

850-5-12

P.A.

TO : Dr. Lyall Black
Director General
Program Management Directorate

FROM : Assistant Deputy Minister
Medical Services Branch

SUBJECT
OBJET

ARSENIC LEVELS IN YELLOWKNIFE, N.W.T.

This is further to our conversation of Tuesday, January 18, following recent press reports on arsenic levels in Yellowknife.

This recent episode left me with the impression that to a degree we have been caught unaware when we should have been better and more readily prepared to react. For example, I feel we should have been aware of the YES report since we had one of our officers on it and I gather we were not fully conversant or perhaps not enough. To avoid this in the future, you may wish to consider requesting from our Regional Directors that we be kept informed of any study in which our field staff is involved, either jointly with or at the behest of other federal departments, provincial/territorial governments or other agencies.

Some thought might also be given to the advisability of obtaining from the Regions quarterly reports on real or potential contaminants, such as cadmium, PCB's, et al or on any monitoring we in Medical Services Branch are conducting and keep the Deputy Minister's office au fait of these situations. This would be done separately from the existing mercury contamination reporting system, which is operating admirably well.

The October 3, 1975 press release stated that follow-up action would take place as follows:

- 1.-) monitor a program of regular medical examinations for workers in those areas of high dust exposure;
- 2.-) monitor regularly the working environment in the mill for occupational health hazards;

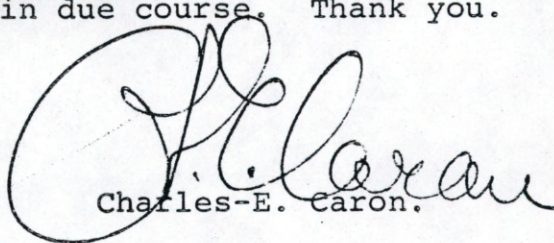
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OUR FILE-N/RÉFÉRENCE
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DATE January 24, 1977

ARSENIC LEVELS IN YELLOWKNIFE, N.W.T.

- 3.-) regular medical assessment for those found to have elevated arsenic levels; and
- 4.-) regular examination of all mill personnel employed in areas of high dust level; measurement and surveillance of dust levels will continue.

I understand that data resulting from these four activities will also be given the "Committee of Three" for review and I would like to see a copy of them or at least a summary in due course. Thank you.



Charles-E. Caron.

GB/dt



news release

1975 - 128

October 3, 1975

ARSENIC LEVELS IN YELLOWKNIFE NWT

OTTAWA -- Health and Welfare Minister Marc Lalonde today released the findings of a comprehensive series of clinical and laboratory examinations of Yellowknife residents whose hair had shown elevated arsenic levels in previous testing.

The latest study was a follow-up of the earlier screening investigation which had been prompted by allegations that the health of Yellowknife citizens was being threatened by excessive exposure to arsenic. The report compiled by Dr. Otto Schaefer concluded that present mine operations do not pose a hazard to the health of the general population of Yellowknife. The final report indicates that:

- there is no evidence that the general public of Yellowknife is being exposed to excessive or dangerous amounts of arsenic;
- employees working in certain areas of Giant Mill and Refinery were found to have elevated arsenic levels in hair and slightly elevated levels of systemic arsenic;
- there was no clinical evidence of systemic arsenic toxicity although evidence was found of local skin irritations and rashes consistent with arsenic dust exposure. In all cases persons experiencing these reactions were employed at the mill.



Health
and Welfare
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The Department tested hair samples of 700 Yellowknife residents earlier this year and of this number, 63 were found to contain in excess of 10 p.p.m. arsenic. Levels up to 10 p.p.m. have been found in populations with no known exposure to arsenic and this level is generally considered to be acceptable. Medical Services Branch chose this level to select those individuals warranting a more comprehensive examination. Based on findings of the initial survey, Medical Services Branch undertook a thorough examination which included blood samples, liver function tests, EKG, chest X-ray, 24 hour urine specimens, and in some cases further hair samples from the scalp and body, in addition to a thorough clinical examination. A review of the individual examination files, including laboratory, electrocardiogram and X-ray findings, shows a complete absence of definitely pathological findings suggestive of chronic systemic arsenic poisoning.

The clinical examinations were conducted in June of this year in Yellowknife and included 58 individuals, 50 of whom had been identified in the initial survey. Of the original 63 persons, 8 had left Yellowknife, their new addresses unknown, and 5 others were out of town on vacation. Six new persons who had not participated in the original hair screening and who were concerned about potential risk due to their long mine or mill experience were included in the comprehensive tests at their own request. The other two were native children who had been found by an independent National Indian Brotherhood study to have elevated arsenic levels in their hair.

Five of the 58 persons examined were found to have slightly elevated levels of body arsenic with urine samples ranging between 0.1 and 0.3 milligrams per 24 hours. The five individuals in question were employed as either roasters, cottrell operators, or laboratory workers in the mill. Their levels although higher than any others in the Yellowknife survey were nevertheless well below a toxic level. A widely held scientific opinion is that urine levels ranging from 0.7 to 1.0 milligrams do not represent an undue hazard for workers in an arsenic environment. The Yellowknife miners were all well below these levels. In addition, a recent study stated that arsenic related disease is not found in people excreting less than 1.0 milligrams per day. The remaining 53 persons examined did not show evidence of excessive arsenic ingestion.

Clinical examination showed a total of 17 persons, including the 5 persons found to have slightly elevated levels of body arsenic, who had experienced episodes of irritation and skin rashes after exposure to arsenic dust. Each of these individuals were mill employees and had experienced the "arsenic rashes" while working either as roasters, cottrell operators, or in the "bag house" where arsenic laden dust is collected. Rashes of this kind are commonly found in workers exposed to chemical dust. The examinations did not reveal any skin lesions of the type generally associated with the development of cancer. Medical Services Branch wishes to be satisfied about possible long range effects of exposure, and will monitor a program of regular medical

examinations for workers in those areas of high dust exposure. (2)

The Branch has also monitored and will continue to monitor regularly the working environment in the mill for occupational health hazards.

The examinations identified a number of medical problems unrelated to arsenic or mine work. In all, 24 people have been referred to their own physician for examination or treatment of these medical problems.

A program of regular medical assessment has been recommended for the five individuals found to have elevated arsenic levels, and the branch will follow-up to assure that examinations are being carried out satisfactorily. In addition, all mill personnel employed in areas of high dust levels will be regularly examined. Dust levels have been measured and surveillance will continue. (3) (4)

Dr. Schaefer's report has been forwarded to mine and union officials as well as to the Federal and Territorial Governments concerned.

Ref. H.L. Brigstocke

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REPORT ON THE EFFECTS OF ARSENIC ON HUMAN HEALTH IN THE YELLOWKNIFE AREA

PHASE II - CLINICAL EXAMINATIONS

This report summarizes the clinical findings on those persons found on previous screening to have elevated ie. above 10 parts per million arsenic in their hair. The report is a compilation of the findings of three physicians, Drs. Brown and Krishnamoorthy of Yellowknife and Dr. Schaefer of Edmonton. Dr. Schaefer acted as organizer and was in general charge of the investigations. The clinical examinations included laboratory investigations of hemoglobin, red blood indices, blood smears with special regard to basophilic stippling and morphology of red cells, white cells and platelets. The S.M. 12 blood chemistry profile which includes serum electrolytes, blood urea, serum proteins, alkaline phosphatase, L.D.H. and S.G.O.T. all of which are important parameters of renal and hepatic function, spirometry, E.K.G., lung x-ray and a 24-hour urine sample which was measured, examined by dip-stick and the measured sample submitted for urinary arsenic analysis by an independent commercial assay laboratory.

A total of fifty-eight (58) individuals were seen in the arsenic examination. Fifty of these were all that were available of the sixty-three (63) individuals identified in Phase I of the 1975 investigation, the remainder having either left Yellowknife or been away on holiday at the time of the investigation. Six were employees of the Grant Mine who volunteered for the

examination feeling that they had an unduly large exposure to arsenic during the course of their duties and the remaining two were Indian children identified as having raised hair arsenic levels by an independent survey by the National Indian Brotherhood earlier this year.

Along with the clinical examinations a certain number of additional hair samples were taken both from scalp and body hair in a further attempt to distinguish between arsenic deposited on the hair or taken in by ingestion or inhalation.

A full hour was allowed for each patient to ensure adequacy of history taking and clinical examinations.

Hemoglobin and red cell indices were analyzed by the Laboratory of Stanton Hospital Yellowknife. The blood smears were read by laboratory technicians at the Charles Camsell Hospital and the S.M. 12 blood chemistry profile was done by a private laboratory in Edmonton.

Spirography was performed by our Special Task Nurse and the results were interpreted by Dr. Schaefer. X-ray of the chest was completed in each case at Yellowknife Hospital and the films were submitted to Edmonton for reading by Dr. Bhinji and Dr. Schaefer with referral of all doubtful cases to radiologists at the Charles Camsell Hospital. Electrocardiograms were read and analysed by Dr. Schaefer. Urinary measurements and simple dip-stick analyses were done by Dr. Schaefer and the Task Nurse.

Upon review of all the examination films one is impressed by the total absence of pathological findings normally to be found in chronic systemic

arsenic poisoning. These findings include wart-like hyperkeratoses, hyperpigmentation of skin, Mees' lines in finger nails, hemolytic and aplastic anemia and peripheral neuritis.

As in the survey in 1966 certain Mill employees, in particular Roasters, Cottrell operators and those working at times in the bag house, complained of episodes of a rapidly subsiding irritation and rash in the perioral and perinasal area, and less frequently also on neck, hands and forearms.

A total of seventeen persons claimed to have experienced episodes of irritation and rashes after exposure to arsenic dust commonly known by Mill employees as "arsenic rash." This rash was reported to last usually for only short periods and disappeared within a few days after the exposure to As_2O_3 dust ceased. It involved predominantly the nasolabial folds and nostrils and less often of the neck collar area and the hands and forearms and very rarely on areas of the trunk such as groin and penile shaft being apparently dependent on direct contact of the moist epidermis with As_2O_3 dust.

All seventeen of these individuals were Mill employees. Six of these experienced the "arsenic rashes" whilst employed as Roasters or Cottrell operators and the remaining eleven whilst being temporarily occupied in the bag house or otherwise exposed to As_2O_3 dust.

All Cottrell operators and Roasters in the fifty-eight persons examined experienced at one time or the other such rashes, eleven of the other thirty-five mill employees and none of the ten miners or nine other residents

in Yellowknife gave such a history.

Two men with long term Roasting experience showed skin lesions, one a dry erythematous rash on both forearms continuous for four months and the other an excessive dry peeling of palms and soles compatible with mild chronic systemic effects of Arsenicism, but neither showed any typical or more definitely pathognomonic signs of chronic arsenic toxicity such as warty hyperkeratosis or hyperpigmentation.

Four of those examined were found to have palpably enlarged livers, eighteen showed abnormalities in one or more than one liver function tests. These findings do not appear to be related to arsenic toxicity. Other pathology identified during the clinical examination included nine cases of obesity, nine with hypertension and twelve with varying degrees of obstructive or restrictive lung disease. A most careful analysis failed to reveal any evidence of an association between these findings and arsenic exposure or indeed arsenic levels in hair or urine. On the other hand, a clear association was to be demonstrated between the presence of such obstructive lung disease and a heavy smoking history or a work history of Hard Rock mining.

The literature is very confusing and to some extent contradictory in regards to what might be considered as normal and abnormal levels of arsenic as measured in hair or urine samples. A review of the available literature

has caused us to arrive at the following understanding.

Skin appendices (hair, finger and toenails) remove and accumulate on their SH radicals arsenic from the circulation which is then stored indefinitely. It is impossible by available analytical methods to distinguish between arsenic which has reached hair from the circulation and arsenic which has been deposited on and absorbed to the hair. It is also impossible to distinguish between the relatively harmless organically bound arsenic which is contained in large quantities in sea food and the more poisonous inorganic arsenic particularly arsenic trioxide. Interpretation of hair arsenic levels therefore must be tempered by an understanding of the various methods by which an increased level may be produced. It appears that there are no reported cases with arsenic hair levels less than 10 parts per 1,000,000 on repeated analysis which have been associated with clinically proven chronic arsenic toxicity. The selected cut off point at 10 parts per 1,000,000 for determining eligibility for further clinical investigation was therefore both justified and practical. Despite the well-documented fact that extremely high levels of arsenic may be found in the hair of persons never exposed to arsenic dust, gases or arsenic polluted water and the general statement in literature that arsenic levels in hair and urine analyses show little if any consistent relationship, there is some consistency though not a direct parallel in hair and urine analyses of samples collected in Yellowknife in June 1975. These are expressed in the table which follows.

HAIR p.p.m.	NO.	MEAN p.p.m. in hair	MEAN micro/l	MEAN micro/l
< 10 p.p.m *	10	7.1	38.7	52.7
10-49 p.p.m	34	21.2	51.7	73.7
50-99 p.p.m	7	66.7	54.9	74.5
> 100 p.p.m	6	203.0	52.0	103.7
TOTAL	57	43.5	49.8	73.1

* Unwashed samples >10
Washed samples <10

1 sample from the 58 persons examined was
not available for comparison or inclusion
in this table.

Assessment of the urinary arsenic excretion figures was complicated and by the fact that a relatively large number of the samples obtained were of very low specific gravity. This is to be associated with a high fluid intake. If we were to follow the standard methodology as given by NIOSH all urines with a specific gravity of less than 1.010 would be discarded. This however would invalidate our examinations. Therefore rather than use correction factors which are known to produce unrealistically modified urinary levels, we chose to estimate total daily arsenic excretion. Using this method we found fourteen individuals excreting more than the upper limit of normal namely 100 micrograms of

arsenic in twenty-four hours, two between 200 and 300 micrograms but none near the 700 to 1,000 micrograms which is given as "the bio-significant threshold indicative in exposed persons of harmful exposure." (H.B. Elkins)

While we may therefore with good justification state that persistent systemic over exposure to arsenic appears not to be a problem at present in Yellowknife, as there was not even one person found with a urinary excretion in the range generally accepted as "indicative of harmful exposure", there was evidence more historical than on physical findings that Cottrell operators and Roasters, and to a lesser degree chemical analysts and other Mill employees, were at the Giant Mine until this Spring repeatedly subject to excessive arsenical dust leading to typical facial skin irritations, particularly around the nostrils, nasolabial folds and under the collar commonly referred to as "arsenical rash." Some of this arsenic has found its way into the body as evidenced by higher hair and urinary arsenic levels. We must also comment that currently normal or only moderately elevated urinary excretion rates do not exclude previous arsenical damage during times of temporarily higher exposure and indeed such occurrence in several individuals appeared likely to have happened according to case histories in 1954 when they were reported to have had "arsenic poisoning" and were treated with blood transfusions and/or had other systemic symptoms and signs of acute or subacute arsenic poisoning.

Five men were found with both high arsenic levels in hair and of arsenic excretion in the urine definitely above the level usually regarded as normal as well as presenting with history and/or clinical or lab findings suspicious of mild chronic systemic arsenic toxicity. Four of these were Roaster or Cottrell operators for more than five years and one was working the assay office. It was recommended that these five and all others who work in a similar setting be monitored on a regular basis. To aid in this the entire findings of this clinical survey on all individuals will be made available to the workers' own physician in Yellowknife and to Edmonton consultants. Furthermore the National Health and Welfare Department will be prepared to provide in the future estimations and analyses which are not normally available in clinical laboratories. These include such things as arsenic examinations in hair and urine.

In respect of the mill environment it is recommended that greater emphasis be placed on a regular monitoring of the inplant sanitation and especially on the work habits and use of protective clothing and equipment by those workers who are perforce in a high dust environment.

It is also recommended that Medical Services Branch:

- (a) monitors the mill environment for occupational health hazards
- (b) a progress of routine medical examinations for workers in areas of high dust exposure is to be set up and Medical Services should monitor this program.
- (c) copies of this report be provided to Mine Management, Union representatives, Territorial Government and the Department of Indian and Northern Affairs.

Finally although data collected in Yellowknife do not support the contention of some recent reports that arsenic exposure is associated with an excess long term cancer mortality we must recognize that workers in the gold mines tend to migrate elsewhere for retirement. If a practical method for doing this can be found it is recommended that a register be kept enabling long term surveillance of all workers in arsenic exposed occupations.

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Respectably