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MEMORANDUM
GOVERNMENT OF CANADA

NOTE DE SERVICE
GOUVERNEMENT DU CANADA

FROM / DE: M16

TO / À: NOTE TO FILE

OUR FILE – N/RÉFÉRENCE:

YOUR FILE – V/RÉFÉRENCE:

DATE: March 19, 1975.

REFER REPLY TO / ENVOYER LA RÉPONSE À:

TEL. NO. / TÉL.:

SUBJECT / SUJET: ARSENIC - YELLOWKNIFE

The Federal-Provincial Working Group on Drinking Water is presently examining Canadian Drinking Water Standards, including the standard for arsenic, which at present is set at 0.01 milligrams per litre ~~arsenic~~ "acceptable" and 0.05 milligrams per litre "maximum allowable". Information submitted to the Committee indicates that arsenic occurs ubiquitously in nature, primarily as pyrites and arsenides of metals and only rarely in its elemental state. It is amphoteric occurring in salts as the positive metal ion or in the negative non-metal ion. The prevalent chemical form of arsenic in water is believed to be the inorganic arsenate (pentavalent) with the equilibrium shifting in favour of the arsenite (trivalent) under reducing conditions. It is believed that the inorganic arsenicals are more toxic than their organic analogues and that the trivalent is more toxic than the pentavalent state. Other major sources of arsenic affecting animals, including man, are trioxide roaster fumes released during ore smelting processes and residues in food resulting from pesticide applications to trees and plants (fruits and vegetables), the use of organic arsenicals in feed grains as growth stimulants (poultry and pigs), or accumulation in the food chain (shellfish). Daily ingestion of arsenic through food is approximately 900 µg/day. Although normal human blood contains 0.2 to 1.0 milligrams/l of arsenic, there is no indication that arsenic is an essential nutritional element.

Inorganic arsenic is absorbed readily from the gastrointestinal tract into the plasma and is subsequently distributed throughout the body tissue. It is excreted slowly in the urine and it is on the basis of the slow excretion that it accumulates in bone, muscle and skin primarily but also in the liver and kidneys to a lesser degree. Excretion by the kidneys increases with increased absorption but the relationship is not sufficiently reliable as to indicate degree of exposure.

Arsenic is both acutely and chronically toxic to man. The mode of action is believed to be the inhibition of intracellular sulphydryl enzymes, which results in diminished cellular oxidation (tissue respiration). Symptoms of arsenic poisoning include gastrointestinal catarrh, kidney degeneration, liver cirrhosis and dermatologic manifestations such as hyperkeratoses. Fatal poisoning may occur upon ingestion of as little as 30 milligrams of arsenic but orchardists have been found to ingest daily as much as 6.8 milligrams without any signs of intoxication. In drinking water over a long period of time, levels as low as 0.21 milligrams per litre have been reported as poisonous to humans but on the other hand levels as high as 0.15 to 0.25 milligrams per

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litre have been reported by others as safe. The concentration of arsenic in hair and nails is higher than in other tissues. No adverse health effects have been documented for a drinking water level of 0.10 milligrams per litre.

Tolerance capabilities are said to be developed but this is presumed to be the result of ingestion of coarse, relatively insoluble arsenic powder. Arsenic is also imputed to have carcinogenic properties but evidence strongly suggests that this is not so at levels occurring environmentally. Attempts have been made to relate dermatological symptomatology and skin cancer but no etiological relationship has been satisfactorily confirmed. Because of the human toxicity factor and cumulative effects, the standard for water has been set to ensure the intake of arsenic from drinking water will be only a fraction (about 1/5) of the average daily exposure to this element. There is a possibility that the new Canadian standard for maximum allowable may be increased from 0.05 to 0.1 milligrams per litre. Confidential information is available that the United States standard may also be amended in this manner.

Treatment of Heavy Metal Poisoning

Three highly effective chemicals are available but they must be used before permanent damage to tissues occurs. These are:

(1) BAL (British Antilewisite)

2,3 - dimercaptopropanol

This substance combines with metallic ions such as arsenic, mercury, cobalt, nickel, antimony and gold and removes them from combination with the enzymes whose function they impair in the body.

(It is not useful for lead.)

DOSE Intramuscularly - (10 days)
4 mgs per kilo of body weight as a 10% solution in oil and 20% benzyl benzoate.
Maximum single dose - 300 mgs
Repeated every four hours on 1st day and every six hours on second day, then t.i.d. for 8 days.

Contraindications

(a) Anuria or oliguria.

(b) Cadmium Poisoning.

(2) Versene (EDTA)

Ethylenediaminetetraacetate
E D T A

This substance forms cyclic, stable, soluble, non-toxic compounds with most metals, including calcium. Therefore, it must be administered as the Calcium Salt to avoid hypocalcaemia.

(Calcium Disodium Versenate)
(Calcium Disodium Edetate)

It is used in the treatment of lead poisoning with considerable success.

DOSEAGE 500 mg in 250 ml of 5% glucose intravenously every 12 hours for 5 days.
May be repeated twice after a pause between each course of treatment.

(3) Penicillamine

(Cuprimine, beta, beta dimethycysteine)

This substance acts as an excellent chelating agent for copper, mercury and lead. It promotes their excretion in the urine. It is well absorbed from the gastrointestinal tract, therefore given orally.

(3A) N-acetyl-dl-penicillamine is reported as being even more effective than penicillamine in protecting against the effects of mercury. It is more resistant to metabolic degradation and is less toxic to the patient.

DOSE Penicillamine - (orally)
1 to 4 Gm daily on an <u>empty</u> stomach.

W. H. Frost, M.D., D.P.H.