cohort changes in Burns, 2002, the age distribution of the cohort appears to have shifted to younger employees, who coincidentally have lower overall mortality. Table 6 provides further information on the employment history of both cohorts.

Table 6
Midland – Bay City Cohort : Length of Employment

	<u>Bond, 1987</u> (1940 – 1982)	<u>Burns, 2002</u> (1940 – 1994)
< 1 yr.	8,648	10,331
1 – 4 yr.	8,509	10,886
5 – 14 yr.	4,730	7,436
≥ 15 yr.	13,406 (+ 4,730 = 18,136)	13,423
Total	37,682	42,076

Remember that 12 years have passed since Bond, 1987 studied the 1940 to 1982 cohort. Bond, 1987's 5-14 yr. group would now have 17 – 26 years of service had they continued working. Since both ≥ 15 yr. groups are approximately the same size (~13,400) in both studies, Dow eliminated approximately **4,700 older employees** from the cohort that Burns, 2002 studied. Elimination of the older employees from the study should have had a significant impact on the reported Overall mortality and the All Cancer mortality. It's rather odd that Dow apparently failed to track and report the mortality of the 4,730 employees that apparently left the company. **Off the payroll, out of the mortality study...** a novel approach, but certainly understandable given the workforce reductions that have occurred at Dow in recent years. There must not be a lot of Dow employees left in the Epidemiology Department... possibly not enough to keep track of those that died.

4. The mortality of the Magnesium Foundry workers that were “excluded” in the Bond, 1987 study but remembered in the Burns, 2002 study is shown in Table 7, *Mortality-Dow Magnesium Foundry*. The 2002 study provides additional data and only the mortality ratios for selected categories are shown.

Burns, 2002 made these comments on the foundry workers, (1) “The men and women employed at the foundry were not included in the previous [1987] study, unless they had worked at the other Bay City or Midland locations.” (2) “ Different organs systems contributed to elevations in deaths among the current cohort (i.e., digestive, respiratory,

and lymphatic), and the conditions were not limited to cancer.” (3) “Industrial hygiene reports in the foundry from the 1940s and 1950s focused on measuring and reducing dust, particularly silica dust. These reports also suggested potential exposure to sulfur dioxide, chromium oxide, fluoride, and formaldehyde.” (4) “The employees of the foundry had excesses of multiple causes of death.” (5) “... we do not recommend further study of this sub-cohort [foundry workers]...”

Table 7
Mortality Experience – Dow Magnesium Foundry Employees

	<u>General Dow Employees</u> (SMR (1))	<u>Dow Foundry Employees</u> (SMR)	<u>% Increase</u>
<u>Male Employees</u>			
All Causes (2)	103	114	+11%
All Malignant Neoplasms	94	111	+18%
Diabetes Mellitus	96	125	+30%
All Heart Disease	92	109	+18%
Bronchitis, emphysema, asthma	86	99	+15%
Average	94.2	111.6	+18.5%
<u>Female Employees</u>			
All Causes (2)	80	89	+38%
All Malignant Neoplasms	88	94	+7%
Diabetes Mellitus	38	125	+329%
All Heart Disease	68	109	+60%
Bronchitis, emphysema, asthma	76	99	+30%
Average	70	107.4	+53.4%

(1) SMR = Standardized Mortality Ratio = Actual deaths/Expected deaths x 100

(2) Non-disease related deaths (accident, suicide, killed in war) excluded

(3) Averages - numerical average

“... we do not recommend further study of this sub-cohort [foundry workers]...”

This must be comforting to the foundry workers, both male and female, that are still alive.

5. Although the 1982 and 1994 studies can not be compared precisely due to the change in the cohorts, it is possible to examine the 1994 study and determine if any worker mortality is increasing at a rate that is higher or lower than expected. Although, most mortality studies do not include this calculation, I have found that a comparison of Expected Deaths per Employee can help to put some of the mortality data into better perspective. Table 8 below summarizes this information for both studies.

Table 8
Expected Mortality Per Dow Employee

	<u>1940–1982</u>	<u>1940–1994</u>	<u>Ratio</u>
Expected Deaths, All Causes	9,130	14,816	
No. Employees	37,682	42,076	
Exp. Deaths/Employee	0.2423	0.3521	1.4533

The higher Exp. Deaths/Employee for the 1940 to 1994 cohort (0.3521) indicates that the average age of the later cohort is older than the average age of the previous 1940 to 1982 cohort. The ratio between Exp. Deaths/Employee (1.4533) between each study can now be used to determine if category-specific mortality of the 1940 to 1994 cohort is increasing faster or slower than expected. This comparison is shown in Table 9, *Dow Chemical Workers – Midland and Bay City Sites: Mortality Comparison*. The table shows that the mortality from **All Malignant Neoplasms** (1940-1994) was **50% higher** ($2.17/1.45 \times 100$) than the Expected Deaths/Employee increase. The Deaths from **All Causes** (1940-1994) were approximately **19% higher** than expected. **Mortality from fifteen (15) specific cancers increased at rates that were higher than expected.** Mortality from only three diseases increased at a rate that was lower than expected.

Table 9

Dow Chemical Workers – Midland and Bay City Sites: Mortality Comparison

<u>Category</u>	1994/1982 (1) <u>RATIO</u>
<u>MORTALITY GREATER THAN EXPECTED</u>	
Prostrate Cancer	3.17
Kidney Cancer	2.58
Mesothelioma	2.57
Cancer of Other Lymphatic Tissue	2.55
Cancer of the Pancreas	2.35
Cancer - Other Respiratory Organs	2.33
Cancer - Large Intestine	2.21
All Malignant Neoplasms	2.17
Cancer of Digestive Organs	2.09
Cancer of the Bladder	2.05
Leukemia-Aleukemia	1.93
Lymphatic - Hematopoietic Cancer	1.92
Cancer of the Rectum	1.84
Cancer of the Stomach	1.79
Cancer of Central Nervous System	1.77
Deaths From All Causes	1.72
Liver Cancer	1.49
Hodgkin's Disease	1.47
 Ratio- All Expect Deaths - 1994/1982	 1.45
 <u>MORTALITY LESS THAN EXPECTED</u>	
All Heart Disease	1.38
Lymphosarcoma- Reticulosarcoma	1.34
Cancer of Testes and Other Genital Organs	1.15

(1) (1940-1994) Deaths/(1940-1982) Deaths

(1940 to 1994 Cohort vs. 1940 to 1982 Cohort)

This section concludes the topic of mortality studies. I would like to thank the readers for being patient and working through the various concepts that must be understood about mortality studies. I believe that many of the readers are now more knowledgeable about a difficult subject and are now better able to judge whether Dow's various statements about the "excellent" health of its workers are true or merely "PR spin."

The association between dioxin exposure and increased mortality from a wide variety of diseases is at the heart of the many issues that still remain unresolved in Midland and along the Tittabawassee River. I believe that a critical examination of both Dow's and NIOSH's data has provided enough information to confirm, at least in the minds of the readers, that the risk of certain cancers and related deaths is increased by dioxin exposure.

I believe that many readers now recognize that "All is not well" with current and former employees of Dow Chemical – that their health has been impacted and their lives shortened not only by dioxin exposure but by non-specific chemical exposure as well.