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HISTORY OF JOHNS-MANVILLE HEALTH RESEARCH

Reports of isolated cases of a specific non-malignant lung disease called asbestosis began appearing in medical journals both in the United States and in Great Britain during the first quarter of this century. Little was known about the disease at that time, and it was not until 1930 that scientists in Great Britain first identified asbestosis as a major health hazard for textile workers occupationally exposed to large quantities of air-borne asbestos dust over a period of many years.

Even before this report was published, Johns-Manville, the largest producer of asbestos and asbestos-containing products in the free world, began to investigate this disease. Starting in 1928, J-M sponsored animal research on the effects of asbestos at the Saranac Laboratory of the Trudeau Foundation in upstate New York. At that time, this laboratory was considered the finest research center for the study of occupational pulmonary diseases in the United States.

Under the direction first of Dr. LeRoy Gardner, and then, after Dr. Gardner's death in 1946, under Dr. Arthur Vorwald, the studies continued over a period of many years.

Dr. Gardner's report on these animal experiments was published in the Journal of Industrial Hygiene in early 1931. Entitled "Studies on Experimental Pneumonokoniosis. Inhalation of Asbestos Dust:

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Its Effect Upon Primary Tuberculous Infection," the paper stated that fibrosis could be produced in animals exposed to heavy concentrations of air-borne asbestos dust.

In 1929, shortly after the launching of the Saranac studies, Johns-Manville and other companies in the asbestos industry asked the Metropolitan Life Insurance Company to determine whether asbestos dust was an occupational hazard and, if so, what was the nature of this hazard and what could be done to control it.

Consequently, the Industrial Health Service of Metropolitan Life undertook a study of dust conditions in asbestos mines and mills in Canada and in fabricating plants along the Atlantic seaboard of the United States. Physical examination records, including x-rays, of asbestos production workers were studied; and the efficiencies of exhaust systems designed to eliminate asbestos dust were analyzed.

The Industrial Hygiene Division of the Department of Public Health of the McGill University Medical School in Montreal assisted Metropolitan Life in this research.

The results were published in 1935 in the Public Health Reports of the United States Public Health Service in an article entitled "Effects of the Inhalation of Asbestos Dust on the Lungs of Asbestos Workers."

The research established that prolonged and heavy exposure to air-borne asbestos fiber could indeed produce an identifiable pulmonary fibrosis in humans. The report recommended that dust control measures be immediately undertaken; that periodic

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physical examinations, including x-rays, be given all employees; and that further research into the nature of the disease be sponsored.

The Saranac Laboratory and Metropolitan Life research provided valuable information to assist in planning Johns-Manville dust control activities for more than 20 years.

As a result of the Metropolitan Life study, additonal health research on the effects of prolonged and excessive inhalation of asbestos fiber on human beings was undertaken at Saranac Laboratory. The Quebec Asbestos Mining Association (QAMA), of which Johns-Manville is a principal member, contributed to this new research.

Among the resulting medical reports was one delivered at the Seventh Saranac Lake Symposium in 1952, entitled "Pulmonary Function Studies in Men Exposed for Ten or More Years to Inhalation of Asbestos Fibers." It was co-authored by Dr. Fernand Gregoire, presently Director of the Clinique Lavoisier, Montreal, and Dr. George W. Wright, presently Director of Medical Research, St. Luke's Hospital, Cleveland.

Another report arising out of the industry-sponsored studies at Saranac Laboratory was "Experimental Studies of Asbestosis" by Dr. Vorwald, Thomas M. Durkin and Dr. Philip C. Pratt. This paper, which appeared in the A.M.A. Archives of Industrial Hygiene and Occupational Medicine in 1951, presented a comprehensive survey of all animal experiments on asbestosis conducted at the Laboratory since 1928.

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In the opinion of the scientists who conducted this research, it was the so-called "long" fiber from 10 to 50 microns in length that was responsible for the production of fibrosis in test animals. Dr. Vorwald therefore recommended to Johns-Manville that, based on his experimentation, a Threshold Limit Value (TLV) of 1.0 million fibers, 10 microns or longer, per cubic foot of air would be an adequate level for safe occupational exposure.

Accordingly, this standard was adopted to evaluate Johns-Manville work environments. In addition, J-M continued to use the Threshold Limit Value of 5.0 million particles per cubic foot established by the American Conference of Governmental Industrial Hygienists (ACGIH) in 1938.*

For purposes of comparison, a fiber is a microscopic elongated particle with a length-to-diameter ratio of not less than three to one, and for the above standards, a length of at least 10 microns. A particle is defined as any material that cannot be classified as a fiber by the above definition. The Saranac Laboratory standard measured fibers; the ACGIH standard measured particulate. Johns-Manville used both standards.

Employing these standards as yardsticks, J-M dust control activities were intensified during the course of the Saranac study as more and more information on the prevention of asbestosis became available.

*These standards remained in effect until 1968 when the ACGIH announced

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a new intended TLV for asbestos fiber of either two million particles per cubic foot of air, or 12 asbestos fibers, five microns in length or longer, per cubic centimeter of air. In 1970, these intended standards were reduced even further, to a time-weighted average of 5 fibers, five microns in length or longer, per cc, with a ceiling of 10 fibers per cc. Johns-Manville has adopted these new standards.

The protection afforded J-M employees during this period was considered adequate in light of the medical knowledge then available and of the dust control equipment that had been developed. Subsequently, Johns-Manville has continually improved its dust control programs as better equipment has become available and as more has been learned about health problems related to asbestos.

At first, J-M dust control activities were monitored by the Metropolitan Life Insurance Company, and then later by the company's own industrial hygienists. Johns-Manville hired its first industrial hygienist in 1937. These activities increased through the years and in 1958, four regional industrial hygiene laboratories were set up to meet the company's growing requirements. In 1967, Johns-Manville centralized all environmental control activities in one department, one of the first industrial companies to adopt such an approach.

In 1947, E.R.A. Merewether in Great Britain reported finding bronchogenic cancer in 13 per cent of the people coming to autopsy who had contracted asbestosis as a result of their employment in the asbestos textile trade.

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Although the first major epidemiological study linking asbestos exposure with lung cancer was not published until 1955, Johns-Manville, beginning in the early 1950's, undertook independently as well as with others in the industry, the sponsorship of a number of projects designed to investigate this reported association.

One such project was an epidemiological study of lung cancer among asbestos miners in the Province of Quebec in Canada. This study, sponsored by the Quebec Asbestos Mining Association, was conducted by Dr. Daniel C. Braun and T. David Truan for the Industrial Hygiene Foundation of America, Pittsburgh, Pa., a leading research organization. The study was completed in 1957 and published in the June 1958 issue of the A.M.A. Archives of Industrial Health. The research showed that 5,958 asbestos miners with exposure ranging from 5 to 50 years of employment, including more than 1,700 with 20 or more years of exposure, did not have a statistically significant higher rate of lung cancer than the general Canadian population. In addition, no cases of lung cancer were discovered among those miners who did not smoke cigarettes.

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During this same time period, Johns-Manville also examined possible health hazards arising out of the mining and processing of diatomaceous silica, another basic J-M raw material.

Starting in the early forties, Johns-Manville sponsored animal research at Saranac Laboratory on the biological effects of three varieties of processed diatomaceous earth. This research was interrupted as a result of the death of the project director, Dr. LeRoy Gardner, in 1946. Progress reports on this research were eventually issued in June, 1949; October, 1949, and October, 1950, with the final report being presented to J-M in April, 1953.

These studies showed that each of the three varieties of diatomaceous silica under investigation was capable of producing fibrosis in the lungs of test animals under experimental conditions, but that two of the varieties were much more likely to cause fibrosis than the third. In order to remove any danger to workers, the final report recommended that certain TLV's for the three diatomite varieties be established.

Using the information obtained during the course of this study, Johns-Manville undertook, starting in 1952, an intensified dust control program at the company's extensive diatomite operations in Lompoc, California.

That same year, Johns-Manville and the California State Department of Public Health asked the United States Public Health Service for

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assistance in carrying out a comprehensive environmental and medical study of the diatomite mining and processing industry in California. This study, begun in 1953, was undertaken with the complete cooperation of three principal diatomite producing companies, including Johns-Manville.

The results, published as a 96-page booklet by the Public Health Service in 1958, showed that the control programs instituted by the various companies during the course of the study had significantly reduced dust levels in the plants. The results were also used by the ACGIH as a basis for determining Threshold Limit Values for the major varieties of diatomite.

Follow-up studies by Dr. W. C. Cooper of the University of California in 1965 and 1970 found not one case of diatomaceous earth pneumoconiosis at Lompoc among employees who began work after the intensified control program was undertaken in 1952.

In the early 1950's, J-M constructed facilities in California for the processing of diatomite into synthetic silicates. In order to determine if a health hazard of any type existed for workers handling these silicate products, a health study was funded at the Industrial Hygiene Foundation. Conducted from 1953 to 1955, it showed that experimental animals subjected to abnormally heavy concentrations of two of the four synthetic silicates tested experienced some fibrosis. Based on this research, an adequate dust control system was installed in the new facility to protect

the health of the employees.

Beginning in 1954, as a result of unpublished animal research at Saranac Laboratory linking the volcanic mineral perlite with tuberculosis, Johns-Manville, which used some perlite in its manufacturing operations, undertook an x-ray study of employees exposed to both natural and expanded perlite. Employees were x-rayed and examined twice a year, and at the end of six years of study, there were no x-ray changes observed compatible with any known occupational pulmonary disease or evidence of any effect on tuberculosis.

In 1959, Johns-Manville purchased deposits of perlite in Nevada, and subsequently undertook an x-ray study of the employees at that location, most of whom had been employed there for a number of years before J-M purchased the property. This study, which is still continuing, likewise discovered no pulmonary changes in the workers.

Also, in 1959, Dr. Philip C. Pratt of Ohio State University reviewed the experimental animal data from the Saranac Laboratory study on perlite, and concluded that the overall risk of exposure of industrial personnel to perlite dust would be much less than was implied in the original Saranac report. The x-ray studies by Johns-Manville of its own employees confirmed this view.

This type of J-M sponsored research is continuing, and has in fact increased in size and scope over the past decade.

Intra-tracheal injection experiments on test animals were completed by the Industrial Hygiene Foundation in July, 1968, using asbestos fiber taken from the Johns-Manville mine near Coalinga,

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California. The purpose of this study, sponsored by J-M, was to determine if chrysotile asbestos fiber -- one of the three commercially significant varieties of asbestos -- taken from different geographical locations might produce different biological reactions. The results indicated that the biological effect of the Coalinga chrysotile fiber resembles that of Canadian chrysotile fiber.

Also, in July, 1968, the Industrial Hygiene Foundation completed work on another research project for Johns-Manville -- a study of the effect of automobile brake-drum dust on the lungs of laboratory animals. This research showed that brake-drum dust is biologically inert, producing minor, reversible lesions of the lung when injected into the trachea of rats and hamsters.

In December, 1968, Jeremiah R. Lynch of the National Center of Urban and Industrial Health, Department of Health, Education and Welfare, published a paper on "Brake Lining Decomposition Products" in the Journal of the Air Pollution Control Association. In all but a few extremely severe automobile braking tests, Lynch found less than one per cent asbestos fiber in the brake lining dust, and concluded that brake lining wear was "an inconsequential health factor in urban air pollution." Johns-Manville provided Mr. Lynch with dust samples for use in his work and extended full access to J-M facilities and data.

Possible health hazards associated with the inhalation of fiber glass particles is another area in which Johns-Manville has sponsored considerable research in recent years.

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In 1967, the Kettering Laboratory of the Department of Environmental Health, College of Medicine, University of Cincinnati, completed work on a study to determine if glass fiber particles may be eroded from inside heating or air-conditioning ducts and become air-borne. The Laboratory reported that the ducts studied "showed no evidence of erosion of fibers" and that "no fibers were found in the air stream."

The following six fiber glass studies are presently in progress or have been authorized:

1. FIBROUS GLASS AND MINERAL WOOL INDUSTRY STUDY:
   UNITED STATES PUBLIC HEALTH SERVICE
   This is a 7 to 10-year environmental, clinical and epidemiological study of workers exposed to fibrous glass and mineral wool. Begun in March, 1968, the study is being conducted with the full cooperation of the fibrous glass industry, including Johns-Manville.
   A preliminary report on this study, published in the November-December, 1969 issue of the American Industrial Hygiene Association Journal, stated in part:
   "Animal experiments and human experience reported in the literature seem to indicate that fibrous glass is a relatively inert material with no fibrogenic or other significant toxic properties.
   "From the environmental results found in this survey and data from the previous toxicologic

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and worker studies, there appears to be no reason to class the manufacture of fibrous glass products as a hazardous occupation."

2. BIOEFFECT OF FIBROUS GLASS STUDY:
INDUSTRIAL HYGIENE FOUNDATION OF AMERICA

The purpose of this study is to provide current and definitive knowledge of the bioeffects of fibrous glass on pulmonary function, emphysema, and human pulmonary tissue. It is being sponsored by four major fibrous glass companies, including Johns-Manville. An interim report on the project, released in 1968, was presented to the Threshold Limit Value Committee of the American Conference of Governmental Industrial Hygienists. On the basis of this report, and other data, the Committee in May 1969 raised the tentative TLV of fibrous glass from 5 mg/cc to 15 mg/cc, thus changing its classification from a moderately toxic substance to that of an inert nuisance dust.

3. EXPOSURE OF INSULATION WORKERS TO AIRBORNE FIBROUS GLASS:
UNIVERSITY OF CALIFORNIA

This study, being sponsored by the National Insulation Manufacturers Association (NIMA), of which Johns-Manville is a member, is designed to investigate the air-borne concentrations of fibrous glass in the breathing zone

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of workers engaged in the fabrication, application, finishing and handling of fibrous glass insulation materials. This two-year project was begun in January, 1969.

4. EVALUATION OF FIBROUS GLASS LINED AIR TRANSMISSION SYSTEMS: UNIVERSITY OF CALIFORNIA

This study, also being sponsored by NIMA, is designed to obtain quantitative estimates of amounts of fibrous glass introduced into living and working areas from ventilation or heating ducts lined with fibrous glass.

5. FIBROUS PARTICLES IN AMBIENT AIR: UNIVERSITY OF CALIFORNIA

Another NIMA sponsored project is this recently approved study to determine the types and concentrations of fibrous glass particles to be found in the ambient air. Secondary objectives of the study are to determine the probable sources of such fibers and to describe the natural conditions which favor the presence of fibrous glass in the air, comparing the concentrations of glass fibers to the concentrations of other particulates.

6. SHEET METAL WORKERS OCCUPATIONAL EXPOSURES TO FIBROUS GLASS: UNIVERSITY OF CALIFORNIA

The purpose of this study, also NIMA sponsored, is to determine the air-borne concentrations of fibrous glass in the breathing zones of sheet metal workers engaged in

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the fabrication, application, finishing, and other operations involved in the installation of air transmission systems containing fibrous glass.

Typical of projects in the asbestos-health field currently underway that are being sponsored or co-sponsored by Johns-Manville, or in which J-M is participating, are the following:

1. INSULATION INDUSTRY HYGIENE RESEARCH PROGRAM (IIHRP): MOUNT SINAI SCHOOL OF MEDICINE, CITY UNIVERSITY OF NEW YORK

This program is a major cooperative effort by labor, industry and science, consulting with government, to undertake a health research program for insulation workers. The IIHRP is being co-sponsored by Johns-Manville. Its purpose is to: (1) develop improved methods for minimizing exposure of insulation workers to dusts and fumes encountered in their work; (2) disseminate knowledge of these improved methods of dust control wherever they may be applied advantageously; and (3) to offer cooperation, advice and assistance toward their universal adoption. The Program Director and Chairman is Dr. Irving J. Selikoff, Director of the Environmental Sciences Laboratory, Mount Sinai School of Medicine, New York. The U.S. Public Health Service regards this joint voluntary effort as a model program which it hopes to see adopted by other industries.

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2. ASBESTOS INDUSTRY STUDY:

UNITED STATES PUBLIC HEALTH SERVICE

This is a 7 to 10-year environmental, clinical and epidemiological study of workers exposed to asbestos which is being conducted by the Division of Occupational Health of the U.S. Public Health Service, with the cooperation of the asbestos industry. The purpose of the study is (1) to obtain information on the health effects of exposure to the major types of asbestos used in the United States -- chrysotile, crocidolite and amosite; (2) to develop criteria for safe exposure levels, and (3) to establish medical and environmental criteria for surveillance where asbestos is encountered or used. More than 8,100 workers -- including approximately 800 Johns-Manville employees -- in the U.S. asbestos manufacturing industry, primarily in the asbestos textile trade, are being included in this study.

3. EPIDEMIOLOGICAL STUDY OF J-M RETIRED EMPLOYEES:

UNIVERSITY OF PITTSBURGH SCHOOL OF PUBLIC HEALTH

This is an epidemiological study to determine and analyze the life span, causes of death, and possible causal relationship to work experience, of J-M retired employees. The initial report indicates that while the overall mortality rate is comparable with that of the general population, there are certain types of causes of death which are higher

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than those found in the general population.

4. RELATIONSHIP BETWEEN THE DIMENSION OF FIBERS AND THEIR ABILITY TO PRODUCE PULMONARY TISSUE RESPONSE:
ST. LUKE'S HOSPITAL, CLEVELAND, OHIO

This is a study to further explore the relationship between the dimension of fibers and their ability to produce pulmonary tissue response. This investigation is designed to contribute to our knowledge of the inter-action of fibers with tissue, with the aim of leading ultimately to better control of those inter-actions.

5. BIOLOGICAL EFFECTS OF MODIFIED INORGANIC FIBROUS MICROPARTICLES:
MOUNT SINAI SCHOOL OF MEDICINE, CITY UNIVERSITY OF NEW YORK

This two-year program, being sponsored by J-M, is designed to explore the development of new biological test systems for fibrous materials, and to determine the effect on biological activity of asbestos fiber which has been coated with a variety of physical and/or chemical substances.

6. FIBROUS DUST STUDY:
INDUSTRIAL HYGIENE FOUNDATION OF AMERICA

The purpose of this program is to investigate factors involved in the pathogenicity of major varieties of asbestos fiber and to determine the true nature of ferruginous bodies (often misleadingly called "asbestos" bodies). Other fibrous materials are also being investigated

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in this project, and it has been found that many of these materials are capable of forming ferruginous bodies.

7. **EPIDEMIOLOGICAL STUDY OF THE CANADIAN GENERAL POPULATION: DEPARTMENT OF EPIDEMIOLOGY AND HEALTH, MC GILL UNIVERSITY, MONTREAL**

This is a study designed to examine the relationship between asbestos exposure and disease among various population groups in Canada, primarily the Quebec asbestos miners and millers. It is under the direction of Dr. Corbett MacDonald, Chairman of the Department of Epidemiology and Health at McGill University in Montreal. A progress report, issued early in 1970, showed that of the 12,000 employees studied, the 10 per cent who had the highest dust exposure had an overall death rate about 12 per cent higher than the rest, mainly due to asbestosis, lung cancer and other respiratory diseases. The 70 per cent of employees who had the lowest dust exposure had little or no increased mortality from these diseases.

The study will be continued for another five years for the purpose of developing a Threshold Limit Value for asbestos based on a more definitive review of individual exposure histories and bronchogenic cancer involvement.

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This study is being funded by the Institute of Occupational and Environmental Health, the scientific research arm of the Quebec Asbestos Mining Association (QAMA). As mentioned before, Johns-Manville is a principal member of the QAMA. The Institute of Occupational and Environmental Health plays a vital role in the Johns-Manville health research effort. Besides allocating QAMA funds for research projects, the seven-man scientific advisory committee* of the Institute also reviews requests J-M receives from scientists and scientific organizations for money to conduct research in the asbestos/health field.

*The members of the scientific advisory committee are:

Dr. George W. Wright, Director of Medical Research, St. Luke's Hospital, Cleveland, Ohio - Committee Chairman

Dr. Marvin Kuschner, Professor of Pathology and Director of Laboratories, Bellevue Hospital Center, University School of Medicine, New York City

Dr. Daniel C. Braun, U.S. Steel Corp., Pittsburgh, Pa.

Dr. Premsyl V. Pelnar, Montreal - Secretary of the Committee

Dr. John Beattie, Cambridge, England

Dr. Fernand Gregoire, Director of Clinique Lavoisier, Montreal

Dr. Paul Kotin, Director, National Institute for Environmental Health Sciences, HEW

Other research projects being sponsored by the Institute include:

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8. EPIDEMIOLOGICAL STUDY -- NEW ORLEANS:

TULANE MEDICAL SCHOOL, SECTION OF PULMONARY DISEASES

This two-year study, begun in December, 1969, is designed to examine the health effects related to asbestos exposure in industry in the city of New Orleans. It will concentrate on the health status of present and past employees in the Johns-Manville and National Gypsum plants in the city.

9. EPIDEMIOLOGICAL STUDY -- ITALY:

CLINICA DEL LAVORO, MILANO, ITALY

Initiated early in 1968, this project is designed to study the effect of asbestos dust on miners at the Balangero Mine and among Port of Genoa and LaSpezia Arsenal insulation workers.

10. ANTHOPHYLLITE ASBESTOSIS IN FINLAND:

INSTITUTE OF OCCUPATIONAL HEALTH, HELSINKI

The purpose of this study is to examine the effect of anthophyllite asbestos, a form of the material little used in the United States, on miners and millers in the anthophyllite mining regions of Finland.

11. ULTRASTRUCTURAL STUDY OF EXPERIMENTALLY INDUCED ASBESTOS GRANULOMAS IN HAMSTERS:

RESEARCH BRANCH, UNIVERSITE DE MONTREAL

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12. CELLULAR BASIS OF THE BIOLOGICAL EFFECTS OF ASBESTOS:
UNIVERSITA DEGLI STUDI DI GENOVA, GENOA, ITALY

Proposals for additional J-M sponsored projects, such as a study of the carcinogenic potential of trace metals often found attached to asbestos fiber, and one on central core identification of ferruginous bodies, are also under consideration.

In its own Research and Engineering Center near Manville, New Jersey, J-M scientists and engineers are also engaging in work related to health. In conjunction with the Willson Products Company, J-M has developed a disposable respirator for protection against asbestos and other pneumoconiosis producing dusts. Work is also nearing completion on the perfection of a plastic asbestos-cement mixing bag to which water can be added through a special nozzle to produce a non-dusty slurry. This bag was developed to do away with the old dusty method of emptying the contents of the bag dry into a trough and then adding the necessary water. These two products were developed especially to reduce the dust hazard to asbestos insulation workers, and are part of the recommendations of the IIHRP study.

Although there is no evidence either from experience or from scientific study that anyone in the general public has ever contracted any disease from exposure to the wearing or weathering of brake linings, floor tile, roofing, wall or ceiling panels, or similar asbestos containing items, Johns-Manville is nevertheless engaged in studies to determine the amount of asbestos fiber, if any, released by such products.

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Studies to date, both in the laboratory and, where applicable, on the job site, have not found significant amounts of fiber released by asbestos-cement water pipe, roofing tile or asbestos-containing road paving. These studies are continuing.

In addition, Johns-Manville has, for many years, upon request, provided leading world scientists and research organizations with technical information on asbestos fiber, and with samples of fiber prepared according to the specifications of the individual researcher.

These projects are indicative of Johns-Manville's continuing efforts, begun more than four decades ago, to learn more about possible health hazards associated with the company's basic raw materials, especially asbestos, and to develop methods for their control. The company's basic approach to these efforts is embodied in an official policy statement:

> "In cooperation and in conjunction with other agencies, Johns-Manville will continue to seek new information about the biological effects of asbestos fiber and to develop ways of assuring maximum possible protection from occupational hazards, for its employees in asbestos mines, mills and plants, and among fabricators and applicators of this essential material."

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