Source: Lloyd Tataryn. 1979. Dying for a Living. Deneau & Greenberg.

4. Arsenic and Red Tape

TO MOST OF US, ARSENIC IS A SUBSTANCE QUANT LITTLE OLD LADIES slip into the tea of unfortunate gentlemen callers. That, after all, is the way two beguiling spinsters bump off visitors in the popular play and movie, "Arsenic and Old Lace". But little old ladies notwithstanding, arsenic does much more than poison people. Arsenic can produce skin lesions, nervous disorders, liver problems, respiratory ailments, and worst of all, cancer. Arsenic exposure should not be treated casually.

Yellowknife, the capital of the Northwest Territories, has experienced a succession of arsenic controversies (thanks to the activities of gold mines as opposed to old ladies) and has consequently become known as the arsenic capital of Canada. Two gold mining operations, Giant Yellowknife Gold Mines owned by Falconbridge, and Con Mine owned by Cominco, bracket either end of the Yellowknife town site. The gold-bearing ore dug up by the mining companies contains more arsenic than precious metal. Dumping the arsenic left over after the gold has been extracted has its drawbacks: vegetation dies, animals and fish are poisoned and waterways are contaminated. The health of exposed people is also endangered.

Gold mining and smelting have been operating on a consistent basis in Yellowknife since 1948. By the middle of February, 1949,

two men working one and a half miles north of Giant Mines were hospitalized with a definite diagnosis of arsenic poisoning caused by drinking contaminated snow-water.[1] In May of the same year, a herd of cattle imported for dairy production was wiped out by arsenic poisoning after ingesting contaminated water and vegetation.[2] A year later, an Indian child died after consuming snow laced with arsenic. The first of a series of arsenic check-ups of Yellowknife was initiated after these events occurred.

The town has undergone an intensive arsenic investigation at least once every decade since the gold extracting operations began. Each examination was meant to bury, once and for all, the population's anxieties about the toxic substance. The results of each investigation have been heatedly debated.

Arsenic contamination has therefore continued to be an issue in Yellowknife. The most recent rash of arsenic controversies began in 1975 and mushroomed until, in 1977, the federal government appointed the Canadian Public Health Association to head what was hoped to be the last arsenic investigation of Yellowknife. These controversies probably would never have been ignited if René Mercier, the chief information officer for the health protection branch of Health and Welfare Canada, had not withheld a federal arsenic report from two journalists who asked for it. In November and December of 1974, Mercier informed Ottawa freelance journalist Michael McLoughlin and me in my capacity as a documentary producer for the CBC radio program "As It Happens" that a 1969 federal arsenic health study of Yellowknife was an "internal document" unavailable to the public. We had been independently investigating the arsenic story and as a result of Mercier's decision to withhold the document, we intensified our arsenic research endeavours.

After a series of queries, a copy of the arsenic survey arrived by mail to "As It Happens" from an "unofficial" source. The report was then sent by the CBC to three arsenic specialists for their assessment. Another call was placed to René Mercier in Ottawa to determine if the study in the meantime had been made available to the public. Again he refused to hand over the document to the CBC

or to freelancer McLoughlin[3] who also repeated his request for a copy.

Richard Bronstein, now executive producer of CBC's "Morningside" program, assisted in the airing of the arsenic documentary. "We knew the story would create a controversy as soon as we were told by the health department we couldn't have the report," says Bronstein. "It's always interesting when someone says you can't have a report you already have."

In early January, 1975, an arsenic documentary based on the 1969 federal study was ready for broadcast. A final attempt was made to obtain the report from "official" sources before the documentary was aired. The parliamentary library was asked for the arsenic survey but a search failed to turn up a copy of the study. Dr. Ali Uygur, director of medical services for the Mackenzie Zone of Health and Welfare, was telephoned in Yellowknife. He said he was unaware of the report since the survey had been conducted well before he had moved to the Northwest Territories. René Mercier was then asked again for the document. When he insisted the report was still an "internal document", he was informed that the CBC would broadcast excerpts from the arsenic study that evening.

Dr. Kingsley Kay is a toxicologist involved in research for New York's Mount Sinai Medical School and the U.S. National Cancer Institute. He has had firsthand experience with Yellowknife's arsenic problems. In 1956 he had headed an investigation of arsenic in Yellowknife for Canada's Department of National Health and Welfare.[4] On January 8, 1975, Kay made the following comments on the CBC documentary examining the federal Yellowknife survey which began in 1966 and was completed in 1969:

> What we've got here is a situation like the famous study of syphilitics conducted among black people in the southern United States twenty years ago. The U.S. Public Health Service decided for research purposes to divide a group of men suffering from syphilis into two groups. One group was given anitbiotics, and the other was denied treatment. The two groups were observed from time to time in order to compare the progress of men given medical attention, to those who went without treatment.
>
> The residents of Yellowknife, like the men in the U.S. experiment, are much like guinea pigs.
>
> We did an arsenic study of Yellowknife in 1955, the government of Canada has done another study in 1966, and perhaps they're going to do another study in 1976.
>
> But the fact of the matter is, we're experimenting. It was known in 1940 that arsenic exposure causes cancer, and when we come to the conclusion in 1976 or 1980 — and it will be about then — that these people have much more cancer than other people, then we'll say something has to be done about it. . . .
>
> That's what the history of these two studies show. And that's why I regard it as a human experiment — an experiment in which you make measurements to determine how much people are exposed to, and then wait to see what will happen to them.

Dr. Tom Hutchinson, a professor of biology at the University of Toronto, has conducted a number of environmental investigations in the Yellowknife region. On the 1975 CBC arsenic program he noted that pollution from the mines in the form of toxic substances like arsenic, lead, copper, zinc and cadmium has adversely affected the entire food chain in the area. "It's quite clear that the soil and some of the vegetation in the vicinity of Yellowknife are contaminated," he said. "So we are not just dealing with the water problem and with a problem through fish to man. We are dealing with an area which is in all respects contaminated. . . . Certainly we are talking of, in terms of sediment pollution in the Yellowknife region, the highest I have personally come across in North America."

Dr. Bertram Carnow, head of occupational and environmental medicine at the University of Illinois, spoke next on the CBC arsenic documentary about the consequences of arsenic exposure:

Everybody has heard about arsenic poisoning in large quantities but what people don't realize is that it can do things even at doses that don't kill. There are certain brain enzymes that are attacked by arsenic and also the heart muscle can be attacked, so arsenic can hit virtually every system. It can cause lesions of the skin, it can cause redness or discolouration and eventually it can cause cancer of the skin. It can affect the nervous system in the brain so when we see people who have taken a fair amount of arsenic they develop motor palsy and they can develop abnormalities of balance and walking.

Much of our medical information relates to working people. These are adults who are usually resistant people. The tremendous concern that we have relates to people who we call high risk people. These are aged people, who have poor circulation to begin with, or very young children who may be exposed over a prolonged period of time. And this is very different from an adult. We're finding out that children can have a lot of serious effects at levels adults are not bothered by at all. When we see this kind of material out in the general public, it's very bad. Is there a safe level of exposure? Anything that produces cancer, as far as I am concerned, has *no* safe level for a number of reasons. We don't know how much arsenic it takes to produce a cancer. Nobody knows that. We do know now, however, that the longer someone is exposed to it the better their chances of contracting cancer. It takes twenty, thirty or forty years for somebody to develop this disease. When you have a disease like that — once you have it you're dead or the possibility of a cure is extremely small — then that kind of material should not exist in the environment. As far as I am concerned, there is a *zero* tolerance to this sort of thing.

Carnow made these comments about the 1969 federal health study of Yellowknife which had been sent to him by the CBC:

They found what's known about arsenic. They found an increase in deaths from heart disease. Well, we know that arsenic does affect the heart muscle. As a matter of fact there are a number of studies which have shown abnormalities in electrocardiograms even with relatively low arsenic exposures. The fact that there are increased deaths from heart disease in a pioneer population — that is a population which should be much healthier than people in cities — suggests very strongly to me this may be related to the arsenic. In terms of the cancers of the blood, the leukaemias and lymphomas they found in excessive numbers, this too is very significant because these are not common cancers and when you find that number of cancers in a relatively small population, then it would seem to me something should be done immediately.

The federal survey of Yellowknife, which began in 1966 and was completed in 1969, uncovered a high prevalence of the following abnormalities in the people examined: skin lesions, respiratory diseases, codable electrocardiographic changes, a higher than expected death rate due to diseases of the respiratory system, an excess number of cancer deaths — all factors coincident with arsenic exposure.[5] Nevertheless, the number of people examined was relatively small and the town's population is also small. The authors of the 1969 report were therefore hesitant to attribute the ill health found to arsenic exposure. They carefully noted, however, that the maladies observed were the very ones physicians would expect to find in an arsenic-loaded community.

The citizens of Yellowknife reacted in anger to the CBC arsenic documentary. Bill Walton, a former Yellowknife alderman, furiously suggested "the bureaucratic asses who decided . . . whether or not the study ought to be released should be hung from the nearest tree."

"I tried to get a copy of the study for six years," said former mayor, Fred Henne. "I was a private citizen when I was one of the participants in the 1966 health study and later when I spent a full day in my boat helping a federal government man take hundreds of water samples in the Yellowknife Bay. When I got in the chair as mayor in 1968, I thought, now I am in a position to get a copy of the study. Northern Health Chief Dr. Gordon Butler kept saying he would get me a copy, but I've never seen it."[6]

In the face of heavy criticism, federal Health Minister Marc Lalonde promised to upgrade Yellowknife health services and

launched a new comprehensive arsenic survey of Yellowknife. Lalonde also said the 1969 arsenic study really had been made public. Although no one associated with the town council could recall ever seeing the report, Lalonde pointed out that a copy had been sent to the town in 1972 (well after the study's completion). No other copies had been distributed outside the federal and territorial government. In fact it wasn't until the CBC arsenic broadcast that copies were sent to the parliamentary library or even to the national health and welfare library and the medical services library of National Health and Welfare.[7] No explanation was given as to why René Mercier had told freelance journalist Michael McLoughlin and the CBC program "As It Happens" that the report was an "internal document" and unavailable to them.

In 1977 yet another investigation of Yellowknife's arsenic difficulties was conducted by a Canadian Public Health Association Task Force. The investigators made this observation on the candour of federal health officials:

> The task force has found that there was a *failure to communicate* the findings of the earlier studies to concerned groups and individual members of the public. The reasons behind this lack of communication have been the subject of speculation by members of the media, including the charges of cover-up by the federal government and bureaucratic incompetence. The controversy has been further fuelled by an apparent disparity in the data reported in, and the conclusions drawn from, the government studies and those resulting from a study done jointly by the United Steelworkers of America and the National Indian Brotherhood. It is possible, of course, that another factor in the early failure to communicate the findings of the government studies to the public was the desire not to alarm the public if, in fact, no threat to community health was definitely shown to exist.[8]

Dr. Bertram Carnow says there is little justification for "failure to communicate" early studies such as the 1969 Yellowknife report, for whatever reason. "For the world at large, studies such as this become a very important part of the international literature and make it possible for the rest of us who are concerned about

these materials to then take appropriate action. We have to bu up a body of knowledge of this kind and if people don't report t in the general medical literature, it is impossible for us to determi the level of protection people are going to require."

It wasn't until after the CBC arsenic documentary th references to the 1969 Yellowknife arsenic began appearing in t international scientific literature.[9]

But if Health and Welfare Canada can be criticized for failing keep the international scientific community abreast of the arse situation in Yellowknife, the department can be doubly chasti for failing to inform the people who have lived in the area for long as man can remember — the native people — of the full ext of the arsenic hazard. The 1969 federal investigation examined water supply for the town of Yellowknife. This is what they fou:

> It is seen that the water supply was within acceptable limits less th 16 per cent of the time. . . . Approximately 15 per cent of the time, water supply is estimated to have been above the maxim permissible level of 0.05 ppm. On one day, June 20, 1966, the wa contained 2.92 ppm. . . . This value is ten times greater than generally accepted emergency level of 0.3 ppm.
>
> In the months of June and July . . . the water was of accepta quality only 1.3 per cent of the time. *In no one month could one estimate the water would be of an acceptable standard for more than 30 per cent o time.*[10]

In 1969, the federal government announced a $1 mill pipeline construction project to bring water from the Yellowk River to residents of Yellowknife. The river is upstream from Y lowknife Bay, the old water supply source for the town, and a from the mines which dump arsenic-saturated effluent into Bay. Fred Henne, Yellowknife's mayor at the time, says that town council was never told why the town had been granted windfall project.[11]

The Latham Island Indian community sits on the edge of the Yellowknife town site directly across Yellowknife Bay from Giant Mines. Indians continued to take water directly from Yellowknife Bay long after arsenic-free water was piped into the homes of the white citizens of Yellowknife from the Yellowknife River. The Latham Island Indian community was not hooked up to the pipeline. It wasn't until the spring of 1974 that signs in English were posted on Yellowknife Bay warning people that drinking the water could be hazardous to their health. It wasn't until the fall of 1974 — five years after a clean water supply had been provided for the town of Yellowknife — that signs were posted in the *native* language warning the Indians of the potential hazard. A water truck made deliveries throughout this period to Latham Island residents who paid a five-dollar fee. Those on welfare could apply for free delivery.

Nevertheless, some people from Latham Island chose not to pay the fee or apply for free delivery. One such person was Mike Sikyea, a seventy-year-old Dogrib Indian. He was interviewed on the January 1975 "As It Happens" documentary along with Marion Betsina, also a Dogrib Indian and a mother of seven children.

Question: Mr. Sikyea, are you drinking water from the lake or are you taking water from the delivery service?
Mr. Sikyea: We usually get water from the ice, we take ice from the lake.
Question: How are you getting it?
Mr. Sikyea: I pull it on a trailer. I pull it on the sled. I just use ice water.
Question: What's the problem here, Mrs. Betsina, is it not convenient to deliver it to anybody?
Mrs. Betsina: Well, the City Hall wanted every house who got water delivered to it to pay their bill — five dollars a month. Some people cannot afford that, eh? Old folk, old pensioners, like Mike, who cannot afford it.
Question: So he goes down to the lake and takes the ice?
Mrs. Betsina: Yes, a lot of people do that.

Question: So this water service is not automatically included in any service?
Mrs. Betsina: No.
Question: How many people like Mike Sikyea are scraping ice off the lake for their water supply?
Mrs. Betsina: Oh there's lots of old pensioners in Yellowknife. There in the Village, there's a lot of old people.
Question: And it's money that's keeping them from getting the water service?
Mrs. Betsina: Yes...
Question: Mr. Sikyea, has the Government ever warned people about the arsenic, do you think, sufficiently? Have they told them exactly what arsenic is doing to people?
Mr. Sikyea: You see the Chief doesn't even understand the English. They don't understand what they're talking about.
Mrs. Betsina: I don't think the Government ever did come around or talked to the people about arsenic. We are the ones. We just found it out just recently, you know through the Health Centre, eh? Then we start seeing the signs.
Question: How long ago did the signs go up?
Mrs. Betsina: Oh just this, maybe in June or May or June anyway the signs came up.
Question: Did they know about arsenic much before that?
Mrs. Betsina: Yes, they knew that and the Indian sign came up just recently. The Fire Department Chief, he came down to Mike Sikyea's place. I brought him there to read the Indian sign.
Question: Before that the sign was only in English?
Mrs. Betsina: It was only English.
Question: Mr. Sikyea, how come you are not following these warning signs? Why are you still drinking that water?
Mr. Sikyea: Because I don't want to pay for my water.
Question: You don't want to pay for water?
Mr. Sikyea: Ya. Before the white people came in 1914 there were not a soul of a white man around here. I and the people were feeling happy that time.

And when they start the mine that is the time the water is getting spoilt. It is getting worse now.

The position of Indian leaders in the Yellowknife area has always been that Indians should not have to pay for a resource they once enjoyed free of charge and unpolluted. They say that the mining companies, in their quest for profits, should not be allowed to impose the cost of water delivery on their already meagre resources. In their opinion, the companies should provide free, uncontaminated water to the Indians whether the people are on welfare or not.

After the 1975 CBC documentary, federal Health Minister Marc Lalonde promised to pay particular attention to "native people and high risk groups such as children"[12] in their 1975 arsenic investigation of Yellowknife. In May of that year, Health and Welfare Canada announced the results of hair arsenic levels in the people tested by the department.[13] (One of the ways arsenic is eliminated from the body is through hair growth. The simplest way to detect arsenic ingestion is to clip hair from someone's scalp and examine it for arsenic content.) In the government hair survey, smelter workers were found to have high arsenic hair levels along with "a small number of individuals". No mention was made of native people in the release of the survey. No mention was made of native children and their arsenic levels.

The seven hundred people who participated in the 1975 government hair survey were not chosen randomly. They were not part of a scientifically selected group. They were volunteers. It is important to note that if the Gallup organization ever based a poll on a volunteer sampling of voters, no astute observer of politics would ever take that poll seriously.

But in 1977, the Canadian Public Health Association Task Force on Arsenic came to the following conclusion: "Indian people and particularly Indian children are acquiring an increased arsenic load."[14] The task force concluded: "The levels are considered sufficiently high to require further investigation and continuing surveillance." The task force also noted: "This

phenomenon has only been demonstrated in native children. T same tendency may exist in the general child population." T task force recommended "additional hair sampling in the gene child population."[15]

Health and Welfare Canada did not uncover the fact tl "Indian people and particularly Indian children are acquiring increased arsenic load;" this fact was uncovered first in 1975 by National Indian Brotherhood working in co-operation with th affiliate, the Indian Brotherhood of the Northwest Territories (n re-named the Dene Nation). When the Dene (the Indian word people) informed the National Indian Brotherhood that ma Indians had been missed in the government's volunteer survey, National Indian Brotherhood decided to launch a small arse investigation of its own. Hair was clipped from eighteen Indi missed in the government survey and sent to the University Toronto for arsenic analysis. The Indian organizations hoped federal government would launch a more intensive examinatio the group it originally called a "high-risk population", if eighteen people were found to have high arsenic levels.

Hair samples collected by the National Indian Brotherhood a Dene Nation from eighteen of the hundreds of Indians misse the 1975 government volunteer survey were found to have h arsenic levels. Some of the Indian children tested were foun have particularly high arsenic levels. The Indian people w briefed on the findings and the names of those tested were han over to Health and Welfare Canada. The government was urge conduct another study based on a scientifically selected san rather than a volunteer sample.

Federal officials made it clear that they were not impressed v the Indians' independent arsenic survey. They pointed out National Indian Brotherhood survey was nowhere near the siz the seven hundred volunteers examined by the government searchers. On October 3, 1975, in a Yellowknife press confere Dr. Richard Eaton, programs medical officer for the North Territories region of the medical services branch of Health Welfare Canada, explained that there were "no plans to do fur

tests of the general public."[16] This meant no further tests would be done of the native population.

Eaton elaborated on the hair survey conducted by Health and Welfare. "Ten parts per million we took as a guideline to split our population to see who was the most likely group to find something in. Normally it is said in an exposed population if the hair level is less than 100 parts per million, you're wasting your time looking for clinical evidence of arsenic toxicity. We divided that by 10. We decided to be ten times as safe as we could have been." Eaton reported, "There was only one member of the general public who had a really significant level of arsenic in the hair."

Dr. Eaton's comments on hair arsenic levels were made without comparing the Yellowknife findings to samples taken from a population not exposed to arsenic. No control group was used in Health and Welfare's 1975 arsenic survey of Yellowknife.

Eaton's comment about safe levels of hair arsenic can be put in further perspective by relating an incident involving the arsenic hair content of a famous historical figure. In 1961, historians began debating the circumstances surrounding Napoleon's death when a group of forensic scientists announced the results of arsenic hair levels taken from Napoleon's body. The investigators speculated that Napoleon's death on May 5, 1821, may have been a result of chronic and acute arsenic poisoning. They noted the torments experienced by Napoleon during his last days in exile on St. Helena were coincident with the symptoms of arsenic poisoning. They cited as evidence the opinion of the medical officers who attended Napoleon during his fatal illness, as well as the diagnosis of the physician who performed the autopsy on Napoleon. The medical men disagreed with the diagnosis that the former emperor of France had died from cancer. And they added fuel to the poisoning theory by reporting that "the value found for the sample of hair (from Napoleon) was 10.38 parts per million (ppm). This is high by comparison with the normal mean arsenic content of about 0.8 ppm."[17]

All but one of the National Indian Brotherhood's eighteen samples collected from people missed in the government's volun-

teer survey had arsenic hair levels above 0.8 ppm, the le
reported to be normal as far back as 1961. Two children had lev
almost double the arsenic level which stimulated the debate on
possible poisoning of Napoleon.

Dr. Eaton was asked at his Yellowknife press conference: "A
there no long-term effects of arsenic poisoning?" He replied: "Y
Mostly they express themselves as thickening of the skin, wa
expressions in skin. You also get lines in the fingernails.

"There has been some publicity given recently to the possil
ities of long-term arsenic exposure being related to an increase
carcinoma and cancer. I would say that this is still rather dou
ful."[18]

Dan Billing, the territorial government's chairman of
standing committee on arsenic agreed with Dr. Eaton. Bill
pointed out that "one expert in the United States has claimed t
in fact arsenic is an anti-cancerous agent."[19] On the national C
television program "90 Minutes Live", Billing told host P
Gzowski: "Supposing someone decided that bathing in seaw
could cause cancer. Would you say that everyone in the wo
should stop bathing in the sea until they found out if it was tru
not?" Billing added, "There certainly is no obvious evidence t
[arsenic] is carcinogenic. There is none. Every piece of evide
that is brought forward is in dispute."

Despite Eaton's and Billing's assurances, the documentat
linking arsenic exposure to cancer and a host of other diseas
considerable.

In 1820, Dr. A.J. Paris attributed scrotal cancers among cop
smelter workers in Cornwall, Wales to exposure to arsenic fum
In 1879, physicians who investigated "schneeberg lung" wl
afflicted miners (later diagnosed as cancer) blamed the condi
on arsenic dust.[21] Later research showed the cancers were prob
a consequence of radiation exposure.[22]

Arsenic for a long period was valued by doctors as a hea

poison. In 1887, the first study relating skin cancers to the use of arsenic for medicinal purposes was published.[23] But a recent study of Danish patients treated with arsenic for various diseases found a considerable increase in internal cancers and concluded that "arsenic has a carcinogenic effect even in relatively small doses." The investigators advised: "Arsenic should not be used in human therapy."[24]

In 1893, over half the inhabitants of Reichenstein in Silesia were found to eventually die of internal cancers. Gold ores containing arsenic were smelted in Reichenstein and arsenic from the fumes and slag contaminated the brooks from which the people drew their water supply.[25] A new water supply was provided in 1928, and what became known as "Reichenstein's disease" virtually disappeared.[26] In 1898, the citizens of Cordoba, Argentina, began falling victim to skin cancers in unusual numbers. Their water was contaminated with arsenic.[27] During the 1920's, arsenic was once more implicated in the development of cancers, this time in lung and sinus cancers in a Wales nickel refinery.[28]

Medical survey after medical survey has outlined the disease potential of arsenic. In 1948, an English factory manufacturing an arsenical sheep-dip reported an excess of cancer deaths amongst its workers.[29] In 1958, German vinegrowers exposed to arsenic insecticides were reported dying of various types of cancer. The rate of cancer deaths in these vinegrowers was an alarming 64 per cent.[30] A United States study of over eight thousand men conducted in the period between 1938 and 1963 showed an even greater incidence of death due to respiratory cancer, tuberculosis, diseases of the heart, and cirrhosis of the liver. All these men had been exposed to arsenic while at work.[31] A 1974 study of Japanese workers exposed to arsenic also observed a high incidence of lung cancer.[32] When a later, more comprehensive investigation of the same Japanese smelter was conducted, a twelve-fold increase of lung cancer and a three-fold increase of colon cancer was found amongst the workers.[33] In Sweden, workers exposed to arsenic on the job have been reported dying from lung cancer, cardiovascular diseases, leukaemia and cirrhosis of the liver at abnormal rates.[34]

Arsenic dumped outside the industrial plant gate has also been shown to induce diseases in the unlucky recipient communities. In 1955, the United States Department of Health, Education and Welfare reported that male lung cancer mortality rates in Montana counties with arsenic-emitting smelters were well above the U.S. lung cancer death rate.[35] A more recent study of Anaconda, Montana, a town where arsenic is emitted from a copper smelter, has observed an excess of lung cancer mortality among both men and women living in the community.[36]

In Germany, the 1958 study of vinegrowers and residents of wine-producing areas uncovered a significant increase in lung cancer among inhabitants of the Moselle River where pesticides containing arsenic were used. No elevated level of lung cancer was found among residents of the wine-producing areas of the Ahr River where pesticides containing arsenic were *not* used.[37]

In 1975, an American study compared the mortality rates in thirty-six counties, with refining operations releasing substantial amounts of arsenic, to the mortality rates of thirty-five counties where small amounts of arsenic were smelted. The study showed a significant increase in lung cancer mortality for males and females in the thirty-six arsenic-exposed communities when compared to the residents in the thirty-five relatively non-exposed communities. The authors of the study note that "the excess mortality was not attributed to differences in geographic region, population density, urbanization, socio-economic status, or other manufacturing processes." The investigators concluded that "the most likely explanation for the increased lung cancer mortality in this study is neighbourhood air pollution from industrial sources of inorganic arsenic."[38]

A Swedish study of cancer mortality in an arsenic-exposed area observed similar disturbing disease patterns. An increase in female cancer deaths was found, and an increase in male cancer deaths was noted when the lung cancers of the men occupationally exposed to arsenic were included in the cancer evaluation.[39]

Further investigations of the arsenic-contaminated Swedish area were conducted. The birthweight of the offspring of women

working in the smelter was examined, as was the birthweight of children born to women living at four different distances from the arsenic-polluting operation. The researchers found a decreased birthweight in the offspring of employees and in two populations close to the smelter. The authors suggest environmental pollutants may have affected fetal growth and shortened the gestation time (and therefore the birthweight) in the pregnancies.

An examination of spontaneous abortions in the four areas surveyed found an increased frequency of miscarriage in the area closest to the plant. The authors concluded: "While explanations in terms of differing socio-economic backgrounds in the areas examined are possible, a more probable explanation appears to be pollution from the smelter causing an increased frequency of genetic damage."[40]

Although medical evidence documenting the cancerous consequences and other deleterious effects of arsenic exposure has risen steadily, industries (and Health and Welfare officials like Dr. Eaton) have long contended that the link between cancer and long-term arsenic exposure is doubtful. Arsenic-polluting industries have continually pointed to scientific surveys which showed that arsenic failed to cause cancer. Less well-advertised is the fact that the key studies rationalizing arsenic exposure are industry-sponsored investigations.

Two key investigations of a major U.S. arsenic polluter, the American Smelting and Refining Company (ASARCO) were headed by Dr. Sherman Pinto (with ASARCO support). In 1953, the researchers concluded that while arsenic dust may have produced an irritant effect on body surfaces of workers, systemic poisoning from arsenic inhalation was rare.[41] Ten years later, Pinto concluded in another study of the same ASARCO plant that arsenic exposure had no significant effect on worker cancer mortalities.[42] These findings have since been challenged.

For his study, Pinto divided people working in ASARCO's

operations into "exposed" and "non-exposed" categories. But because he failed to choose a control group from an arsenic-free environment, Pinto in effect reached his conclusion about the relative safety of arsenic exposure after comparing two populations "exposed" to arsenic.[43]

The U.S. Department of Health, Education and Welfare's research agency, the National Institute for Occupational Safety and Health, conducted an examination of Pinto's findings. When the cancer deaths in Pinto's supposedly "exposed" and "non-exposed" workers were combined, it was found that ASARCO workers were dying of cancer at more than twice the expected rate.[44]

Pinto's mortality statistics have also been called into question because the study was only of ASARCO's active plant employees and pensioners. It failed to take into consideration the total working population at risk, since workers who left the plant before retirement were excluded. A further update of Pinto's study population found a number of cancer victims not included in Pinto's original evaluation. This brought the number of ASARCO cancer deaths to three times that of people not exposed to arsenic.[45] Since the publication of these results, Pinto has produced a study of ASARCO workers *confirming* the two critical evaluations of his work.[46]

A study conducted by Dow Chemical Company also helped puncture the argument that arsenic has failed to produce cancer. When the Occupational Safety and Health Administration (OSHA) announced that the U.S. arsenic exposure standard was to be re-evaluated, Dow Chemical submitted a study of one of its pesticide plants which by then was no longer in production. Dow reported that "a significant increase in respiratory cancer was found among the exposed employees."[47] Industries with workers still exposed to arsenic generally handed in less candid results to OSHA. A report produced by the Kennecott Copper Corporation (KCC) of its existing operations is a case in point.[48] OSHA blasted the KCC study for submitting "diluted results" of its smelter workers by including workers in the study not at risk from arsenic

exposure.[49] OSHA later received an independent survey of cancer deaths in Kennecott's operations which found workers in the Utah plant with a lung cancer mortality three times that of the state population.[50]

The testimony at the OSHA hearings into the establishing of a U.S. arsenic exposure standard generally ran true to form: arsenic-polluting industries produced data which attempted to justify arsenic exposure; independent scientists contradicted the industry data.

And in Canada, Health and Welfare officials were true to form in their pronouncement on the Yellowknife arsenic situation. Dr. Richard Eaton informed the citizens of Yellowknife in his October 3, 1975, press conference, "Our cancer statistics of people in the Yellowknife area are one-quarter the national cancer statistics." He added, "If there were an increase in the cancer level in the mines, it would be reflected in the total cancer mortality, and the total cancer mortality is very much lower than anywhere else in Canada."[51]

Eaton did not base his comments on any government, industry, or independent epidemiological study of Yellowknife cancer deaths. Such a study has never been conducted of the territorial capital's residents or gold mine workers.[52]

Upon discovering that no epidemiological investigation of cancer deaths had ever been launched in Yellowknife, researchers at the National Indian Brotherhood (NIB) approached demographers at Statistics Canada to determine if Health and Welfare's cancer claims for Yellowknife were correct. Statistics Canada indicated Yellowknife actually had a *higher* cancer death rate than the overall Canadian rate.[53]

It is impossible to state beyond a shadow of a doubt that arsenic is the cause of Yellowknife's high cancer death rate when compared to the Canadian rate (2.4 per thousand as compared to

1.4 per thousand). Yellowknife's population is small and the number of cancer deaths observed, although elevated, was correspondingly small. It is difficult to reach iron-clad conclusions when working with small numbers. (Yellowknife's white population also tends to retire to more hospitable climates and cancers are generally more prevalent in older groups.) It is possible to state with certainty, however, that Health and Welfare Canada's claim that "cancer statistics of people in the Yellowknife area are one-quarter the national cancer statistics" is false. Apparently Health and Welfare Canada officials never bothered to check with the demographers of Statistics Canada when they made their Yellowknife cancer death rate claims.

In addition to conducting poor research, federal officials have made a practice of playing down the risks of arsenic exposure. Consider the following memorandum (originally obtained and made public by the author) written by the head of Environment Canada's air pollution control section for Canada's northwest region to his Yellowknife district manager. It dealt with the Canadian "industrial hygiene standard for arsenic" and began this way:

> I was advised yesterday afternoon that [the U.S.] organization that sets industrial hygiene standards for in-plant environmental conditions, has recommended that the previous arsenic eight-hour-exposure limit, be reduced from 500 micrograms per cubic metre to 4 micrograms per cubic metre. . . .
>
> This very dramatic change in the industrial hygiene standard resulted from the review of an old study upon which the [old standard] was based. The known carcinogenic characteristics of arsenic, confirmed in two recent studies, had prompted the review.

The Environmental Protection Service chief concludes his memorandum this way: "*It would be advisable not to release this information to the public as it may cause undue concern at this time.*"[54]

The federal government's public relations antenna also proved very sensitive to the possibility of criticism over the amount of arsenic the Falconbridge-owned Giant Yellowknife Gold Mines continued to spew into the air. In August, 1975, the Environmental Protection Service conducted a test of the amount of arsenic shooting up Giant's smelter stack.[55] It is important to know the amount of arsenic released, of course, since this arsenic mixes into the Yellowknife soil, is bound up in the Yellowknife vegetation, and is absorbed and inhaled by Yellowknife citizens. The government investigators monitored the effluent from Giant Mine's stack for a one-week period.[56] At the same time, researchers at the National Indian Brotherhood obtained the results of Giant's own monitoring of its stack emissions.

Environmentalists and union officials are usually sceptical when companies police their own pollution levels. Independent tests show that companies generally underestimate how much waste they expel. In Yellowknife, the reverse is true — Giant Mines admitted dumping more arsenic than the government study said they were dumping.

The government's arsenic effluent figures were compared by the National Indian Brotherhood researchers to the amount of arsenic Giant Mines acknowledged spewing into the environment. One week before the government survey began, company records show Giant Mines dumped 400 per cent *more* arsenic than the government investigators recorded in their week of monitoring. One week after the government finished its testing, company records again revealed 400 per cent *more* arsenic shooting up Giant Mines' stack than reported by the government. On no single day throughout the year did the company's effluent measurements approach the low figures reported in the government survey.[57]

In January, 1977, the National Indian Brotherhood issued a statement on the discrepancy between the government and company arsenic emission figures:

> Either the government study is fraudulent, or it's inadequate. Either the government data has been manipulated, possibly by monitoring in a time of low production, or the data has been gathered incorrect Either way, the government figures are questionable.

William Moore, Giant Mines' general manager, was quick issue a statement that the company had the utmost confidence the monitoring system set up by the federal government. He not that after 1953, "using the best and most up-to-date technolo available, Giant installed at considerable cost an extreme efficient system for recovering arsenic from the exhaust gases fro the roaster and for removing arsenic from the environment which the mill employees work."[58]

In its final report, the 1977 Canadian Public Health Associati Task Force on Arsenic expressed the following views on arser emissions: "The present arsenic input into the Yellowkn environment can be decreased by 1979 to about 20 per cent of present level."[59] In other words, the arsenic pollution could l reduced by 80 per cent. The task force observed:

> Available data on emission rates are not consistent, varying from average emission rate calculated by the Environment Protection S vice at 167 pounds per day, to rates of the order of 500 pounds per d quoted by the company. These differences may well be due variations in measurement techniques, or to production variatic during the test period. In any case, it is clear that further reductions emission rates are required and can be achieved.
>
> ... Giant Yellowknife could be expected to reduce emissions approximately 25-30 pounds per day of arsenic. This, of course, wou be a significant improvement over the emission rates currently bei experienced at the Giant smelter.[60]

The government's manoeuvres to minimize the arser difficulties in Yellowknife produced distrust among the gold mi workers. It also heightened the native people's suspicions th government officials had little concern for their well-being.

These suspicions were compounded when, at the time the National Indian Brotherhood began directing its research efforts into the Yellowknife arsenic issue, the author, acting as co-ordinator of the investigation, uncovered a training manual used in the Northwest Territories correctional services. The training manual, put together by a committee in 1971, was loaded with racist comments. It had been used in at least two employee instructional sessions before its withdrawal from circulation.

Two of the sections of the manual under "Indian Psychology" are headed, "The Indian is an adolescent", and "The Indian is an oriental". The contents of the manual illustrate why many Indian people have grown sceptical of northern government officers in recent years. The manual states "the characteristic trait of the Indian comes from his mongol origin." It claims:

> Like the Japanese, he [the Indian] copies to perfection but has no creative artistic genius. His lack of imagination and his ignorance of somewhat complicated human sentiments are manifest in his way of acting on the stage; his musical talent is rather technical, his interpretation of drama or music is not original, it is soulless.

The manual adds:

> Having nothing that is his, neither glorious past nor autochton (original) culture nor religion nor country, he feels insecurity and seeks all the possible means of evasion; dreams, drink . . . the ready pleasures of the flesh, simple and unromantic, without perversity nor abnormality, for the sole brutalizing pleasure of sex naturally accomplished.

It says the Indian's key weakness is weakness of will. This makes the Indian fearful, easily tempted, inconsistent and timid. The manual attributes to the Indian a deceitful mentality and describes him as one whose "intellectual inertia hinders him from following our adult intellectual cadence." The manual contained no equivalent section on the characteristics, culture and abilities of white people.

When the training manual was made public at the National Indian Brotherhood general assembly in Whitehorse in 1976, Northwest Territories Chief of Corrections Clare Wilkins accepted blame for allowing it into the correctional system. He resigned from his position. Granted early retirement, he maintained that other people read and approved the document before it was used. "It looks increasingly as if I'm the fall guy," said Mr. Wilkins the day he resigned.[61] (The other board members who Wilkins said initially approved the manual retained their jobs.)

After their 1975 hair-sampling campaign, federal health officials indicated there would be no further tests of the general public. Members of the National Indian Brotherhood and Dene Nation expressed concern since their small, independent survey of Indians who were missed in the government's sampling of volunteers had discovered people with high arsenic levels. The Indian organizations concluded that only another, larger, independent survey would uncover the true extent of arsenic exposure in the Indian communities. The National Indian Brotherhood therefore worked out an agreement with the United Steelworkers of America to conduct a joint study of the organizations' respective members. (The United Steelworkers represented both the workers of Giant Mines and Con Mine until the Giant local switched union loyalties in a membership raid by the Canadian Association of Smelter and Allied Workers.)

On January 15, 1977, the National Indian Brotherhood and the United Steelworkers of America held joint press conferences in Toronto and Yellowknife. They observed that numerous medical investigations contradicted statements by Health and Welfare Canada that a link between long-term arsenic exposure and an increase in cancer was "still rather doubtful". The organization

pointed out that Health and Welfare Canada's claim that "cancer statistics of people in the Yellowknife area are one-quarter the national cancer statistics" did not coincide with evidence compiled by Statistics Canada. The Indians and union members contrasted the federal government's emission claims for Giant Mines' smelter with the company's own figures. The Indians and union showed that over 90 per cent of snow samples taken in a government survey of Yellowknife exceeded the Canadian safety standard; vegetables, especially leafy types, were found with high arsenic levels, arsenic in Yellowknife soil was as much as fifteen hundred times above normal and dust from the pavement in Yellowknife streets was up to forty times above normal.[62] As Dr. Tom Hutchinson, a biologist from the University of Toronto and a former head of the university's Institute of Environmental Sciences, commented at the press conference on the government's data on arsenic levels in Yellowknife's snow, vegetation and soil: "Yellowknife is probably the most severely arsenic-contaminated area in the world."

The United Steelworkers and National Indian Brotherhood (NIB) made public their independent arsenic hair survey. They also compared the government study based on *volunteers* with their survey. The independent survey was based on hair samples clipped from 100 per cent of the men who worked in Giant Mines' smelter, and 100 per cent of the children, aged six to thirteen, living in the community across the bay from Giant Mines' operations.

Unlike the government study, the National Indian Brotherhood-Steelworker study also used a control group. The Yellowknife samples were compared for arsenic content to hair samples cut from a randomly picked group of steelworkers employed in Whitehorse in the Yukon, and a randomly chosen group of Indian children from the Whitehorse Indian Band.

The hair samples collected by the Indians and steelworkers were analyzed for arsenic content in the nuclear reactor at the University of Toronto by Dr. Robert Jervis, the university's Dean of Chemical Engineering. (Dr. Jervis did not charge the organizations for his work.) As expected, the Yellowknife steelworkers had extremely high arsenic hair levels, as high as 278 parts per million

(ppm). (The federal study had also found high levels in Yellowk steelworkers.) Ed McRae, then the Yellowknife steelworker re sentative, said, "I don't want more measurements, I want a cle up. After all, it's been almost two years since they did their sur and we're finding that arsenic levels in the men haven't redu one bit."[63]

None of the Indian children and none of the steelworker Whitehorse had an arsenic hair level above 1 part per mil (ppm). In Yellowknife, all but two of the Indian children te had an arsenic level above 1 ppm. One 11-year-old boy had a l of 28 ppm. of arsenic in his hair. The government hair survey fo *no* Indian children with elevated arsenic hair levels. (The fed government's study, which had not used a control group, sugge it was common to find arsenic levels up to 10 ppm in unexpo populations, a level, they said, "generally considered ceptable".)

Noel Starblanket, president of the National Indian Brotherh wondered, "Why weren't these children found by Ottawa in t survey? This is the second time we've done independent test Yellowknife of Indian children and both times we've fo elevated arsenic levels.

"Ottawa may be unperturbed about the risk to Indian Yellowknife but we will not be content until the arsenic level Yellowknife Indian children are as low as in the children Whitehorse."

Dorothy Noyes Kane is a prominent U.S. commentator on vironmental health matters with a doctoral dissertation "Children, Pediatricians and Polluted Air" to her credit. K says concern about exposing children to pollutants is hardly r placed:

> Seven basic distinctions render children more vulnerable than ad to polluted air: higher inspiratory flow rate at rest, higher lev activity, closer proximity of breathing zone to the ground, r frequent respiratory tract infections, and age-specific developme factors.[64]

According to Kane, in proportion to their weights, children breathe in more air, and thus more pollutants, than do adults. Their manner of play (their dust-raising activities) and habit of putting their fingers in their mouths also adds to their consumption of pollutants. Kane says that "safety" standards, which have been most often set for adult exposures, have largely disregarded the greater susceptibility of children to pollutants.

Consequently, "many of the after-effects of airborne insults to our young population (and to our pregnant population) may be seen, not just in acute short-term ... disorders, but in long-term problems affecting both physical and mental well-being over a lifetime."

The Indian-union revelations then launched a slightly absurd urine-versus-hair debate. Government officials waved bottles of urine in the air while the union and Indians countered with fistfuls of hair. Health Minister Marc Lalonde criticized the Indians and union for failing to collect urine samples in their survey when "urinalyses are necessary to determine if health is really damaged or likely to be."[65] Health and Welfare officials reported that the "normal" urinary arsenic levels found in Yellowknife indicated that exposure was not a problem. The independent investigators maintained that the high levels of arsenic in the Yellowknife hair samples warranted a reduction in arsenic pollution.

Dr. Otto Schaeffer, who designed the federal study,* testified to the Canadian Public Health Association Task Force on Arsenic that Health and Welfare's use of a urinary arsenic index was based on the studies of Dr. Sherman Pinto.[66]

*The Yellowknife arsenic survey was not Dr. Schaeffer's first controversial Indian-related survey. In 1971, Schaeffer and three Edmonton colleagues published a study which apparently showed Indians metabolized alcohol more slowly than white people. (D. Fenna, L. Mix, O. Schaeffer and J.A.L. Gilbert, "Ethanol metabolism in various racial groups," *Canadian Medical Association Journal*, vol. 105 (1971) p. 472.) The study seemed to corroborate the Edmonton group's observation that Inuit and Indians take longer to sober up after an alcoholic debauch than whites and led to the suggestion that possibly genetic differences were implicated. (C.S. Leiber, "Metabolism of Ethanol and Alcoholism: Racial and Acquired Factors," *Annals of Internal Medicine*, vol. 76 (1972) pp. 326-7.) But upon evaluating the Fenna, Mix, Schaeffer and Gilbert study, various other scientists have delivered blunt criticisms of the study's design. In a letter to the National Indian Brotherhood (September 18, 1978), Dr. Howard Kalant, professor at the University of Toronto Department of Pharmacology pointed out that in fact, the Edmonton team compared the alcohol metabolism rate of sick Indians to healthy whites. "First, most of the Indian and Inuit subjects were hospitalized patients while the Caucasian subjects were healthy medical students and hospital staff... The second reason is that there are internal consistencies in the results. ... Finally no one else has been able to confirm the findings reported. Some groups have reported no difference between Indians and Caucasians with respect to rate of alcohol metabolism. Several groups, including our own, have found that Indians and Orientals actually metabolize alcohol more quickly." (T.E. Reed, H. Kalant, R.J. Gibbons, B.M. Kapur and J.G. Rankin, "Alcohol and acetaldehyde metabolism in Caucasians, Chinese and Amerinds," *Canadian Medical Association Journal*, vol. 115 (1976) pp. 851-5.) Other critics observed that the white control population in the Fenna, Mix, Schaeffer and Gilbert study had an unusually high rate of alcohol metabolism, somewhat similar to that found in alcoholics or in very heavy drinkers. (L. Goldberg, "Introduction" in M.W. Everett, J.O. Waddell and D.B. Heath, (eds) *Cross-Cultural Approaches to the Study of Alcohol* (Chicago: Aldine, 1976) p. 7.)

Two other studies question the Edmonton group's findings. Researchers from the University of Oklahoma examined a group of Indians living their traditional life-styles with a diet very unlike the standard white man's diet. They found that Indians "metabolize ethanol faster than do Caucasians. These last findings are in direct conflict with the findings reported [by the Edmonton group]." (see A.R. Zeiner, A. Paredes and L. Cowden, "Physiologic Responses to Ethanol Among The Tarahumara Indians," *Annals of the New York Academy of Sciences*, vol 27 (1976) pp. 151-8.) Another study conducted by researchers at the University of Indiana reported, "In contrast to the report of [the Edmonton group] that Canadian Indians metabolize alcohol at a significantly slower rate than whites, the present study revealed no difference..." (see L.J. Bennion and L. Ting-Kai "Alcoholic Metabolism in American Indians and Whites," *New England Journal of Medicine*, vol. 294 (1976) pp. 9-13.)

As outlined earlier in this chapter, the quality of Pinto's work had been critically challenged in the United States well before the Yellowknife controversy began. Pinto developed the "urinary arsenic index" for the American Smelting and Refining

Company (ASARCO) in Tacoma, Washington. Pinto used his urinary measures to divide workers into "exposed" and "non-exposed" categories and concluded that arsenic exposure was *not* producing cancers in ASARCO employees. When NIOSH found excess cancers in ASARCO workers, and produced a study showing Pinto's control population had, in reality, been an arsenic-exposed group, Pinto published a study confirming the cancer findings. Dr. Howard McMartin, NIOSH's director of research and standards development, says that "utilization of arsenic urinary levels as a measure of exposure is questionable." According to McMartin:

> Because of the limited definition of the study group (retirees only) and use of urinary arsenic excretion levels as an exposure index, it would not be appropriate to draw any conclusions concerning a no-effect environmental level for arsenic from this [Pinto's] study.[67]

Paul Falkowski, the steelworkers' environmental representative, was largely responsible for promoting the joint Indian-union independent survey in Yellowknife. He expresses scepticism over the use of urine samples as a means of detecting exposure to toxic substances. "In the lead industry, companies have frequently manipulated their urine data by sampling their workers on Monday morning. Medical people tell us that most of the contaminant that is excreted through the urinary system is done so within two days of exposure. By taking their urinary lead samples on Mondays the companies attempt to get low levels since most, if not all, of the pollutant would have been eliminated at their homes on the weekend.

"Urinary arsenic levels, I am told by the health professionals we respect, are subject to the same sorts of fluctuations and manipulations. I think the urinary arsenic controversy created by Health and Welfare Canada in Yellowknife says a great deal about the primitive approach to occupational and environmental health that exists in Canada.

"The federal government's attitude is to use the worker's body to monitor the contamination level of his work environment. In my opinion, when you start finding pollution in the people's bodies it's too late.

"The best way to protect human health is to carefully monitor the *environment*, not people. If cancer-causing agents are found in the environment, then they should be eliminated. The unsafe conditions should be altered *before* they are exhibited in any way in people's bodies.

"I find it quite ironic that at the same time that the Canadian government advocates testing procedures endorsed by the most irresponsible polluters in North America, the United States government is passing legislation rejecting these same testing methods."

On May 5, 1978, the Occupational Safety and Health Administration (OSHA) published the new legal standard for arsenic exposure in the United States. In outlining the standard and the obligations arsenic-polluting industries must undertake under U.S. law to protect the health of exposed workers, OSHA included the following evaluation of urinary arsenic sampling:

> OSHA has concluded that it is not appropriate to use urinary arsenic measurements as the primary means for determining employee exposure. Airborne monitoring is effective and is capable of detecting levels over the permissible exposure limit before overexposures to employees occur. Urinary monitoring is variable and the correlation between airborne and urinary levels is weak to moderate. OSHA has further concluded that it will not require urinary arsenic determinations as a supplement to airborne monitoring.[68]

The hair samples collected in the Indian-union study had been carefully washed to eliminate external contaminants.[69] Dan Billing, the chairman of the territorial government's standing committee on arsenic, nevertheless dismissed the Steelworker Indian hair survey in stating that hair tests have no correlation to the amount of arsenic actually *in* the body. "The only accurate way to measure body levels," said Billing, "is to measure blood and urine tests."[70]

Two overseas studies of arsenic exposure have since been published which belie Mr. Billing's claims. A Romanian researcher investigated two Romanian populations exposed to arsenic-polluting operations and concluded that "arsenic in hair was found to be a more reliable biologic test than urine."[71] Similar conclusions were reached in a Czechoslovakian study which examined the hair, urine and blood of ten-year-old boys living in an arsenic-polluted region.[72] The Czech investigators found significant degrees of hearing loss in the arsenic-exposed children. These findings were particularly startling to the Indians since the arsenic hair levels in the Czech children were lower than the levels found in Yellowknife Indian children.[73]

The results of another study, this time from Halifax, Nova Scotia, also undermined Health and Welfare Canada's claim that there was no connection between arsenic hair levels and untoward health effects. Dr. Thomas Hindmarsh of the Departments of Pathology and Medicine at Dalhousie University found changes in nerve conduction rates in people with hair arsenic levels above 1 ppm. The people examined had ingested water from wells contaminated with arsenic from the tailings of abandoned gold mines in Waverly, Nova Scotia.[74] (The Canadian Public Health Association also found some correlation between nerve conduction rates and arsenic hair levels in Yellowknife. These nerve changes were also apparent for raised urinary arsenic levels.)[75]

In July, 1978, Dr. Eaton of Health and Welfare Canada announced that a retest of Yellowknife Indian children found lower arsenic hair levels than reported by the University of Toronto a year earlier. Noting that there had been a reduction in arsenic emissions from Giant Mines and that arsenic levels in the snow were lower (although still unsafe), Eaton said the new testing made it apparent the earlier levels were caused by airborne arsenic.[76] This had been the contention of the Indians and union a year earlier when the two organizations called for a reduction in arsenic pollution.

Besides making urine-versus-hair an issue in the arsenic controversy, federal and territorial government officials raised two other arguments to suggest that Yellowknife's arsenic difficulties were not all that severe. It was observed that the majority of the arsenic in the Yellowknife area was insoluble and less toxic than soluble arsenic and therefore relatively safe.[77] The size of the arsenic particles was also said to affect the safety of arsenic exposure.[78] Both arguments were evaluated and rejected by the Occupational Safety and Health Administration in setting the occupational arsenic exposure standard for the United States.[79]

Health and Welfare Canada's most dramatic response to the Indian-union charges was not to order an immediate clean-up of the Yellowknife environment but to order another study. Health Minister Marc Lalonde announced that the Canadian Public Health Association(CPHA) had been chosen to appoint three scientists to investigate the charges made by the two groups and make recommendations to alleviate the arsenic problem, if any should be needed. The Steelworkers and the National Indian Brotherhood welcomed any action which might lead to environmental improvements. They would have preferred, however, a series of orders cutting back air and liquid pollution from the gold mines, a reduction in workplace arsenic levels, a scientifically designed study to detect people missed in the original survey, and a program to reclaim the contaminated environment. The two organizations nevertheless insisted that the people appointed to head yet another arsenic study of Yellowknife be acceptable to all sides in the dispute — the companies, the unions, the Indians and the government. The CPHA chose not to follow this recommendation.

Three people were appointed to the CPHA task force without consultation with the parties who raised the issue. They were Dr. Courtlandt Mackenzie of the University of British Columbia Medical School, Dr. Robert Sutherland formerly of the Province of Ontario's Health Department and now a consultant in occupational health, and Edward Tupper of the Nova Scotia

government's Department of Health. The Steelworkers examined the track records of the "experts" and pointed out that if the union had been *consulted*, they would have not endorsed the people chosen to conduct the CPHA arsenic investigation.

The CPHA was therefore advised that the union and Indians were not happy with the appointees who were acceptable to the government and the companies. The CPHA then suggested the Indians and union submit the name of a qualified individual who would not be a member of the Task Force but who would serve as a consultant. Dr. Hector Blejer was proposed. The CPHA approved of his qualifications and Blejer therefore became the only person privy to the task force's information and deliberations who was acceptable to all parties in the arsenic dispute.

Blejer is the director of occupational health for the City of Hope National Medical Centre (a U.S. research foundation) in Duarte, California, and a faculty member of the University of Southern California Medical School. Before moving to California, Blejer was a deputy director of the division of field studies of the National Institute for Occupational Safety and Health. While at NIOSH, Blejer helped compile the evidence which led to the U.S. government's re-evaluation of its arsenic exposure standard.

The union and Indians eventually endorsed many of the CPHA's recommendations. The organizations approved the call to reduce arsenic emissions, properly monitor the work environment, and conduct scientifically designed nerve conduction studies of arsenic-exposed people using control populations. The men working in Giant Mines will no longer be showering in and drinking water taken from arsenic-polluted Yellowknife Back Bay thanks to the task force hearings. There is little doubt that if the CPHA had not made the recommendations, even these reasonable environmental reforms would not have been carried out.[80]

The union and Indians also appreciated the task force's evaluation of the federal government's performance on arsenic and health matters in Yellowknife:

> The pattern in Yellowknife has been to have a survey and a review o the situation every ten to fifteen years. Each of these events seems t have produced an improvement in one or more aspects of the pollutio problem. It is surprising that at the time of the excellent review b deVilliers and his associates [the deVilliers study is the 1966-69 surve which was broadcast on the CBC in 1975] ongoing programs were no put into effect. These programs should have taken the form of regula public health and industrial hygiene practices. Industrial practice have been modified and improved but the provision of public healt and industrial medical monitoring and practice has lagged.
>
> Medical surveys without exception have remarked on th prevalence of skin and respiratory infections. No ongoing follow-up c these facts is evident. . . . No serious effort seems to have been made t compare morbidity rates in Yellowknife with other comparabl northern communities.
>
> . . . The task force *deplores* the previous pattern of intermittent surve followed by periods of relative inactivity. Future action must take th form of continuous surveillance and corrective action when and necessary.[81]

Nevertheless, the union and Indians strongly disagree wit certain arsenic exposure recommendations made by the task forc For example, the task force recommends that the occupation exposure standard for arsenic be established at 30 micrograms p cubic metre of air.[82] The task force terms the standa "acceptable" and says the cancer risk at the 30-microgra standard would be "negligible".

But in the United States, the Occupational Safety and Heal Administration does not find the 30-microgram standard "a ceptable". On May 5, 1978, OSHA announced that the legal enforced arsenic occupational exposure standard in the U. would be 10 micrograms per cubic metre of air as of August 1978.[83] (If OSHA and the CPHA are both correct, then Canadi working people are three times hardier than their U.S. counte parts.)

Furthermore, OSHA does not pretend the cancer risk at the l microgram standard is "negligible". Dr. Joseph Wagon

formerly the director of field studies at NIOSH and now special advisor to OSHA on occupational carcinogenesis, put it this way: "I certainly will not, and can not indicate we can stand up and say we won't have any further cancer as a result of the 10-microgram standard. I think that one of the unfortunate circumstances we were faced with was that whereas most of the copper smelters in the United States could achieve the much lower standard that was recommended by NIOSH (2 micrograms per cubic metre of air), we had one scavenger smelter, ASARCO in Tacoma, Washington. This smelter could not achieve the NIOSH recommended standard. So the 10-microgram standard was not established according to what the *best* smelters in the U.S. could achieve, but according to what the *worst* could achieve. On that basis I feel we can't be assured the 10-microgram standard will resolve the arsenic cancer problem and to indicate that it would would be a disservice to the worker."

Wagoner adds: "I obviously don't accept the 30-microgram standard and don't think there is the scientific basis to support an arsenic standard of 30 micrograms." (Dr. Hector Blejer, the only person acceptable to all parties in the Yellowknife arsenic controversy, also disagreed with the 30-microgram arsenic standard.)

A Giant Yellowknife Mines' report on arsenic concentration in its work environment between December, 1977, and February, 1978, shows that arsenic levels were above the U.S. standard in eleven out of fifteen samples collected. This means that if Giant Mines was operating in the U.S., they could have been prosecuted for violating the arsenic exposure standard. In that same time period, the arsenic concentration exceeded the CPHA standard only once.[84] (It should be noted that work environment measures had *never* been collected until after the 1975 "As It Happens" documentary.)

Mike Walzcer has worked for Giant Mines for close to twenty years. He says that arsenic exposure has always been an on-the-job hazard.

"We've known for a long time that surface workers, construction workers or trades people who, say, lifted a pipe or some timbers, or worked in an area cleaning up, eventually got their clothing contaminated with dust. If you rubbed a sweaty forehead you'd break out in an immediate rash almost like a sunburn rash, almost like sun blisters.

"We've seen guys break into a rash on their forehead or around the collar of their neck from working on the surface, not in the plant itself, you know, just in the immediate vicinity. In the plant and in the fall-out zone around it, anything you touch is loaded."

In the U.S., OSHA does not accept the theory that there is a safe level of exposure to a cancer-causing agent such as arsenic. But OSHA is required to set standards which are "feasible" to achieve. The 10-microgram standard was the compromise OSHA reached between what was "feasible" for the worst arsenic polluter in the U.S. to achieve the workers' health.

The CPHA Task Force on Arsenic, on the other hand, found a 30-microgram arsenic standard "acceptable" and notes: "Between the concepts of threshold or no-threshold, we feel the balance of research to the present tends to favour the threshold concept."[85]

The strongest evidence the CPHA presents to justify its conclusion comes from Dr. Paul Kotin:

> Nevertheless, for carcinogenic organic and inorganic chemicals, metals, non-ionizing and ionizing radiation, and specifically for vinyl-chloride and asbestos, dose-response data and no-effect levels have been found. To deny the existence of dose response would erroneously place chemical carcinogenesis outside the universe of pharmacological principles that govern enzyme induction, feed back, repair mechanisms, primary and alternative metabolic pathways, metabolite excretion, and so on — clearly an insupportable concept.[86]

Sounds impressive. But after reading the CPHA conclusions, Dr. Joseph Wagoner of OSHA, had this to say: "I think it's appropriate to put the quotations of Dr. Kotin in their proper

perspective. The quotation referred to is a quote taken from an article Paul Kotin submitted to the New York Academy of Sciences, at an occupational carcinogenesis conference at which I was the co-chairman of the proceedings. When I saw this statement I asked the New York academy to write to Dr. Kotin for certain information. Since it was such a profound statement, I felt it was certainly worthy of being referenced.

"Dr. Kotin did indeed provide the references for those agents for which he felt there were no demonstration of excessive risk. I took those agents and the articles he referenced and found that either: (1) the article had not been published and had not undergone scientific scrutiny; (2) the article did not state there was a no-effect level; or (3) the author himself, or herself, following critique of the article, had retracted the original article in the scientific press. So those agents that Dr. Kotin was referring to — vinyl chloride, asbestos, ionizing radiation — as having a threshold did not stand the test of scientific scrutiny.

"I think it's also noteworthy that Dr. Kotin, while working for the U.S. government as the director of the National Institute of Environmental Health Sciences, testified on the need for more stringent standards for radium mines. At that time he took the position and publicly stated he himself belonged to the group of scientists that maintained there was *no* safe level for a carcinogen. Certainly the statements that are put forth by him now depart from those earlier statements that were made."

In 1970, the surgeon general of the United States formed a "blue-ribbon committee" to determine the effects of low-level exposure to cancer-causing agents. Kotin, as the director of the National Institute of Environmental Health Sciences, was a member of the committee. In its report, the panel concluded:

> No level of exposure to a chemical carcinogen should be considered toxicologically insignificant for man. For carcinogenic agents a "safe level for man" cannot be established by application of our present knowledge.[87]

The committee further stated:

> It is impossible to establish any absolute safe level of exposure to a carcinogen for man. The concept of "toxicologically insignificant" levels, of dubious merit in any life science, has absolutely no validity in the field of carcinogenesis.[88]

What caused Kotin to reverse his opinion? As Dr. Wagoner pointed out, it doesn't appear to be well-documented scientific evidence. Certainly Dr. David Rall, the current director of the National Institute of Environmental Health Sciences (Dr. Kotin's former position), is not convinced of the threshold concept. Rall says that "the addition of any amount of carcinogen will increase the risk of the cancer appearing, or appearing earlier, and adversely affecting life."[89] (Every major U.S. regulatory agency adheres to the "no-threshold" view.) Since leaving the National Institute for Environmental Health Sciences, Dr. Kotin has been in charge of occupational and environmental health for Johns-Manville, one of the world's largest asbestos producers.

The Steelworkers and Indians also had serious reservations about the terms of reference given the CPHA task force on arsenic. The CPHA defined the problem this way:

> The issue . . ., in its simplest terms, could be stated as follows:
> *Does there exist in Yellowknife, Northwest Territories a serious health hazard to the population of that community as a result of possible arsenic poisoning?*[90]

Dr. Hector Blejer, the California specialist on occupational health, was the only person acceptable to all parties in the dispute with full access to the task force data. He commented on the CPHA's definition of the potential health problem as outlined in their interim report and restated in their final report:

By stating the issue in this way, the task force has pre-ordained that very little will be uncovered. Arsenic has for a long time been associated with clinically overt, severe poisoning. However, medical surveys have also determined that long-term, low-level exposure to arsenic can have other deleterious health effects. By stating that Yellowknife's main potential environmental health problem may be linked to clinical "poisoning", the task force has in fact glossed over the more subtle, less immediate, deleterious, health effects that have been clearly affiliated with arsenic exposure. In other words, the interim report appears to be understating the very real danger anyone exposed to arsenic has of contracting arsenic-related diseases such as cancer.

A properly conducted scientific study of the Yellowknife populations would undoubtedly uncover examples of the less immediate health problems coincident with even relatively low levels of arsenic exposure. But by defining the key problem as a "poisoning" problem, the Canadian Public Health Association Task Force has decided to look for the gross levels of arsenic most commonly associated with suicide or homicide cases.

The task force has also been deficient in defining exactly what is meant by the term "a serious health hazard". Until the word "serious" is clarified by the task force, it is difficult to readily understand how the task force arrives at a conclusion that a carcinogen is "not" serious.[91]

Dr. Blejer has never been on the payroll of United Steelworkers or of any Indian organization. The views he expressed were those of an independent health professional assessing the situation as he saw it. The union and Indians agreed with Blejer that their main health concern was not "poisoning" but the many other health problems associated with arsenic exposure.

Paul Falkowski of the Steelworkers assesses the events which led to the formation of the CPHA task force this way: "If I were a member of a government faced with embarrassing charges on occupational and environmental health matters, I would look for an agency like the Canadian Public Health Association and ask them to resolve the controversy.[92] Then I'd define the problem in such a way so as to obscure the real health concerns raised by the people who created the controversy.

"Our members were involved in three major occupational health investigations in the last three years. In the investigation of the asbestos industry in Quebec, Judge René Beaudry, who headed the commission, was acceptable to all parties in the dispute and we agreed with his terms of reference. In the investigation of mine safety in Ontario, Professor James Ham was similarly acceptable to everyone involved as were his terms of reference. In Yellowknife, however, the Canadian Public Health Association chose people to head their arsenic task force who we were not happy with. We also were unhappy with their definition of the main health problem which people exposed to arsenic in Yellowknife face. Consequently, although we agree with many of their recommendations, we disagree with the CPHA's evaluation of an 'acceptable' level of arsenic exposure, and their evaluation of the health risks faced by anyone, workers or the general public, to arsenic."

The CPHA task force on arsenic expressed the opinion that arsenic levels in Yellowknife "appear to be well below dosages that would produce detectable cancer increases in the population."[93] The CPHA assessment of cancer risk in Yellowknife was not, however, based on an epidemiological investigation of the community. Although over two dozen arsenic surveys have been conducted in Yellowknife,[94] not one of the studies conducted was designed to determine the cancer rate among those exposed to arsenic. As the task force itself observed, few health or population records of Yellowknife are available, and "prospective cancer studies have never been initiated."[95] When attempts were made to assess the cancer rate among Giant Mines' workers, it was discovered that Giant's personnel records of men employed before 1969 had unfortunately been destroyed. The CPHA task force concluded that researching the records of Cominco's Yellowknife gold operations would require an "inordinate amount of effort and expense."[96] As a result, Yellowknife's true cancer death rate remains to be researched.

Dr. Hector Blejer, the consultant to the CPHA task force on arsenic recommended by the Indians and Steelworkers, says that most of the recommendations made by the task force were " comprehensive and extremely judicious." But Blejer quickly points out that he disagrees with their "acceptable" exposure standard and definition of what constitutes a cancer risk.

Blejer says Canada is about ten years behind the U.S. in its approach to occupational and environmental health. He points out that many of the debates in Canada over thresholds, measuring methods and technological remedies have already taken place south of the border. The results are apparent when U.S. environmental and occupational legislation is compared to Canada's legislation.

At the CPHA arsenic hearings in Ottawa, Blejer quietly told the Steelworkers and Indians that after hearing the testimony of the government officials, he saw less evidence of a conspiracy to hide the arsenic situation and more evidence of an inability to understand the problem. "In my opinion the Canadian government's approach to arsenic exposure has more to do with incompetence than anything else. They simply don't seem to know what they're doing.

"The 1975 Health and Welfare arsenic study of Yellowknife is a case in point. The study was carried out by two internists and a general practitioner and was conducted without taking into consideration adequate epidemiological techniques. In a study of this kind, you'll find the least amount by using physicians. You're always wise to use competent epidemiologists in such cases and any epidemiologist worth his salt would have rejected the survey design used by Health and Welfare.

"The study lacks the benefit of a proper biostatistical design as evidenced by its bias in using a volunteer sample. This means the study missed sick people. Sick people generally are too sick to volunteer in such surveys. It also means the study attracted a large number of kooks. Kooks and hypochondriacs tend to be the first to come forward in volunteer surveys.

"No controls were employed in the study. Without properly

selected controls it is difficult to accurately assess the significance, : any, of the Health and Welfare data.

"The study, at best, is a limited clinical survey whose finding concerning overt arsenical poisoning can in no way be generalize to the Yellowknife population. The study cannot pretend t comment with any authority on the cancer risk and th consequences of chronic exposure to arsenic in Yellowknife. The simply should have done a better job."

Blejer says that Canada, with Medicare, is further ahead tha the United States in many social policy areas. "But, it is readil apparent Canada does not have many individuals properly traine in occupational and environmental health."

Blejer has an intimate knowledge of the Canadian system. H was educated in Canada at McGill University and the Universit of Toronto. (His international reputation is such that in 1974 h was appointed by the World Health Organization to help plar establish and develop the Pan American Centre for Huma Ecology and Health in Mexico City.)

"I left Canada because there was so little being done i occupational and environmental health. No one was doing th work. I realized it would take me twenty years to do in Canad what it would take me three to five years to do in the United State When I hear about some of the occupational health disasters tha have taken place in Canada I see that, although we have a lor way to go here, you people are only now beginning to come to grij with the problem."

Yellowknife will have to come to grips with the gold mines' arsen waste for a long, long time. Most of the arsenic produced in th gold mining process is stored underground in abandoned sectio of the gold mines. The storage areas are located within what known as the "permafrost" horizon. In a "confidential" 197 memorandum to the Northwest Territories mining engineer, th Territories mining inspector, Erland Bengst, observed that t

1974, Giant Mines' underground storage facilities will contain 174,000 tons of arsenic. He noted, "The Giant storage contains sufficient water soluble arsenic to kill the world population four times over." He went on to observe: "Thus the Giant storage of soluble arsenic is sufficient to pollute a fresh water body 290 miles long by 62 miles wide by 300 feet deep to above (the federal government's) acceptable level."

The mining inspector expressed concern about the situation:

> The Giant mining operation appears to be approaching a shut-down within two years. [The price of gold has since extended the life of the mines.] When the operation shuts down the underground de-watering operation will cease. Thus the ground water will accumulate and the underground workings become flooded. It is estimated this will require from three to six years. If at that time the "permafrost" is less than perfect, the ground water will enter the arsenic storage and dissolve arsenic. The dissolved arsenic will be carried by the natural water table and discharged into a fresh water system at some point unknown. If this is allowed to develop a most serious condition may develop.
>
> If the "permafrost" horizon at Giant is perfect, there is of course no danger from arsenic pollution. However, within a period of several years or decades, it is possible that climatic changes may result in the reduction of frost.
>
> It is my opinion that the Giant mine working should not be allowed to become flooded until the extent and permanency of the "permafrost" is determined.[97]

The CPHA task force on arsenic considered Bengst's fear about the possible flooding of mines after they were closed. The task force recommended that Giant "seal off all points of entry of surface water and runoff into the mine." When the mine shuts up shop, ground water levels in the mine will have to be monitored on a routine basis by the government from then on.[98]

In the spring of 1978, yet another evaluation of arsenic in the Yellowknife environment was completed by the Environmental Protection Service. The study was conducted between 1974 and

1977 to determine the impact of Giant Mines' effluent on Bak Creek, which flows into Yellowknife Bay, the bay from which tl miners' drinking water came before the CPHA investigation ar the one bordering on the Indian community of Latham Islanc

The report noted the discharge of effluent from Giant's tailir ponds has "severely contaminated the lower section of Baker Cre and caused almost complete destruction of the native biota." T study found that while aquatic life in the upper reaches of Bak Creek was abundant and diverse, "below the mine, fis crustaceans, insects and rotifers were never encountered." T researchers found the sediments of Yellowknife Bay "highly cc taminated with arsenic, mercury, copper, lead, zinc and oth heavy metals." The report concluded: "The ongoing discharge highly lethal waste into Yellowknife Bay will probably cause: (1 further expansion of the zone of influence, (2) further destruction the bottom fauna, and (3) maintenance of very high arsenic lev in the water of Yellowknife Bay." The results of bioassay testi (toxicity tests conducted on a living organism) done at the mouth Baker Creek during the study indicated a 100 per cent mortality rainbow trout within ninety-six hours. The research recommended that after the mines close, the stability of the arse tailings ponds and underground arsenic storage areas must be cc tinuously monitored.[99]

Gina Blondin is a Dene from Yellowknife. In a brief to t CPHA Task Force on Arsenic, Ms. Blondin referred to the stora of arsenic waste underground by Giant Mines. "We would like know who will be responsible for monitoring these wastes foreve she said. "When Giant Mines has removed the last easily coverable gold from the land, made its last profits and packed and gone home, who will pay for the storage shaft to be pump forever? Who will see that this is done? Who will pay for all of tl

"The continuing pollution and destruction by corporate int ests of our air, water and soil and the government's failure to s this contamination, are prime examples of why we insist we can longer allow our land and our lives to be controlled by other

The latest in a seemingly endless series of Yellowknife arsenic studies was made public on November 15, 1978. The Canadian Public Health Association study compared hair and urinary arsenic levels from people in Yellowknife to people in the arsenic-"free" community of Hay River in the Northwest Territories. The study found "obvious differences in hair arsenic and urine arsenic levels between the populations sampled in the two towns."[100]

The CPHA study also conducted sensitive measurements of the speed of an impulse moving along a nerve, known as electromyographic tests. According to Dr. Thomas Hindmarsh of Dalhousie University, who has conducted extensive electromyographic studies on people exposed to arsenic in Nova Scotia, arsenic has different effects on different nerves. Arsenic seems to selectively affect the sensory nerves of the lower limb.[101]

According to Hindmarsh, the CPHA tests seem to corroborate the Nova Scotia findings. The CPHA researchers found no correlation between hair arsenic levels and nerve conduction rates in the nerve tested in the upper body (the median nerve), but did find a correlation between hair arsenic levels and nerve conduction rates in the nerves tested in the lower limb (the lateral popliteal nerve). The correlation with hair arsenic levels and nerve conduction rates was only true for hair levels between 2 ppm and 5 ppm, a fact which may suggest, observes the CPHA, that hair arsenic levels above 5 ppm may have been that high because of surface arsenic contamination.[102] The CPHA chose not to test the nerve velocity in the sural nerve (one of the nerves in the lower limb most sensitive to arsenic exposure) even though they had been advised to do so.

The CPHA observed:

> This electromyographic study has established an information base on those populations tested in Yellowknife and Hay River that can be utilized to determine if there are any comparative differences in future years when similar testing programs are conducted.

The study determined that some Yellowknife residents are ingesting arsenic in detectable amounts. Much of what we will

know in future years about the effects of exposure to low levels of arsenic will come from studies conducted on these people. As the years pass and more research is conducted in Yellowknife our information base will grow. In this context it is interesting to recall the words of Dr. Kingsley Kay on the 1975 CBC "As It Happens" documentary:

> . . . that's why I regard it as a human experiment — an experiment in which you make measurements to determine how much people are exposed to, and then wait to see what will happen to them.

Yellowknife is not the only Canadian city exposed to industrial arsenic waste. At times, the Ontario centres of Sudbury, South Porcupine and Welland have all registered arsenic air concentrations as high or higher than the capital of the Northwest Territories.[103]

And Yellowknife's gold mine employees are not unique in being at risk because of the arsenic they encounter on the job. In Red Lake, a gold mining town in northwestern Ontario, men working in the gold-producing operations have registered high arsenic levels. The question of Red Lake's arsenic difficulties was first raised by the United Steelworkers, who pursued the issue because high arsenic levels were found in the soil, vegetation and water around the town.

Nevertheless, Ontario's former minister of labour, Bette Stephenson, went to great lengths to play down the arsenic health problem.[104] Ontario government officials rationalized their complacent attitudes towards the arsenic contamination of Red Lake on the basis of a single series of voided urine specimens.[105] The Steelworkers were unhappy with the government's response to their plight. The management of Dickenson Mines was also concerned and, in a co-operative gesture with the union, agreed that employees of Dickenson Mines should undergo more extensive arsenic examinations by a competent health professional. At the

union's request, Dr. Bertram Carnow of the University of Illinois was chosen to conduct the examinations, which Dickenson Mines agreed to finance.

In his study, Carnow noted that arsenic levels in the urine

> ... have been shown to correlate poorly with environmental measurements as well as toxic manifestations of arsenic exposure. Additionally, urinary arsenic levels reflect only exposure over the previous twenty-four to forty-eight hours and may also be affected by certain foods. Hair and nails, on the other hand, reflect cumulative exposure over the past two to three months and once arsenic enters the hair and nails it remains fixed there for many, many months.[106]

Carnow tested a significant number of Dickenson employees with abnormal liver conditions. His results showed that abnormal liver conditions are not correlated with alcohol intake and that they appear to generally be correlated with increases in arsenic levels in the hair."[107]

The Chicago investigators also found other symptoms associated with arsenic exposure, such as abnormal electrocardiograms, various circulation difficulties, and certain skin problems. Fortunately, no malignant tumours were found among the workers examined. Carnow stated: "This group of Dickenson Mine employees would appear to have had excessive exposures with consequent abnormality of multiple target organs." He concluded that:

> ... continued exposure to levels producing the body burdens found might be expected to ultimately lead to the occurrence of [cancers] in some of the employees. The program to reduce the arsenic levels in the working environment and the institution of measures to prevent arsenic absorption in workers whose activities require exposure is mandatory.[108]

Six industrial hygiene recommendations were made by the Chicago medical team to guide the mine towards achieving an arsenic clean-up.

If the men working at Dickenson Mines had relied on the advice of the Ontario government the Carnow study would never have been carried out. Similarly, if the mine's management had not been as concerned as the union about protecting the health of the gold mine workers, the study would probably never have taken place. In fact, the manager of Dickenson Mines received a great deal of criticism from other mining operators in the Red Lake area for co-operating with the union in the arsenic study. Unfortunately, the critical mine managers and the Ontario government were quite willing to carry on business as usual — the way it has usually been carried out in places like Thetford Mines, Elliot Lake and Yellowknife.