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NEWS
from

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SUMMARY OF
SCIENTIFIC AND MEDICAL RESEARCH
ON
ASBESTOS-CEMENT PIPE AND HEALTH

Some persons who have inhaled heavy concentrations of asbestos fibers in industrial settings have shown increases in gastrointestinal cancer. Since there is evidence that the inhalation of asbestos under certain conditions can be harmful, some have theorized that the ingestion of asbestos in drinking water may also be harmful. Considerable amounts of asbestos-cement (A/C) water pipe are used in North America, Europe and other parts of the world. Thus, questions have been raised about the possible health hazards associated with drinking water conveyed through A/C pipe.

In order to determine whether the swallowing or ingestion of asbestos in drinking water represents a health hazard, two types of studies have been conducted: (1) Statistical or epidemiological* studies, in which the medical experience of one group, exposed to a high level of ingested asbestos, is compared to the experience of another group, exposed to a lower level or no ingested asbestos; and (2) animal studies, in which conclusions are derived from the ingestion, by animals, of asbestos under scientifically controlled conditions.

One of the first major studies was conducted by a panel of government and independent authorities in pathology, epidemiology, analytical methods and public health. Commissioned in 1974 by the American Water Works Association Research Foundation, the committee concluded:

> **"No firm evidence shows that the proper use of asbestos-cement pipe poses a hazard to health by reason of ingestion of asbestos fibers. Calculations comparing the probable ingestion exposure in occupational groups to that likely to occur as a result of ingestion of potable water from asbestos-cement pipe systems suggests that the probability of risk to health from the use of such systems is small - approaching zero."**

EPIDEMIOLOGIC STUDIES

Thomas J. Mason, et al in 1974 conducted a study entitled "Asbestos-Like Fibers in Duluth Water Supply." The study undertook to determine whether fibers present in the drinking water in Duluth, Minnesota produced increased cancer mortality. The study concluded:

> **Thus, in Duluth, one would expect a greater excess of cancer in the esophagus and stomach than in the rectum, but this did not occur.**

In 1976, B. S. Levy of the Minnesota Department of Health continued the investigation made by Mason. Levy was the Acting State Epidemiologist for Minnesota and his co-authors were associated with the University of Minnesota School of Public Health and the Mayo Clinic.

* Epidemiology: the study of the distribution and dynamics of disease in human populations.

Gastrointestinal cancer incidence data for the cities of Duluth, Minneapolis and St. Paul were gathered and compared in the same manner as in the Mason study. (Minneapolis and St. Paul have populations similar to Duluth, but they have few, if any, asbestos fibers in their water supplies). After a thorough investigation, the authors concluded:

> **" ... there was no consistent pattern of statistically significant differences observed" among the three cities.**

The Levy study was updated in 1981 by Eunice Sigurdson, R. N., M.P.H., of the Minnesota Department of Health. She reaffirmed previous findings, stating:

> **... there is currently no observed etiologic or causal association between exposure to amphibole fibers in the Duluth drinking water supply and the development of cancer.**

Thomas R. Fears of the National Cancer Institute published an article in the American Journal of Epidemiology entitled "Cancer Mortality and Asbestos Deposits." The specific question posed in that study was: "Is there an increase in risk from cancer associated with naturally-occurring asbestos?"

The abstract of the study states:

> **The study of cancer mortality rates in these matched counties provides no evidence that naturally-occurring asbestos is a great hazard to the general population of counties with asbestos deposits.**

Donald T. Wigle, M.D., Ph.D. and M.P.H., Bureau of Epidemiology, Health and Welfare, Canada, conducted an extensive study in 1977 of municipalities in the Province of Quebec. Entitled "Cancer Mortality in Relation to Municipal Water Supplies," these comparison studies presented an unusual scientific opportunity to analyze cancer mortality in populations exposed to as much as 1.3 billion fibers per liter of drinking water. Despite the extremely high levels of asbestos in drinking water, this study concludes:

> **A study of twenty-two municipalities in Quebec did not reveal excess cancer mortality that could be related to the presence of asbestos fibers in drinking water supplies.**

The Wigle study was also updated in 1981 with similar conclusions:

> The mortality rates for persons living in two localities in which asbestos was present in high concentrations in water samples from the distribution system were analyzed. Although there are serious limitations to this type of study, no consistent increase of mortality rates for any cancer was demonstrated.

The Commins report, published in 1979 under the aegis of the internationally prestigious Water Research Centre, entitled "Asbestos in Drinking Water: A Review," summarized the Wigle study in this fashion:

> It is reassuring that a recently reported, detailed, epidemiological study carried out in 22 municipalities in Quebec failed to reveal excess cancer mortality that could be related to the presence of asbestos fibers in drinking water supplies. This was despite the fact that some of the water supplies fed to these municipalities were reported to be fairly heavily contaminated with asbestos fibers.

The first of two studies made in Connecticut concerning the use of asbestos-cement water pipes and the incidence of cancer was entitled "An Investigation of the Use of Asbestos-Cement Pipe for Public Water Supply and the Incidence of Gastrointestinal Cancer in Connecticut." Referred to as the Harrington study, it was published in the American Journal of Epidemiology in 1978 and was co-authored by officials of the U.S. Center for Disease Control, U.S. Environmental Protection Agency (EPA), Yale University School of Medicine and Connecticut State Health Department.

As the Harrington study stated:

> The possibility of studying reliable cancer incidence data over a 35-year period through the Connecticut Tumor Registry and linking these data with information gathered on asbestos cement pipe studies conducted by U.S. Environmental Protection Agency, prompted the present investigation.

The findings of the Harrington study are consistent with a determination that the use of asbestos cement pipe does not create a health hazard:

> This study detected no changes in incidence rates or patterns in Connecticut for cancers of the stomach, colon, or rectum over the period 1935-1973, that could be construed as related to the introduction around 1950 of A/C pipes to carry domestic water supplies to some or most of the residents of certain towns.

The Meigs study, entitled "Asbestos Cement Pipe and Cancer in Connecticut 1955-1974," was

Published in the January/February, 1980, edition of The Journal of Environmental Health. The principal investigator, J. Wister Meigs, M.S., is Director of the Connecticut Cancer Epidemiology Unit and Clinical Professor of Epidemiology, Yale University School of Medicine. the Meigs study used essentially the same methods as those used in the Harrington study, but the procedures and techniques were more sensitive and refined. The study was supported in part by the National Cancer Institute and the U.S. Environmental Protection Agency.

Following are the conclusions of the Meigs study:

> These analyses give no consistent indication that use of A/C pipe in Connecticut public water supplies has been followed by increases in incidence either of "all cancers" of the individual sites considered.
>
> Therefore, the lack of coherent evidence of cancer risks from use of A/C pipe is reassuring. (Emphasis in article.) It is consistent with most reports from other areas of the United States.

Hence, the Harrington study and the Meigs study represent independent, thorough and competent epidemiological studies carried out for the sole purpose of determining the question at issue: whether the use of asbestos-cement pipe creates a hazard to public health. Both studies reached the conclusions: (1) that there was no association between the use of asbestos-cement pipe in Connecticut and incidence of cancer; and (2) in the opinion of the authors of the Meigs study, there was no need to change water distribution policies in this State because of the use of such pipe.

The Kanarek study was conducted in five California counties in the San Francisco Bay Area by Dr. Robert C. Cooper (principal investigator), doctoral candidate Marty Kanarek (project coordinator) and others. The study found a weak statistical correlation between the ingestion of asbestos in drinking water and certain cancers. The Kanarek study was an indirect study in which census tracts with differing amounts of asbestos fibers in their drinking water were compared for cancer incidence, after attempting to take into account certain variables.

By its own admission, the study is of limited value in its relevance to asbestos-cement pipe:

> Samples were taken before and after passage of water through lengths of asbestos-cement pipe. In most of the districts sampled, there was not a substantial increase in fiber counts after passage through asbestos-cement pipe. The amount of asbestos-cement pipe in the various distribution systems was not included as a variable in the analysis because of difficulty of determining its location, age and dimensions.
>
> The study design was that of an indirect epidemiological approch in which the observational unit was the census tract. Studies such as this one can only suggest associations, and cannot pinpoint definite causation. (Quotation from doctoral thesis).

The California Department of Health Services has taken the following view of the Kanarek

study:

> The UC (University of California) doctoral thesis abstract entitled: "Asbestos in Drinking Water and Cancer Incidence," contains no new or original evidence of a medical nature about cancer or asbestos, nor does it establish any causal link between asbestos in Bay Area drinking water and the incidence of cancer.

The U.S. Environmental Protection Agency (EPA) has stated of the Kanarek study:

> The University of California investigators are among the first to report finding an association between ingested asbestos and cancer rates. They caution that causative inferences must necessarily be limited because of the indirect nature of the data being compared. This means that the results of this study do not prove that there is a link between Bay Area water and cancer. (Reference 13)

Kenny S. Crump, Ph.D., a highly respected, independent specialist in environmental risk assessment, has made the following observations about the Kanarek study:

> It is generally accepted among epidemiologists that ecologic studies such as this ... should not be used to determine cause and effect relationships — irrespective of their findings.
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> Kanarek et al were unable to control many factors which might have been confounded with asbestos levels. These factors include smoking, eating and other personal habits; occupational exposures to carcinogens; and exposures to other environmental pollutants, such as organic contaminants in drinking water.
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> There were apparent discrepancies between two reported analyses of the six year data which this reviewer could not reconcile.
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> There was a lack of consistency with respect to many of the associations found by Kanarek et al. A number of the associations were found in one sex only.
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> This lack of consistency (with five similar studies conducted elsewhere) suggests that the positive associations found by Kanarek et al. are the result of confounding.

As if these independent opinions were not sufficient to invalidate the Kanarek study, a biostatistician at the University of California-Berkeley School of Public Health, Dr. Michael Tarter, reanalyzed the Kanarek data. He found in San Francisco a negative correlation between asbestos in drinking water and cancer, that is, in census tracts where asbestos levels were high, cancer incidence rates were lower than in census tracts not exposed to asbestos in drinking water. At the U.S. Environmental Protection Agency Summary Workshop on Ingested Asbestos (October 13-14, 1982), Dr. Tarter cautioned, "Until this finding is fully understood, one must be very careful about drawing any conclusions from the Kanarek study."

EPA recently reported findings of an epidemiologic study in Escambia County, Florida. Asbestos levels ranged from 700,000 to 32.7 million fibers per liter for a period of approximately twenty-five years. EPA scientists concluded:

> **There were no statistically significant differences in cancer mortality between high exposure, moderate exposure and no exposure groups.**

In August, 1982, Dr. Lincoln Polissar of the Fred Hutchinson Cancer Research Center published an important study in the American Journal of Epidemiology. This research also was funded by the U.S. Environmental Protection Agency. Naturally occurring asbestos levels in this study were from 37 million to 556 million fibers per liter of drinking water. The population has been exposed to such levels for over fifty years. The authors concluded:

> **Results of this study and prior studies of cancer in relation to waterborne asbestos are inconsistent and provide little evidence that asbestos in community water supplies has altered the risk of any cancer.**

A more accurate case control study also was conducted on this same population group. Such studies seek to determine whether persons with a given disease are more apt to have been exposed to the agent under investigation (asbestos) than disease free individuals. The principal investigator, Dr. Polissar, reported at the aforementioned EPA Summary Workshop on Ingested Asbestos, that no correlations were found between cancer incidence and asbestos in drinking water. This is the most sophisticated epidemiologic study ever conducted on the question of the potential health effects of ingested asbestos.

ANIMAL FEEDING STUDIES

Animal ingestion studies support and confirm the epidemiologic findings that there is no association between the ingestion of asbestos fibers in drinking water and the presence of a health hazard. Test animals have been fed diets containing substantial portions of asbestos, without inducing related tumors or shortening lifespans.

All of the following scientific authorities have concluded that animal experiments do not support the proposition that the ingestion of asbestos in drinking water is harmful.

Bonser, G.M. and Clayson, D.B., "Feeding of Blue Asbestos to Rats," 45th Annual Report of the British Empire's Cancer Campaign, 242 (1976). An experiment was performed to ascertain whether feeding asbestos to rats would induce peritoneal tumors. Sixty-five rats were fed 1,500 milligrams of crocidolite asbestos per kilogram body weight for life and no tumors were observed.

Smith, W. E., "Asbestos, Talc and Nitrites in Relation to Gastric Cancer," American Industrial Hygiene Association Journal 34:227-228 (1973). This too was a complete life span experiment in which hamsters were fed abnormally large amounts of asbestos.

> In 45 hamsters maintained throughout their lives on diets containing 1% of the chrysotile or amosite varieties of asbestos, we found no gastric carcinomas and no tumors in the gastrointestinal tract except for a neoplasm in the mesentery of the colon. We are unable to relate that lesion to the treatment, since ashing has revealed no asbestos fibers in it.

Webster, I., "The Ingestion of Asbestos Fibers," Environmental Health Perspectives, 9:199-202 (1974). Dr. Webster fed baboons heavy doses of crocidolite over considerable periods of time to determine if peritoneal or gastrointestinal cancers could be induced. The report states:

> **In none of the many baboons used was there any evidence of a peritoneal tumor or gastrointestinal tumor.**

Gross, P. et al., "Ingested Mineral Fibers: Do They Penetrate Tissue and Cause Cancer?" Arch. Environmental Health, 29(6):341-347 (1974).

> Twenty-one months of intimate contact of rat GI (gastrointestinal) mucosa with very high concentrations of chrysotile asbestos failed to produce cancer or any other kind of lesion. Short-term and long-term feeding (up to $1\frac{1}{2}$ years) of chrysotile and crocidolite by a second laboratory resulted in no tumor production in the GI tract or mesothelium during the lifetime of the animals.

Smith, W. E., et al., "Health of Experimental Animals Drinking Water With and Without Amosite Asbestos and Other Mineral Particles," Journal of Environmental Pathology and Toxicology, 3:277-330, 1980.

In this study, hamsters were administered asbestos in drinking water for their entire lifetimes. Tumor incidence was compared with hamsters that did not consume asbestos. Dr. Smith concluded:

> **In the present experiment, no malignant tumors were found in hamsters maintained on drinking water containing 13,000 million amosite fibers per liter.**

Hilding, A.C., et al., "Biological Effects of Ingested Amosite Asbestos, Taconite Tailings, Diatomaceous Earth and Lake Superior Water in Rats," Archives of Environmental Health, 36:298-303 (1981).

Rats were fed asbestos during their lifetime and were examined at autospy. The dose levels for the treated animals were the equivalent of 5.5 billion fibers per liter (low dose group) and 78 billion fibers per liter (high dose group) of drinking water. The authors concluded:

> **The most significant finding in our study was the absence of gastrointestinal cancer in the animals exposed to the test materials.**
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> **Under the conditions of our study, ingested asbestos ... had no demonstrable carcinogenic effect on the gastrointestinal tract or on other body tissues of the rat.**

Moore, J.H., "Biological Effects of Ingested Asbestos - Status Report, U.S. Department of Health, Education and Welfare, Public Health Service, National Toxicology Program, January, 1981."

The National Institute of Environmental Health Sciences sponsored a $6 million study on the effects of ingested asbestos in rats and hamsters. The asbestos was administered at the rate of 1% of total diet for the entire lifetime of the animals. Results released in 1981 were reported as follows:

> **There was no adverse effect of amosite asbestos on body weight gain or survival. Neither the amosite groups showed an increase rate of neoplasia in any organ or tissue compared to the control groups.**
>
> **Under the conditions of the bioassay, the ingestion of amosite asbestos was not carcinogenic in male and female Syrian golden hamsters.**

NIEHS officials reported in October, 1982 that the lifespans of rats fed chrysotile and crocidolite asbestos also were not affected by exposure. In-house histopathological reviews also showed no carcinogenic effect. These results will be peer-reviewed and published in early 1983.

These animal feeding studies conducted by the federal government are the most extensive ever carried out to assess the effect of ingestion of asbestos fibers on animals. Using the highest asbestos levels found in drinking water, a person would have to drinking 14 million gallons of water per day to consume an amount of asbestos shown to be non-hazardous in these laboratory animal studies.

CONCLUSION

Since 1973, when questions were first raised about the potential health effects of A/C pipe and asbestos in drinking water, U.S. government agencies -- the Environmental Protection Agency, Food and Drug Administration, National Institute of Environmental Health Sciences, National Cancer Institute and others -- have spent $12-15 million (U.S.) studying this matter. Today, nine years later, the conclusions from this extensive, independent research are clear. There are no apparent adverse health effects from asbestos in drinking water or the use of A/C pipe.

On October 13-14, 1982, EPA held its Summary Workshop on Ingested Asbestos. The purpose of this important meeting was to review all available medical evidence on ingested asbestos and A/C pipe. At that time, Dr. Joseph A. Cotruvo, Director, Criteria and Standards, Office of Drinking Water, announced that EPA would conduct no more research on the subject. The National Academy of Sciences (NAS) Committee on Safe Drinking Water is reviewing the epidemiologic studies on asbestos and drinking water, and will submit its conclusions and recommendations to EPA in early 1983. EPA will use the NAS report, along with the animal feeding study results and public comment, to develop a formal position statement on the issue.