

*Dossier arsenic*

TO  
À

NOTE AU DOSSIER

FROM  
DE

Sous-ministre adjoint  
Services médicaux

SUBJECT  
OBJET

Communiqué de presse - arsenic à Yellowknife.

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N/RÉFÉRENCE 850-5-X751 ( A10 )
YOUR FILE - V/RÉFÉRENCE
DATE Le 7 octobre 1975

En arrivant au bureau ce matin, j'ai pris connaissance pour la première fois du texte français du communiqué de presse du 3 octobre 1975 touchant l'étude sur le taux d'arsenic à Yellowknife.

Le texte contenait une erreur fondamentale de traduction qui laissait croire qu'un taux de plus de 10 p.p.m. d'arsenic était considéré comme acceptable, ce qui évidemment n'est pas le cas.

J'ai immédiatement communiqué avec Mme Angèle C. Leduc, du bureau de M. Lupien, pour l'alerter de la situation et l'informer que je communiquais avec les services de l'information. Dans l'absence de M. Brigstocke, j'ai finalement rejoint messieurs Couture et Boucher qui, après consultation, ont décidé de communiquer avec les journaux de langue française pour savoir s'ils avaient publié la nouvelle, plutôt que d'émettre un communiqué intitulé erratum. M. Couture devait informer le bureau de M. Lupien en conséquence.

Les services de l'information reconnaissent que c'est leur responsabilité de s'assurer de la qualité du texte traduit.

Charles-E. Caron.





# communiqué

1975 - 128

le 3 octobre 1975

## LE TAUX D'ARSENIC À YELLOWKNIFE (T.N.-O.)

OTTAWA - Le ministre de la Santé nationale et du Bien-être social, M. Marc Lalonde vient d'annoncer les résultats d'un ensemble de tests cliniques et biologiques qui visaient à déterminer le taux d'arsenic sur des habitants de Yellowknife. Des tests antérieurs chez ces mêmes habitants avaient révélé des taux élevés d'arsenic dans les cheveux.

Cette étude faisait suite à une enquête préalable de dépistage suscitée par des allégations selon lesquelles la santé des citoyens de Yellowknife était menacée par suite d'une exposition excessive à l'arsenic. Les données compilées par le Dr. Otto Schaefer démontrent que les travaux miniers actuels ne comportent aucun risque pour la santé de la population de Yellowknife. Le dernier rapport indique que:

- rien ne prouve que la population de Yellowknife soit exposée à des taux excessifs ou dangereux d'arsenic;
- les employés de certains ateliers de la "Giant Mill and Refinery" présentent des taux élevés d'arsenic dans les cheveux et des taux à peine élevés dans l'organisme en général;

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- malgré la présence d'irritations et d'éruptions cutanées locales due à l'exposition aux poussières d'arsenic, on a constaté aucune manifestation clinique de cette toxicité arsenicale. Toutes les personnes ayant présenté ces réactions sont employées au moulin de la "Giant Mill and Refinery".

Le Ministère a examiné les cheveux de 700 habitants de Yellowknife au début de cette année; sur ce nombre, 63 échantillons contenaient plus de 10 p.p.m. d'arsenic. Des taux, considérés généralement acceptables, ont été relevés chez des personnes n'ayant apparemment pas été exposées à l'arsenic. La Direction générale des Services médicaux a choisi cet indice pour désigner les personnes sujettes à un examen exhaustif. Suite aux résultats de la première enquête, la Direction générale des Services médicaux a entrepris des examens complets y compris des prélèvements de sang, des tests de la fonction hépatique, un électrocardiogramme, une radiographie pulmonaire, des prélèvements d'urine sur une période de 24 heures et dans certains cas, des prélèvements complémentaires de cheveux et de poils. Un examen des dossiers personnels, dont les résultats d'analyse de laboratoire, les électrocardiogrammes et examens au rayon-X, ne révèle aucun signe pathologique indicateur d'empoisonnement chronique à l'arsenic.

Les examens cliniques ont été effectués en juin dernier, à Yellowknife, et ont porté sur 58 personnes dont 50 avaient fait partie de la première enquête. Parmi les 63 personnes du groupe initial, 8 avaient quitté Yellowknife sans laisser d'adresse, et 5 autres étaient en vacances à l'extérieur de la région.



Six personnes qui n'avaient pas subi les premiers examens de dépistage qui manifestaient de l'inquiétude, par suite de leur long séjour à la mine ou au moulin, ont été ajoutées au nouveau groupe. Deux enfants autochtones ont également été examinés suite à une enquête indépendante menée par le "National Indian Brotherhood" et qui démontrait une teneur élevée d'arsenic dans l'organisme.

Cinq des 58 personnes examinées présentaient des taux légèrement élevés d'arsenic, leur urine contenant entre 0.1 et 0.3 milligrammes par 24 heures. Ces cinq personnes travaillaient soit comme trameurs, soit comme opérateurs de dépoussiéreurs "cottrell", soit dans le laboratoire du moulin. Quoique leur taux d'arsenic fut supérieur à celui de toutes les autres personnes ayant fait l'objet de l'enquête à Yellowknife, il n'atteignait pas le seuil de la toxicité. Selon plusieurs scientifiques, des taux urinaires de 0.7 à 1.0 milligramme ne présentent pas un risque excessif pour des gens travaillant dans un milieu exposé à l'arsenic. Les taux trouvés chez les mineurs de Yellowknife étaient bien inférieurs à ces taux. De plus, une étude récente a démontré qu'on ne trouvait pas de maladie liée à l'arsenic chez les personnes éliminant moins de 1.0 milligramme par jour. Les cinquante-trois autres personnes examinées ne montraient aucun signe d'ingestion excessive d'arsenic.

L'examen clinique a révélé que dix-sept personnes avaient présenté de l'irritation et des éruptions cutanées après avoir été exposées à la poussière d'arsenic. Chacune de ces personnes était employée au moulin et présentait les "éruptions arsenicales" lorsqu'elle travaillait comme trameur, opérateur de dépoussiéreurs cottrell, ou dans la chambre des filtres servant à recueillir la



poussière chargée d'arsenic. Ce genre d'éruptions se manifeste souvent chez les travailleurs exposés à la poussière chimique.

Les examens n'ont révélé aucune lésion cutanée généralement liée à un début de cancer. La Direction générale des Services médicaux se préoccupe cependant des effets à long terme d'une exposition, et mettra sur pied un programme d'examens médicaux réguliers pour ouvriers fortement exposés à la poussière. La Direction générale contrôlera aussi régulièrement les risques professionnels que présente le travail au moulin.

Les examens ont révélé plusieurs problèmes médicaux non reliés à l'arsenic ou au travail dans la mine. En tout, vingt-sept personnes ont été renvoyées à leur médecin pour un examen ou pour un traitement d'affections relevées par les épreuves.

Un programme de contrôle médical régulier a été recommandé pour les cinq personnes chez qui on a trouvé des taux élevés d'arsenic et la Direction verra à ce que les examens soient faits de façon satisfaisante. De plus, toutes les personnes travaillant au moulin dans des zones fortement exposées à la poussière seront systématiquement examinées. On a déjà mesuré les concentrations de poussières et la surveillance se poursuit.

Le rapport du Dr Schaefer a été envoyé aux représentants des mines et du syndicat ainsi qu'aux ministères fédéraux et territoriaux intéressés.

Réf.: Denis Boucher

Tél.: (613) 996-4950



## LE TAUX D'ARSENIC À YELLOWKNIFE (T.N.-O.)

### SOMMAIRE

Cinquante-huit personnes ont subi à Yellowknife au mois de juin 1975 des examens-cliniques complets suivis d'études de laboratoire. Cinquante de celles-ci, dont la teneur en arsenic dans leurs cheveux dépassait 10 p.p.m., avaient été identifiées lors de la phase I de l'opération où près de 700 résidents avaient été examinés. Six de ces personnes étaient associées à la mine Giant et croyaient avoir été exposées à l'arsenic. Deux enfants identifiés par une enquête indépendante du National Indian Brotherhood ont également été examinés.

L'enquête a révélé que:

1. Rien ne prouve que la population de Yellowknife soit exposée à des taux excessifs ou dangereux d'arsenic.
2. Les employés de certains ateliers de la "Giant Mill and Refinery" présentent des taux élevés d'arsenic dans les cheveux et des taux à peine élevés dans l'organisme en général. Malgré la présence d'irritations et d'éruptions cutanées locales due à l'exposition aux poussières d'arsenic, on a constaté aucune manifestation clinique de cette toxicité arsenicale. Toutes les personnes ayant présenté ces réactions sont employées au moulin de la "Giant Mill and Refinery". Cinq personnes seront examinées de plus près à la suite des résultats obtenus des examens médicaux.



3. Selon plusieurs scientifiques, des taux urinaires de 0.7 à 1.0 milligramme ne présentent pas un risque excessif pour des gens travaillant dans un milieu exposé à l'arsenic.

#### RECOMMANDATIONS

1. Qu'un programme régulier d'examens-cliniques pour les travailleurs exposés à un haut niveau de poussière d'arsenic soit entrepris par la Direction générale des Services médicaux.
2. Qu'une surveillance continuelle de l'environnement de la mine et de l'usine soit aussi entreprise par les Services médicaux.
3. Que des copies du rapport soient remises à l'administration de la mine, aux usines, au gouvernement des Territoires ainsi qu'au ministère des Affaires Indiennes.





Gouvernement  
du Canada

Gouvernement  
du Canada

# MEMORANDUM

# NOTE DE SERVICE

P.A. 850-5-X757

TO  
À

Director General, Program Management

FROM  
DE

Programs Medical Officer  
N. W. T. Region

SUBJECT  
OBJET

Arsenic - Yellowknife

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N/RÉFÉRENCE  151 - 1 - 5
YOUR FILE - V/RÉFÉRENCE
DATE  October 7, 1975

I enclose a copy of the Phase II report as issued to the Press, Government of the N. W. T., D. I. N. A., Mine managers, Union representative on Friday, October 3rd, 1975.

You will note only slight changes from the form received over the telecopier in the interests of improved grammar (changes appear on page 8; the bottom two paragraphs).

I should comment that the release was well received at the news conference and the only dissident note came from the union representative who was new, and did not know the background.

We have received word of favourable comment in Yellowknife from those involved in that this time they received information by letter as was promised and that the reports were not delayed as was the case in the previous investigation.

Other than coming to a working agreement for the follow-up suggested in the report and news release it is hoped that this whole matter may now be laid to rest.

attach.

mlm

ACTION	PA date	IF date
11/10	1/10/71	
INFORMATION		
11/15		

R. D. P. Eaton, PhD., M. B., ChB.

*[Signature]*

*File under [unclear] file (only)*

13, 15, 10







# 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 Giant 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. Bhimji 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 files 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  $\text{As}_2\text{O}_3$  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  $\text{As}_2\text{O}_3$  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  $\text{As}_2\text{O}_3$  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      1 sample from the 58 persons examined was  
Washed samples 10      not available for comparison or inclusion  
in this table.

Assessment of the urinary arsenic excretion figures was complicated by the fact that a relatively large number of 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

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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 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 of Cottrell operators for more than five years and one was working in 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) initiates a programme of routine medical examinations for workers in high dust exposure and monitors this programme.
- (c) provides copies of this report 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 occupation.





MEMORANDUM

NOTE DE SERVICE

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Services médicaux

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Charles E. Caron.

*cc Mr Black  
P. Couture  
A. Leduc*

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

850-5-X751 ( A10 )

YOUR FILE - V/RÉFÉRENCE

DATE

Le 7 octobre 1975





# communiqué

1975 - 128

1e 3 octobre 1975

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poussière chargée d'arsenic. Ce genre d'éruptions se manifeste souvent chez les travailleurs exposés à la poussière chimique. Les examens n'ont révélé aucune lésion cutanée généralement liée à un début de cancer. La Direction générale des Services médicaux se préoccupe cependant des effets à long terme d'une exposition, et mettra sur pied un programme d'examens médicaux réguliers pour ouvriers fortement exposés à la poussière. La Direction générale contrôlera aussi régulièrement les risques professionnels que présente le travail au moulin.

Les examens ont révélé plusieurs problèmes médicaux non reliés à l'arsenic ou au travail dans la mine. En tout, vingt-sept personnes ont été renvoyées à leur médecin pour un examen ou pour un traitement d'affections relevées par les épreuves.

Un programme de contrôle médical régulier a été recommandé pour les cinq personnes chez qui on a trouvé des taux élevés d'arsenic et la Direction verra à ce que les examens soient faits de façon satisfaisante. De plus, toutes les personnes travaillant au moulin dans des zones fortement exposées à la poussière seront systématiquement examinées. On a déjà mesuré les concentrations de poussières et la surveillance se poursuit.

Le rapport du Dr Schaefer a été envoyé aux représentants des mines et du syndicat ainsi qu'aux ministères fédéraux et territoriaux intéressés.

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## LE TAUX D'ARSENIC À YELLOWKNIFE (T.N.-O.)

### SOMMAIRE

Cinquante-huit personnes ont subi à Yellowknife au mois de juin 1975 des examens-cliniques complets suivis d'études de laboratoire. Cinquante de celles-ci, dont la teneur en arsenic dans leurs cheveux dépassait 10 p.p.m., avaient été identifiées lors de la phase I de l'opération où près de 700 résidents avaient été examinés. Six de ces personnes étaient associées à la mine Giant et croyaient avoir été exposées à l'arsenic. Deux enfants identifiés par une enquête indépendante du National Indian Brotherhood ont également été examinés.

L'enquête a révélé que:

1. Rien ne prouve que la population de Yellowknife soit exposée à des taux excessifs ou dangereux d'arsenic.
2. Les employés de certains ateliers de la "Giant Mill and Refinery" présentent des taux élevés d'arsenic dans les cheveux et des taux à peine élevés dans l'organisme en général. Malgré la présence d'irritations et d'éruptions cutanées locales due à l'exposition aux poussières d'arsenic, on a constaté aucune manifestation clinique de cette toxicité arsenicale. Toutes les personnes ayant présenté ces réactions sont employées au moulin de la "Giant Mill and Refinery". Cinq personnes seront examinées de plus près à la suite des résultats obtenus des examens médicaux.



5. Selon plusieurs scientifiques, des taux urinaires de 0.7 à 1.0 milligramme ne présentent pas un risque excessif pour des gens travaillant dans un milieu exposé à l'arsenic.

#### RECOMMANDATIONS

1. Qu'un programme régulier d'examens-cliniques pour les travailleurs exposés à un haut niveau de poussière d'arsenic soit entrepris par la Direction générale des Services médicaux.
2. Qu'une surveillance continuelle de l'environnement de la mine et de l'usine soit aussi entreprise par les Services médicaux.
3. Que des copies du rapport soient remises à l'administration de la mine, aux usines, au gouvernement des Territoires ainsi qu'au ministère des Affaires Indiennes.





# 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  
Canada

Santé et  
Bien-être social  
Canada



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.

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.

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

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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. Bhimji 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  $\text{As}_2\text{O}_3$  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  $\text{As}_2\text{O}_3$  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  $\text{As}_2\text{O}_3$  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      1 sample from the 58 persons examined was  
Washed samples <10      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.