PLAINTIFF'S EXHIBIT

CAP-473

A STUDY OF THE PROBLEM OF ASBESTOS IN WATER

by

The American Water Works Association Research Foundation
6666 W. Quincy Avenue
Denver, Colorado 80235

for the

A/C Pipe Producers Association
Suite 1113, 1875 Connecticut Avenue, N.W.
Washington, D.C. 20009

July 1974

TABLE OF CONTENTS

Sections		Page
I.	PROJECT HISTORY	2
II.	BIBLIOGRAPHY	6
III.	SUMMARY	14
IV.	RECOMMENDATIONS	17
V.	COMMITTEE REPORT	18
VI.	REFERENCES	26
VII.	APPENDICES	29

CAPCO JEN 0002459

PROJECT HISTORY

Research has revealed a recognized occupational health hazard connected with excessive and prolonged inhalation of asbestos dust. A related question has arisen regarding the possible health hazard that may result from the presence of asbestos fibers in water, beverages, food, or fluids used for the administration of drugs. Since considerable amounts of asbestos-cement pipe convey potable water in North America, Europe, and other parts of the world, a question has also been raised with respect to the possible health hazard that may be associated with drinking water which has flowed through asbestos-cement pipe.

The asbestos industry has been investigating the biological effects of asbestos for many years. Additionally, the A/C Pipe Producers Association contracted with the American Water Works Association (AWWA) Research Foundation to study the problem of asbestos in water, and specifically with relation to the use of asbestos-cement pipe.

The objectives of the study were to: (1) assemble all pertinent literature on the biological effects of asbestos; (2) have a committee examine the technical literature and on the basis of present knowledge issue a report answering the question: Does asbestos in water constitute a hazard to health by causing a greater than normal occurrence of gastrointestinal cancer or malignant mesothelioma of the peritoneum or pleura?; and (3) recommend the research required to finally resolve the matter.

Selection of Study Committee

In the formation of the select committee, considerable attention was given to keeping the group manageably small but invested with competency in the following specialties:

1. An individual familiar with the asbestos problem in air and water.
2. A representative of the U.S. Environmental Protection Agency (EPA) familiar with the problem.
3. A representative of the water supply industry.
4. An expert in analytical methods.

CAPCO JEN 0002460

5. A pathologist.

6. An epidemiologist.

7. An international expert knowledgeable in the water, medical and public health fields, and capable of providing input and insight from abroad.

The fact that the committee members accepted the first invitation to serve indicates their interest in the subject.

The following persons served on the study committee:

Marvin Kuschner, M.D.
Dean, School of Medicine
State University of New York
Stony Brook, New York

Roger Lee
Chief, Surveillance & Technical Assistance Section
Program Operations Branch
Water Supply Division
U.S. Environmental Protection Agency

Gordon G. Robeck
Director, Water Supply Research Laboratory
U.S. Environmental Protection Agency

John R. Rossum
Sanitary Engineer
California Water Service Company

Marvin A. Schneiderman, Ph.D.
Associate Director for Field Studies and Statistics, DCCP
U.S. Department of Health, Education, and Welfare
Public Health Service
National Cancer Institute

E. Windle Taylor, C.B.E., M.A., M.D., D.P.H., F.R.C. Path.
Director of Water Examination (retired March 1974)
Metropolitan Water Board
London, England

George W. Wright, M.D.

CAPCO JEN 0002461

Procedure

Two meetings of two days' duration were held. Prior to the first meeting the AWWA Research Foundation staff gathered and analyzed, to the extent possible, all the pertinent literature on the biological effects of asbestos. Copies of papers dealing specifically with asbestos in water, including analytical methods, were sent to the committee members for their study prior to the first meeting. Each committee member also received abstracts of the Lyon Conference papers, the full text of which was available for their examination upon request. The committee members were also instructed to conduct their own search for additional information.

The Lyon Conference, convened by the International Agency for Research on Cancer, was held in Lyon, France on October 5-6, 1972. It involved 137 participants from 20 countries and was called to review all evidence relating asbestos with cancer and other biological effects.

Worthy of mention is the fact that in addition to the technical papers listed in the bibliography, the conference resulted in the issuance of a report of the advisory committee on asbestos cancers. Panels specializing in epidemiology, pathology, and physics and chemistry, met in a separate session after the conference and prepared a report which consisted of two sections.

The first section provided a general review in the form of answers to a number of important general questions about the relation of asbestos to cancers of different body sites while the second section offered recommendations for further research. Question seven in the first section was phrased as follows:

> "Is there evidence of an increased risk of cancer resulting from asbestos fibres present in water, beverages, food or in the fluids used for the administration of drugs?"

The answer was as follows:

"Such evidence as there is does not indicate any risk."

The panel on pathology and experimental pathology recommended the following two projects for further experimental study.

1. "The effect of long-term ingestion of fibres of various sizes, shapes, and chemical composition should be studied."

2. "The effects of fibres and associated metals on the metabolism of target organs should be investigated."

CAPCO JEN 0002462

Neither of these two projects were rated high in priority.

The bibliography lists the material distributed to each member or available for their study.

The purpose of the first meeting was to orient the committee, exchange information and views, discuss the work reported in the literature, and assign various tasks to be performed by the committee members during the three-month interim between meetings.

The second committee meeting concentrated on the health hazards posed by asbestos in water (based on present knowledge of the subject) and recommendations for research needed to answer unresolved questions.

Following the second meeting, several committee members collaborated on the development of the statement of the committee's position and recommendation. This was circulated by mail to all members.

Section III (Summary); section IV (Recommendations); section V (Committee Report); section VI (References); and section VII (Appendices) comprise the COMMITTEE REPORT.

CAPCO JEN 0002463

BIBLIOGRAPHY

General

Bonser, G.M. & Clayson, D.B. Feeding of Blue Asbestos to Rats. British Empire Cancer Campaign for Research. Annual Report 1967. p. 242.

Burns, A.F. Chrysotile Fiber Levels in Municipal Water Systems. Johns-Manville Research Report No. 404-79, June 4, 1971.

Burns, A.F.; Jaunarajs, K.L.; & Reimschussel, G.P. Method for the Quantitative Determination of Chrysotile Fiber in Samples from Various Sources. Johns-Manville Research Report No. 404-67, August 3, 1970.

Carriere, J.E. Behaviour of Asbestos-Cement Pipes in the Soil. International Water Supply Assn. paper presented at Stockholm, Sweden, June 15-19, 1964.

Cunningham, H.M.; & Pontefract, R. Asbestos Fibers in Beverages and Drinking Water. Nature 232:332 (July 30, 1971).

Eick, Horst. Corrosion in Asbestos Cement and Concrete. International Water Supply Association paper presented at Vienna, Austria, September 1-5, 1969.

Elmes, P.C. & Simpson, M.J.C. Insulation Workers in Belfast. 3. Mortality 1940-66. Brit. J. Indust. Med. 28:226-236 (1971).

Enterline, P.; DeCoufle, P.; & Henderson, V. Mortality in Relation to Occupational Exposure in the Asbestos Industry. Journal of Occupational Medicine. 14:897-903 (Dec. 1972).

Gould, D. A Dangerous Dust. New Scientist, p. 453 (9 March, 1967).

Harwood, C.F. Asbestos Air Pollution Control. November 1971 report prepared for Illinois Institute for Environmental Quality.

Kiviluoto, R. & Meurman, L. Results of Asbestos Exposure in Finland.

Kristiansen, Hans. Extraction of Calcium by Soft Water from Concrete and Asbestos Cement Pipes. Norwegian Institute for Water Research, March, 1973.

Lewinsohn, H.C. The Medical Surveillance of Asbestos Workers. (British) R.S.H. 2 1972 pp. 69-77.

CAPCO JEN 0002464

Mancuso, T.F. & Coulter, E.J. Methodology in Industrial Health Studies. Archives of Environmental Health 6:210-226. (Feb., 1963).

Mancuso, T.F. & El-Attar, A.A. Carcinogenic Risk and Duration of Employment Among Asbestos Workers. pp. 161-166 of unknown publication.

Meurman, L.O.; Kiviluoto, R.; & Hakama, M. Mortality and Morbidity of Employees of Anthophyllite Asbestos in Mines in Finland. Paper 31 at Lyon, France Conference, Oct. 2-5, 1972, 10 p.

McDonald, J.C. Cancer in Chrysotile Mines and Mills. Paper 29 at Lyon, France Conference, Oct 2-5, 1972, 14 p.

McDonald, J.C.; McDonald, A.D.; Gibbs, G.W.; Siemiatycki; & Rossiter, C.E. Mortality in the Chrysotile Asbestos Mines and Mills of Quebec. Archives of Environmental Health 22:677-686 (June, 1971).

McDonald, J.C.; Rossiter, C.E.; Eyssen, G.; & McDonald, A.D. Mortality in Chrysotile Producing Industry of Quebec: A Progress Report. Manuscript presented at 4th Pneumo. Conference, Bucharest, 1971.

Newhouse, M.L. A Study of the Mortality of Workers in an Asbestos Factory. British Journal of Industrial Medicine. 26:294-301 (1969).

Newhouse, M.L. Cancer Among Workers in the Asbestos Textile Industry. Paper 32 at Lyon, France Conference, Oct. 2-5, 1972, 13 p.

Oettle, A.G. Mortality from Malignant Neoplasms of the Alimentary Canal in Whites, Coloreds, and Asians in South Africa, 1949-1958. National Cancer Institute Monograph No. 25. Tumors of the Alimentary Tract. pp. 111, 112, 121, 122, 130, 131 (July 1967).

Olson, H.L. Does Asbestos in Water Supply Present a Health Hazard? Paper presented at the Conference of State Sanitary Engineers at San Francisco, CA, May 7-10, 1973.

Pontefract, R.D. & Cunningham, H.M. Penetration of Asbestos through the Digestive Tract of Rats. Nature 243:352-353 (June 8, 1973).

Pooley, F.D. Mesotheliomas in Relation to Exposure. Paper 34a at Lyon, France Conference, Oct. 2-5, 1972, 15 p.

CAPCO JEN 0002465

Quint, S.M. Transite Pipe Test Line -- Determination of Asbestos Fiber in Water. Johns-Manville Research Report No. 425-T-1360. Sept. 29, 1971.

Rickards, A.L. Estimation of Submicrogram Quantities of Chrysotile Asbestos by Electron Microscopy. Anal. Chem. 45:809 (April, 1973).

Sargent, H.A. Asbestos in Drinking Water. Paper presented at New England Water Works Association meeting at Northfield, Vermont, May 17, 1973.

Selikoff, I.J.; Hammond, E.C.; & Churg, J. Carcinogenecity of Amosite Asbestos. Arch. Environ. Health 25:183-186 (Sept. 1972).

Selikoff, I.J.; Hammond, E.C.; & Seidman, H. Cancer Risk of Insulation Workers in the United States. Paper 33 at Lyon, France Conference, Oct. 2-5, 1972, 20 p.

Speil, S.; & Leineweber, J.P. Asbestos Minerals in Modern Technology. Environmental Research 2:166-208 (1969).

Swinburne, L.M. Report on Research at St. James' Hospital, Leeds. Appendix 4. Included in report from Asbestos Research Council (Gt. Br.) Oct. 70 to Oct. 71.

Vigliani, E.C.; Ghezzi, I.; & Maranzana, P. Epidemiological Study of Asbestos Workers in Northern Italy. pp. 147-150 of unknown publication.

Wagner, J.C. letter dated 27th October 1972 addressed to Dr. P.V. Pelnar.

Westlake, G.E.; Spjut, H.J.; & Smith, M.N. Penetration of Colonic Mucosa by Asbestos Particles. An Electron Microscopic Study in Rats Fed Asbestos Dust. Laboratory Investigation 14:2029-2033 (Nov. 1965) Official Journal of the International Academy of Pathology.

Asbestos-Cement Water Pipe and Human Health

Cancer Research in 1967. British Medical Journal. (July 13, 1968).

Does A/C Pipe Constitute a Hazard to Health by Causing an Excessive Occurrence of Gastrointestinal Cancer or Malignant Mesothelioma of the Peritoneum or Pleura?

CAPCO JEN 0002466

Eliminating the Hazards of Asbestos Waste. Municipal Engineering. (British) p.297 (13 Feb., 1970).

Exposure to Asbestos. Nature 234:383-384 (Dec. 17, 1971.)

Municipal Water Systems Analysis -- Table provided by Johns-Manville Research Center.

Lyon Conference Papers

Ahlman, K.; Partanen, T.J.; Rintala, E.; & Wiikeri, M. Anthophyllite Mining and Milling as a Cause of Asbestosis.

Akehurst, R.L. The 1969 Asbestos Regulations - Their Economic Appraisal.

Allison, A.C. Effects of Asbestos Particles on Macrophages, Mesothelial Cells and Fibroblasts.

Ashcroft, T.; & Heppleston, A.G. Quantitation of Asbestos Fibres in Lung Tissue.

Becklake, Margaret R. Assessment of Methods Used in the Studies of the Biological Effects of Asbestos -- C. Lung Function.

Berry, G. Hygiene Standards - Theory and Application.

Boersma, A.; P. Degand; and Havez, R. Mesotheliome Diffus. Etapes Biochmiques du Diagnostic. Detection et Dosage de L'Acide Hyaluronique Dans Le Liquide Pleural.

Bohlig, H.; and Gilson, J.C. Assessment of Methods Used in the Study of Biological Effects of Asbestos: Radiology.

Bohlig, H.; and Hain, E. Cancers in Relation to Type of Fibre, Dose, Occupation and Duration of Exposure (b) Manufacturing - III Environmental.

Butler, E. Blanche; and Berry, Ann V. Diffuse Mesotheliomas Diagnostic Criteria Using Exfoliative Cytology.

Cooper, W. Clark; and Miedema, J. Asbestos in Relation to the Type of Fibre and Dose in the Insulation Industry.

Cralley, Lewis J.; and Sunderman, F. William. Interactions of Metals and Minerals in Carcinogenesis. Interim Report of Investigations after

CAPCO JEN 0002467

22 months.

Elmes, P.C. Therapeutic Openings in the Treatment of Mesothelioma.

Elmes, P.C. The Natural History of Diffuse Mesothelioma.

Enterline, Philip E.; and Weill, Hans. Asbestosis in Asbestos Cement Workers

Gibbs, G.W.; and Du Toit, R.S.J. Environmental Data in Mining.

Gilson, J.C. Progress in Epidemiology.

Greenberg, M. The Value of A Cancer Register in the Study of Asbestos Tumours.

Hammond, E. Cuyler; and Selikoff, Irving J. Relation of Cigarette Smoking to Risk of Death of Asbestos-Associated Disease Among Insulation Workers in the U.S.

Harington, J.S. Chemical Factors (Including Trace Elements) as Aetiological Mechanisms.

Harries, P.G. Assessment of Methods Used in the Studies of the Biological Effects of Asbestos.

Hinson, K.F.W.; Otto, H.; Webster, I.; and Rossiter, C.E. Criteria for the Diagnosis and Grading of Asbestosis.

Holmes, S. Criteria for Environmental Data and Bases of Threshold Limit Values - Environmental Data in Industry.

Holmes, S. Sampling Methods.

Jones, J.S.P.; and Sheers, G. Pleural Plaques.

Kannerstein, M.; Churg, J.; and Magner, D. Histochemical Studies in the Diagnosis of Mesothelioma.

Langer, Arthur M.; and Pooley, Fred D. Identification of Single Asbestos Fibers in Human Tissues.

Le Bouffant, L.; Martin, J.C., and Durif, S. Structure Et Composition Des Plaques Pleurales.

CAPCO JEN 0002468

Lindell, K.V. Asbestos and the Community -- Industrial Uses.

McCaughey, W.T.E.; and Oldham, P.D. Diffuse Mesotheliomas: Morbid Anatomical and Histological Diagnostic Criteria, Including Observer Variation in Histological Diagnosis.

McDonald, J.C. Asbestosis in Chrysotile Mines and Mills.

McDonald, J.C. Cancer in Chrysotile Mines and Mills.

Meurman, L.O.; Kiviluoto, R.; and Hakama, M. Mortality and Morbidity of Employees of Anthophyllite Asbestos Mines in Finland.

Morgan, A.; and Cralley, L.J. Chemical Characteristics of Asbestos and Associated Trace Elements.

Newhouse, Muriel L. Cancer Among Workers in the Asbestos Textile Industry.

Nicholson, W.J. & Pundsack, F.L. Asbestos in the Environment.

Oldham, P.D. Asbestos in Lung Tissue.

Oldham, P.D. A Trial of Techniques for Counting Asbestos Bodies in Tissue.

Pooley, F. D. Mesothelioma in Relation to Exposure.

Pooley, F.D. Methods for Assessing Asbestos Fibres and Asbestos Bodies in Tissue by Electron Microscopy.

Rajan, K.T. Experimental Methods - Organ Culture.

Selikoff, Irving J.; Hammond, E. Cuyler; and Seidman, Herbert. Cancer Risk of Insulation Workers in the U.S.

Sluis-Cremer, G.K.; and DuToit, R.S.J. Amosite and Crocidolite Mining and Milling as Causes of Asbestosis.

Smither, W.J.; and Lewinsohn, H.C. Asbestosis in Relation to the Type of Fibre, Dose, Occupation and Duration of Exposure in Textile Manufacturing.

Stanton, Mearl F. Some Aetiologic Considerations of Fiber Carcinogenesis.

Suzuki, Y.; Kannerstein, M.; and Churg, J. Electron Microscopy of Normal, Hyperplastic and Neoplastic Mesothelium.

CAPCO JEN 0002469

Timbrell, V. Physical Factors as Aetiological Mechanisms.

Timbrell, V. Progress in Physics and Chemistry.

Wagner, J.C.; and Berry, G. Considerations of Aetiological Mechanisms and Other Factors - Information Obtained from Animal Experiments.

Wagner, J.C.; and Berry, G. Investigations Using Animals.

Wagner, J.C. Report on Progress Made on the Recommendations of the UICC Working Group on Asbestos and Cancer, 1964.

Warwick, M. Turner; Parkes, Raymond; Hanson, Audrey; Smither, Walter; Harries, Peter; and Oldham, P.D. Immunology and Asbestosis.

Webster, Ian. Malignancy in Relation to Crocidolite and Amosite.

Summary Report of the Advisory Committee on Asbestos Cancers to the Director of the International Agency for Research on Cancer, a Division of the World Health Organization, Lyon, France, Oct. 5-6, 1973.

Recommendations for Further Research by Epidemiology, Pathology and Experimental Pathology, and Physics and Chemistry Panels.

Abstracts of Papers

Curry, M.G.& Gigliotti, G.M. Cycling and Control of Metals. Proceedings of an Environmental Resources Conference, Columbus, Ohio. Oct. 31 - Nov. 2, 1972. Report No. NERC-C-73-1. Feb. 1973, 187 p.

Smith, R. W.; Choi, I.K.; Allen, M.P.; & Thomas, R. E. Aqueous Surface Chemistry of Asbestos Minerals. Chemical and Metallurgical Engineering Dept., California State University and Colleges, University of Nevada, School of Mines, Reno, Nevada 89507. Smithsonian Science Information Exchange Notice of Research Project supported by Health, Education and Welfare, Public Health Service, Health Service Mental Health Administration, National Institute of Occupational Safety and Health. Sept. 71 to August 72.

CAPCO JEN 0002470