



## MEMORANDUM

## NOTE DE SERVICE

TO  
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Regional Director

FROM  
DE

Programs Medical Officer

SUBJECT  
OBJETArsenic Studies - Yellowknife

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

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YOUR FILE - V/RÉFÉRENCE

DATE

September 10, 1975

Dr. Schaefer has advised me that he has now completed the work on the clinical follow up of As - exposed individuals identified by the preliminary hair screening completed in the spring of this year.

In brief the findings confirm our preliminary impressions that there is an As exposure hazard in certain categories of mill workers - specifically Roaster and Cottrell operators - and possibly also workers in the Assay laboratory.

For all others urinary arsenic levels are low and clinical examination and investigations reveal no evidence of any health hazard attributable to Arsenic.

Dr. Schaefer will have a completed report prepared by the end of this week, when it will be presented to you.

Obviously further activity must depend on Branch opinion and it is felt likely that a meeting in Ottawa will be called to discuss the results and determine the future course.

It is suggested at this point that Medical Services involvement in this investigation might now be considered to be at an end, once we have fulfilled our commitment to the press and the people of Yellowknife to make available the results of the study. There is no general hazard from Arsenic.

In-plant hazards and worker health and safety are legally the responsibility of D. I. N. A. and the mine owners and it seems appropriate that future follow up should be dictated by Medical Services but completed by the appropriate responsible authority.

It is understood that Giant mines have a contract for physician services with an Edmonton based physician located in the Baker clinic and it is specifically recommended that all the findings of this investigation which point to a possible As hazard to employees be turned over, with the approval of the individual employee, to both this physician and to the employees personal physician in Yellowknife.

Secondly it is recommended that abnormal clinical findings





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not related to As intoxication be made known, with the individuals approval, to the family physician in Yellowknife.

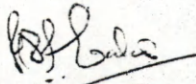
Any further press releases must reinforce the previously given opinion that no health hazard exists to the general population and should point out that Medical Services involvement is now considered to be completed.

The question of the increased Mercury levels in the hair of the Goulet children has not yet been satisfactory explained, but we now have reports on urinary assay indicating levels in the lowest range of normal (3-4 in a normal range of 0-25 mcg/l.)

It is therefore evident that we are not looking at a dangerous situation but one that is at one time unexplained and very interesting.

Further investigations of Hg levels in hair, blood and urine in other members of the Goulet family are to be carried on next Monday - when Branch's requirements of prompt delivery of specimens to a receiving laboratory can be met by the airlines.

Additionally we shall be probing more deeply into family activities, medicamentation, etc. which might give a clue to the source of this high Mercury level - I would suspect that it might not be totally inappropriate to interview the affected children individually to enquire whether any substance could have been deliberately applied, though I view this as extremely unlikely.

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

c.c. Dr. O. Schaefer

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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, spirography, 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 58 individuals were seen in the Arsenic examination. 50 of these were all that were available of the 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 <sup>an</sup> who volunteered for the examination feeling that they had/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.

Grant mine

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 Cammell 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. Rhinji and Dr. Schaefer with referral of all doubtful cases to radiologists at the Charles Cammell 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 17 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 neckcollar 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 17 of these individuals were Mill employees. Six of these experienced the "Arsenic rashes" whilst employed as Roasters or Cottrell operators and the remaining 11 whilst being temporarily occupied in the bag house or otherwise exposed to  $As_2O_3$  dust.

~~It should be noted that~~ All Cottrell operators and Roasters in the 58 persons examined experienced at one time or the other such rashes, 11 of the other 35 mill employees and none of the 10



miners or 9 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, 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, 18 showed abnormalities in 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 9 cases of obesity, 9 with hypertension and 12 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 hair or body levels. 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 appendages (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 ~~from~~ 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 <sup>well</sup> 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 <sup>from</sup> ~~done~~ in June 1975. These are expressed in the table which follows.

HAIR p.p.m.	NO.	MEAN p.p.m. IN HAIR	URINE	
			MEAN micro/l. <sub>from</sub>	MEAN micro/24 hr. <sub>from</sub>
< 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 " <10

These ~~57~~ 58 samples 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 14 individuals excreting more than the upper limit of normal namely 100 micrograms of arsenic in 24 hours 2 between 200 and 300 micrograms but none near the 700 to 1000 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 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 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 worker's own physician in Yellowknife and to Edmonton consultants. Furthermore ~~the~~ National Health and Welfare 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 performe in a high dust environment.

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.

It is also recommended that Med. Service Branch monitor the mill environment for occupational health hazards. A

B) A program of routine medical examinations for workers in areas of high dust exposure is recommended. <sup>be set up</sup> Medical Service should be ~~prepared to~~ monitor this program.

It is recommended that <sup>C</sup> copies of this report be provided to Mine Management, Union representatives, Territorial govt & DIANA