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# Dr. Barry Castleman

REPORT OF BARRY I. CASTLEMAN

## I. Qualifications

My name is Barry I. Castleman. I live at 4406 Oxford Rd., Garrett Park, Maryland 20896. My education consists of a Bachelor's Degree in Chemical Engineering from Johns Hopkins University 1968. I have a Master's Degree in Environmental Engineering, which was mainly in areas related to air pollution control from Johns Hopkins University, 1972. I have a Doctor of Science Degree in Health Policy from Johns Hopkins School of Hygiene and Public Health, 1985. My consulting rate is $400 per hour.

My professional experience goes back over 30 years in the area of asbestos and other occupational and environmental health problems. My field is occupational and environmental health policy, which is a branch of Public Health, mainly oriented towards the recognition of risk factors and the prevention of disease from industrial activities.

My Doctoral degree was awarded after two years of course work, various examinations, and the writing of my doctoral dissertation. The course work was mainly in the areas of toxicology, epidemiology, biostatistics, physiology, and public health policy. These are the tools that are used to understand how the body works and can be damaged by toxic substances, how these effects can be identified by means of various studies of people, studies of animals experimentally exposed and so on.

My Doctoral thesis was, Asbestos: An Historical Case Study of Corporate Response to an Industrial Health Hazard. The substance of my thesis is largely identical to a book published in 1984 by Prentice Hall Law and Business called Asbestos: Medical and Legal Aspects (now in its 5th Edition, 2005). The doctoral thesis is an historical review of the asbestos problem as a public health problem in society worldwide, but mainly in the United States. I have attached a copy of my resume for a complete list of all my publications and a partial list of my professional experiences.

In researching and subsequently writing and publishing my doctoral thesis, I performed a comprehensive review of medical literature of all kinds, as well as other literature available in libraries and published sources such as government publications, safety magazines, engineering journals, trade magazines, insurance publications, encyclopedias, popular magazines, and newspapers. Over the decades since writing my thesis, and in the process of my professional work and publication of the later editions of my book, I have updated and supplemented my initial research on an ongoing basis.

In preparing my doctoral thesis I also researched unpublished government records. The government records included workers' compensation claims files where claims had been made by individuals alleging that they had asbestos-related diseases of the lungs, claims against various companies that were their employers, some of which were also manufacturers of asbestos insulation products these individuals has used in the course of their work.

I also examined unpublished information available from the U.S. government archives, the archives of scientists and the archives of institutions that had worked for and with asbestos companies. I also reviewed unpublished information that was obtained in legal discovery. This included trade association minutes, corporate documents, and testimony of corporate officials who were associated with asbestos hazards over the years, doctors, plant managers, executives, and other people who were aware of events that transpired.

In addition to published information, governmental documents and corporate and industry information that was mainly disclosed in legal discovery, I have also interviewed many historic figures in the field of industrial medicine and hygiene. These figures include physicians who were active in the field of occupational medicine, such as Harold Stewart, who first published on asbestosis in 1931, and Alfred Angrist, who first published on asbestos and lung cancer in 1942 (both are pathologists). Another historic figure in the field of industrial medicine, occupational and environmental health with whom I met was Dr. Wilhelm Hueper. Dr. Hueper was a leading authority in the field of occupational cancer in the United States, and the world, and was the first director of the environmental cancer section of the National Cancer Institute. I also met repeatedly with Dr. Irving J. Selikoff, the leading epidemiologist and public asbestos authority in the United States. Dr. Hueper, Dr. Harriet Hardy, Dr. Thomas Mancuso, Dr. Gerrit Schepers, Dr. Richard Doll, Dr. Morris Greenberg, and others I have interviewed were involved in the area of asbestos and health over the past decades.

## II. Materials Reviewed and Relied Upon.

As described above, over the years, I have systematically reviewed published information about the hazards of asbestos, I have reviewed corporate documents on safety, hazard recognition, and knowledge of asbestos dangers, and government documents. I have also interviewed and/or reviewed the testimony of witnesses of all types (union members, workers, government officials, corporate officials and medical professionals). The vast majority of the material I have reviewed to form the foundations of my opinion is detailed in the updated, published version of my doctoral thesis. While I am identifying several documents that specifically relate to the case at hand, I would refer the parties and the Court to my publication, Asbestos: Medical and Legal Aspects, for a more complete listing of the materials I have reviewed in forming my opinions. I understand that counsel for Plaintiffs has provided a copy to counsel for the defense, as a supplement to this report. All of the materials relied upon are available to anyone who wants them.

## III. The Body of Knowledge That Exists

### A. Asbestosis

First let us consider what was available in published sources and how the published knowledge base developed. The originally published reports in the era of the modern asbestos industry came at just before the turn of the century, and the first reports in the English language were included in the annual reports of the chief inspector of factories and workshops in Great Britain. The report published in 1899, the report for the year 1898, talked about the observation of lung disease in individuals who had worked in asbestos manufacturing plants and about the "evil effects of asbestos dust."

The medical literature of asbestos disease mainly developed after the publication of a case report in the British Medical Journal by Dr. Cooke, a pathologist in Britain in 1924. This was called, "Fibrosis of the Lungs Due to the Inhalation of Asbestos Dust." Dr. Cooke reported on the death of a 33-year-old woman who had worked off and on in asbestos plants from the age of 13. According to Cooke, the scarring of her lung tissues was largely attributable to the inhalation of asbestos in the course of her work. There followed a number of other reports in British sources, and this is reflected as well in the United States in editorials of the Journal of the American Medical Association. In one JAMA editorial, on January 14, 1928, called "Pulmonary Asbestosis", reference is made to Cooke's case and other reports on the disease now called asbestosis. The JAMA recommended that further attention be paid to this disease, as it may well be occurring in the United States. The JAMA issued another editorial in 1930 about asbestosis, this time noting the asbestosis had become a compensable occupational disease in Great Britain under the workers' compensation law. According to medical historians, the JAMA, the preeminent medical journal at the time, was read by about 80% of American physicians in those years.

In the meantime, there were additional reports of asbestosis published in the British Medical Journal, which is in each of the medical libraries in which I have performed research. The reports mainly involved deaths of individuals who were verified as having asbestosis by autopsy.

In 1930, a report was published by a physician, Dr. E.R.A. Merewether, and an engineer named C. W. Price. Merewether and Price reported a survey that had been conducted by the Factory Inspectorate in England, including 363 asbestos workers who were actively employed. Of these individuals, 26% were found to have asbestosis. Merewether and Price reported that the people longest exposed had the highest prevalence of the disease: 80% in workers with 20 years or more in the industry. There were no cases of asbestosis in individuals with less than five years, and Merewether referred to that phenomenon that the disease was delayed in appearance and developed gradually over a period of years. It could in seven years be substantially developed in the most severe cases, but more often 11 years or more would elapse before the disease had become largely developed in exposed individuals. This is the time from the onset of exposure. Merewether urged that workers be "educated to a sane appreciation of the risk" to health posed by asbestos dust. Merewether's 1930 writings on asbestosis are among those most often cited in the literature on asbestosis.

There were also reports of the progression of disease caused by asbestos fibers trapped in the lungs, including a report by the radiologist, Sparks, called "Pulmonary Asbestosis," published in the United States in 1931. Sparks talked about the fact that the disease progressed in some individuals after the cessation of exposure. This was demonstrated by the chest x-rays of the individuals who had been removed from exposure but who had continued to go downhill in terms of their lung conditions.

There are also publications by Dr. Harold Stewart, whom I mentioned, and his coworkers in 1931, describing two cases of asbestosis in the Archives of Pathology, published in the United States. One of these individuals had been exposed for only nine months to uncontrolled asbestos dust conditions and nine years later had developed a severe degree of asbestosis when seen at autopsy.

Other sources were also remarking on the disease, asbestosis. A journal called National Underwriter, a publication of the insurance industry, in a 1932 article called "Occupational Diseases are Not Generally Understood," repeatedly called attention to asbestosis and referred to asbestos industries as dangerous industries from the standpoint of insurers who might be prevailed upon to sell coverage of various kinds for the health of workers in such industries.

In this connection, it warrants mentioning that as early as 1918 there was a United States publication authored by Frederick Hoffman called Mortality from Respiratory Diseases in Dusty Trades. This made reference to the annual reports of the Chief Inspector of Factories in England and the reports of asbestos disease there. This 1918 report, written by an insurance company actuary, noted that it was the practice of American and Canadian life insurance companies to not sell life insurance to asbestos workers on account of the assumed deleterious conditions in the industry.

By 1932 there were 60 or more publications in print on asbestosis. These were noted by way of reference in a bibliography published by the International Labor Organization in 1932. These publications continued to emerge from many countries. The first cases of asbestosis in the United States were reported in 1930. Asbestosis was also described in an article in the trade magazine Asbestos in the United States in the March 1930 issue, amid numerous advertisements from asbestos mining and manufacturing companies.

In 1932, the first case of asbestosis in an asbestos product end-user was reported at a conference held by the Industrial Commission of Wisconsin, proceedings of which were published. Here, Dr. Albert Russell of the United States Bureau of Mines described an individual who had worked maintaining the insulations on pipes in a government hospital and had been diagnosed as having asbestosis and had been compensated by the government for disability sustained from this asbestos condition. This is the first published product user case. There were other cases reported in the United States in 1933 by Philip Ellman and also reported by Ellman in 1934 in The British Journal of Radiology. In 1934, Wood and Gloyne reported on cases of asbestosis including a boiler riveter who would have been exposed to asbestos because it was used as an insulation material on boilers. Wood & Gloyne's report, called "Pulmonary Asbestosis: A Review of 100 Cases," was published in The Lancet, the world's oldest medical journals. The Lancet is, like the British Medical Journal, a general medical journal published in England and available very widely in medical libraries in the English-speaking world. This

article was widely cited in subsequent literature. Of the hundred cases of asbestosis they reported on, the shortest duration of exposure in any case was six months, in the case of two women who had worked in an asbestos plant.

In 1933 and 1934 in the British journal, Tubercle, Dr. Merewether published "A Memorandum on Asbestosis." He emphatically noted that asbestosis shortened people's lives. Merewether showed that, in the British experience, individuals who had died with silicosis, another occupational lung disease, had an average age at death of 54. In the case of asbestosis, the average age at death was only 41. The duration of exposure was also very different. In the cases of silicosis in which death occurred, the average duration of exposure was 40 years. For asbestosis, the average duration of exposure was only 15 years.

In 1935, the Pennsylvania state authorities published a report on asbestosis in the industry in the state. This was called Asbestosis, published by Fulton and his coworkers at the Pennsylvania Department of Labor and Industry. One-fourth of the workers they examined had asbestosis. They included an impressive bibliography of 125 references to asbestos-related disease previously published in journals in the United States, England, France, Italy, Germany and other countries. The Pennsylvania study included an effort to relate dose and response. The authors had sampled the exposure of the workers to dust in four asbestos plants and the found that, overall, average concentrations of dust could be broken down into three groups that varied from 4.64 million particles per cubic foot up to 44 million. Asbestosis was reported in all three groups, with the prevalence and severity of disease greater in the more heavily exposed groups. But no level of exposure was found to be free of the disease. This was one of the first surveys of this kind in the United States similar to that which had been done by Merewether and Price and published in Great Britain and the United States separately in 1930. In all of these studies at least 25% of the workers were diagnosed as having asbestosis.

The study by Lanza and his coworkers at Metropolitan Life, published in 1935 and initiated at the request of representatives of the asbestos industry, found that 53% of the workers examined with three or more years of exposure had asbestosis.

In 1938, a similar study done by the United States Public Health Service, included an effort to account for workers who had been discharged before the Public Health Service was admitted to the North Carolina asbestos textile plants to do the study. An estimated asbestosis rate in the workplace was given as 27%. The report recommended that dust exposure in asbestos plants be limited to 5 million particles per cubic foot. This guideline was recommended as a tentative occupational exposure limit, though it was noted that the Pennsylvania study had found cases of asbestosis at that level of exposure.

Literature on asbestosis was substantially developed by 1935. The disease was shown to have a distinctive pathological appearance with asbestos bodies, types of scarring that would form around the asbestos fibers trapped in the lung tissues. This was commented upon a great deal by pathologists in the 1920s. The disease was shown to have an identifiable radiological appearance on chest X-ray distinctly different from such diseases as TB and silicosis. The disease was also characterized by shortness of breath, which would become more pronounced as the individual became more seriously affected by the disease.

The risk of the disease involved not only mining and manufacturing plant workers but by 1935 it had come to include users of some asbestos products, mainly insulation products such as these used by insulation workers. Also, there were two reports on clerical workers in asbestos manufacturing plants with 30 to 40 years of experience, and these individuals were among the victims of asbestosis described in the medical literature published in Britain and the United States in 1934 and 1935.

The disease was consistently found to affect a large percentage of people who were employed in the industries where asbestos products were manufactured. This was reported in four surveys in the United States and Britain by the mid to late 1930s.

**B. Lung Cancer**

In 1935, another aspect of the hazard of asbestosis was identified with the publication of medical case reports of asbestosis in combination with lung cancer. The first such reports were published by Lynch and Smith in the United States in 1935 in the American Journal of Cancer and by Dr. Gloyne in Great Britain in Tubercle in two separate reports in 1935 and 1936. In these reports, the question was raised that chronic irritation of the lung tissues from asbestos might be producing cancer as well as lung scarring, already well identified as an asbestos-related phenomenon. At the time, lung cancer was an extremely rare disease.

There were additional reports of lung cancer in combination with asbestosis reported by Egbert and Geiger at Yale in 1936, and Nordmann in 1938. An abstract of this last publication appeared in the United States in the Journal of Industrial Hygiene & Toxicology, also in 1938. The article was entitled "The Occupational Cancer of Asbestos Workers." The German author, Nordmann concluded that asbestosis was definitely related to lung cancer, that lung cancer was in fact an occupational disease of asbestos workers. Various features of the six cases Nordmann knew of were tabulated to justify that finding. Nordmann noted that the prevalence of lung cancer among autopsied victims of asbestosis was one in six, both in Germany and Great Britain. This was much higher than the prevalence of lung cancer in the general population. The high rate of lung cancer among people dying with asbestosis was a consistent finding around the world.

There were additional publications of cases of lung cancer and asbestosis in 1939 in the United States and in 1941 and 1942 in Germany. Holleb and Angrist reported in the American Journal of Pathology on two individuals who had been pipe coverers (users of asbestos products) diagnosed at autopsy as having both asbestosis and lung cancer. These were the first cases of cancer and asbestosis in users of asbestos products published in the medical literature. Holleb and Angrist tabulated a total of 10 cases of lung cancer in combination with asbestosis that had been published in the United States, Britain, and Germany. This gave readers of their articles the benefit of a review of what had come up until that time in worldwide literature on lung cancer and asbestosis. This was a feature of many medical articles on asbestos disease; that is, they make extensive reference to preceding work. So, that if one finds a single article, one has the windows open on a great deal of knowledge that preceded it.

In 1942, Dr. Wilhelm Hueper published a book on occupational cancer called Occupational Tumors and Allied Diseases, nearly 900 pages long. It included a lengthy section

on asbestosis and cancer from asbestos, in which a large number of references from the United States, Great Britain and Germany were cited in support of the view that asbestos most likely did cause cancer. Dr. Hueper made unequivocal statements the next year in the article called: "Cancer in its Relation to Occupational and Environment" published in the Bulletin of the American Society for the Control of Cancer. There, Hueper said that asbestosis cancer of the lung as he called it then, was the newest proved occupational cancer of the lung, to be listed with the ones that were already known up at that time. In the Journal of the American Medical Association (JAMA), there appeared an editorial called "Environmental Cancer" in 1944, in which asbestos was listed among agents known and suspected of causing occupational cancer.

By 1950, there were more than 80 articles and abstracts referring to the lung cancer hazard of asbestos, including writings in newspapers and popular magazines (see D below).

### C. Mesothelioma

The disease mesothelioma of the pleura was attributed to exposure to asbestos or asbestosis starting in 1943 with the report of Dr. H.W. Wedler in Heidelberg. There were additional reports in the German literature as well as British literature. The case reports that appeared prior to 1960 are annotated and cited by way of reference in Chapter 2, table 5 of my book. Dr. Wedler was the first to state that he believed the pleural cancers were occupational cancers, and his work was prominently cited in the United States in the 1940s. Other German pathologists starting with Leicher in 1954 would identify peritoneal mesothelioma as an asbestos disease.

A major report of pleural mesothelioma came from South Africa by Wagner and his coworkers, published in the British Journal of Industrial Medicine in 1960. Within a very short time it was widely accepted: that asbestos caused mesothelioma; that levels of asbestos exposure present from environmental exposure as well as occupational exposure were sufficient to cause mesothelioma; and that mesothelioma was affecting a considerable number of workers in shipyards. Reports, such as those in the British Medical Journal in 1962, described the different types of workers who were being affected by mesothelioma in shipyards.

In 1964, Dr. Irving Selikoff and his coworkers published a mortality study in JAMA showing that there was a substantial excess of occupational cancer and deaths from asbestosis among people involved in the insulating trades. A group of workers who installed insulation and removed it regularly was found to have 45 deaths from pulmonary cancer in a group where only six or seven such deaths would have been expected. There were four deaths from peritoneal and pleural mesothelioma in this cohort, and this was described as a very rare disease and a substantial excess over what would have been expected. There were also 12 deaths from asbestosis in this work force.

Later in 1964, at an international conference held in New York and published in 1965, Selikoff and coworkers reported that around 80% of the people who were in the insulating trade had developed asbestosis by the time they had been in trade for 20 or 30 years or more. At the conference in New York, British researchers Newhouse and Thompson presented a report on 76 deceased mesothelioma patients and an equal number of "controls", based on interviews with relatives. Their report showed strong evidence that mesothelioma patients were far more likely to

have had occupational, household, or neighborhood exposure to asbestos than the comparison patients who died from other causes at the same hospital.

As discussed in more detail below, there were periodic discussions in the medical and scientific communities regarding what level of exposure to asbestos would be allowed. The ACGIH eventually selected the Threshold Limit Value for asbestos dust at 5 million particles per cubic foot of air as providing some, but not complete, protection against the fibrotic disease asbestosis. The ACGIH recognized, as did the scientific community, that "People vary greatly in response to drugs and toxic substances. Therefore, it is a figment of the imagination to think that we can set down a precise limit below which there is complete safety and immediately above which there may be a high percentage of cases of poisoning among those exposed." ACGIH 1948. As mentioned above, the TLV was formulated in the context of limitation of asbestosis, not cancer.

In 1956, when the industrial hygiene and public health community first began to critically evaluate the TLV with regard to carcinogens, Union Carbide's Henry Field Smyth proclaimed that when it came to carcinogens, "it is prudent to set the standard . . . at zero . . . and no consideration can justify allowing the inhalation of any concentration which is avoidable." Smyth, *Improved Communication – Hygienic Standards for Daily Inhalation*, April 25, 1956. By 1964, the sentiments expressed by Dr. Smyth were being expressed in the context of asbestos. At the 1964 Conference on the Biological Effects of Asbestos, one corporate safety man stated: "We do not believe there is any safe limit. We have our ideas as to how low we can get and are always striving to get right down to zero." That same commentator made clear the American total dust TLV had "no scientific basis." An American observer commented that "as far as a safe level of asbestos is concerned, our own conclusion . . . is that there is no safe level. The safe level is nil and anything above the safe level represents certain risk."

### D. Other Sources of Knowledge

The subject of asbestosis was receiving attention in other types of circles. The Encyclopedia Britannica first noted the disease asbestosis in the regular publication of the Encyclopedia in 1940.

By this time, The National Safety Council had been established for 28 years as management's response to the industrial safety issue, with its associated problems of disability compensation and labor unrest. Dust diseases were increasingly of concern throughout the 1920s, and by 1929 there was a presentation at the National Safety Congress by a major insurance carrier that acknowledged silicosis, asbestosis and various other "osis" diseases as compensable diseases.

Throughout the 1930's the National Safety Council published numerous articles, pamphlets and other materials concerning the hazards of asbestos. Many sections of the annual National Safety congresses held forums and discussions about dust disease. The "transactions" of these meetings were automatically mailed to the industrial members. Many of the presentations were then separately also published in the National Safety Council's monthly magazine, "Safety News", which was also sent to all members.

During the 1930's there were an increasing number of lawsuits for dust diseases contracted in the workplace. To confront this dust disease threat, a meeting of about 250 people representing over 50 industries with industrial disease problems was held on January 15, 1935. The meeting covered the hazards of asbestos and silica dust. During this and subsequent meetings of the association, which was initially called the Air Hygiene Foundation, lawyers outlined a plan to limit dust disease lawsuits and compensation. This included eliminating the right to trial and limiting workers' ability to claim workers compensation. The Air Hygiene Foundation (renamed the Industrial Hygiene Foundation in 1941) produced publications, meetings and conferences to inform its members about dust diseases and the responsibilities of manufacturers to warn concerning hazards associated with their products.

Among the means by which the Industrial Hygiene Foundation disseminated information was the Industrial Hygiene Digest, which published abstracts of articles from hundreds of journals that were being published. In January of 1945, the Industrial Hygiene Digest included abstracts of industrial medicine articles that had appeared in the journals which included reference to cancers of the lung and pleura associated with asbestos exposure originally reported by Dr. Wedler in 1943.. Wedler's article had been published in the German Medical Weekly. Here, we see the first references to cancers of the pleura as well as cancers of the lungs all being counted as pulmonary, asbestos-related cancers in literature.

In 1944, a trade magazine called Heating and Ventilating carried an article called "Dust is an Industrial Health Hazard" by Hutchinson, in which was noted that fatal cases of asbestosis occurred in shorter periods of time than fatal cases of silicosis, and also that the hazard of asbestosis extended to industries including the insulating industry. Hutchinson said at that time there was no known safe level of exposure.

The Journal of the American Medical Association carried an editorial called "Asbestosis and Cancer of the Lung" in August of 1949. This reported British statistics on 235 deaths in which asbestosis had played a part. Of these 235, 31 (13%) of the individuals were also found to have cancers of the lung or pleura. This was considered quite excessive compared to the normal rate of lung cancer in the general population of 1% of all autopsies. This editorial in the Journal of the American Medical Association was promptly summarized in the abstract form in the Industrial Hygiene Digest in 1949.

Reference to cancer from asbestos appeared in the New York Times on Jan. 7, 1948, Business Week Nov. 13, 1948 (citing Dr. Hueper), Washington Post Nov. 21, 1948, and Scientific American in January 1949 in an article called "Cancer and Environment." It appeared in Newsweek magazine May 15, 1950. The reference to asbestos in Newsweek was in relation to the rising rate of lung cancer in urban dwellers compared with people in the rural areas. This was partly attributed to the presence of carcinogens like asbestos in urban air, according to Dr. Hueper, Chief of the Environmental Cancer Section, National Cancer Institute. The Los Angeles Times noted the carcinogenicity of asbestos April 6, 1951, the Chicago Tribune on June 10, 1951. The Encyclopedia Britannica made reference to asbestos as one of the causes of occupational cancer under the title "Cancer" in 1952, and asbestos was described as a lung cancer hazard to steamfitters working with asbestos in the Wall Street Journal on April 7, 1959.

## E. TLV's

Various guidelines have been recommended to limit asbestosis as a hazard in places where asbestos is used. These guidelines included so-called Threshold Limit Values (TLVs) or maximum allowable concentrations. The Public Health Service in its survey in 1938 recommended 5 million particles per cubic foot for dust in which asbestos was present in the workplace, as a ceiling concentration, though reduction of dust to the lowest possible levels was always encouraged. This was adopted by a non-governmental group, a volunteer professional organization, called the American Conference of Government Industrial Hygienists (ACGIH). It was recommended as a guideline in some states prior to the enactment of the Occupational Safety and Health Act in 1970.

Authors in other countries took issue with the idea that one could recommend an occupational exposure limit of dust in the air and thereby completely control health hazards. Under the heading "The Prevention of the Dust Disease" Dr. McLaughlin, of the Factory Inspectorate in Great Britain, writing in The Lancet in 1953, said that people in some countries who recommend these maximum allowable concentrations seem to think that man is a "standardized machine which he clearly is not." McLaughlin noted a number of factors that would distinguish people in terms of their risks in ways that we could recognize as well as not recognize, where one individual exposed to the same thing gets sick and another person working next to him does not.

Others such as that of Dr. May Mayers of New York, in 1952, and Warren Cook, also writing in the United States in 1956, observed that maximum allowable concentrations that were recommended to prevent other effects than cancer could not be considered to be safe if the substances also caused cancer. Herbert Stokinger, a well-known figure in occupational health, recommended reducing the TLV by a factor of 100-500 times for a carcinogen, such as asbestos, when the TLV was created to protect against a chronic disease like asbestosis. Asbestos was noted by both of those authors as one such substance that caused cancer.

The Documentation of the Threshold Limit Values, published in 1962, and in its second edition in 1966, clearly indicated that the asbestos TLV was based on the 1938 Public Health Service study and was only suggested to protect against the disease asbestosis. The word cancer was not even mentioned in the 1966 Documentation, whose most recent cited reference on asbestos was dated 1955.

Many corporations recognized that the asbestos TLV was not protective for cancer or even meaningful because it measured total dust, rather than actual dose of the harmful asbestos. DuPont actually enacted its own TLV for asbestos, setting the limit its workers could be exposed to at 500,000 particles per cubic foot and Turner Brothers recognized the ACGIH TLV as unreliable in the 1950s.

## F. End-Products Users

There were many articles coming out in the 1940's and 1950's that noted the risk of asbestosis and cancer in individuals who were exposed to asbestos in the course of using asbestos-containing products; there were more than 50 separate case reports, some involving

one or two individuals, some involving as many as ten or more. These case reports were published mostly in the English language in medical journals between 1932 and 1963. These reports are tabulated in Chapter 5, Tables 2 and 3 in my book, Asbestos: Medical and Legal Aspects. Indeed, the Navy and Maritime Commission performed inspections at shipyards for industrial hygiene hazards, including asbestos, in the early 1940s. For example, the inspection at Western Pipe & Steel's shipyard in 1943 recognized the need for engineering controls, dust suppression and respiratory protection in workers sawing finished asbestos-containing products.

Companies marketing products that could release respirable asbestos dust either were or should have been aware that most dusts can either cause or aggravate problems in the lungs of end-product users.

### G. Household Contact Asbestos Exposure and Disease

In 1897, the first physician in modern times to write about lung disease in asbestos workers also commented on ill health among the workers' family members. The families of asbestos-exposed workers in the 20th century were exposed to asbestos brought home on the clothes, shoes, hair, toolboxes, lunch boxes, and automobiles of the workers.

As far back as 1913, the text, Safety, by W.H. Tolman and L. B. Kendall (p. 249) emphasized the importance of having workers remove work clothes before leaving a factory where toxic materials are handled, so the poisons would not be carried "into the homes of workers."

Some chemical companies using toxic and carcinogenic chemicals provided work clothes and laundered them in plants as early as the 1920s. In California, by 1936, the law provided "Employers shall provide a change room, shower baths and lavatories . . . where the lack of such facilities would constitute a health hazard." The U.S. Public Health Service in the Manual of Industrial Hygiene (1943) recommended "Two-compartment lockers, or preferably two individual lockers, should be provided in dressing rooms for employees whose clothes are exposed to poisonous material."

Corporate physicians advised a number of safeguards that would have protected families of workers at a Chrysler plant being built in 1946. The plant was to use asbestos and chemicals that could cause toxic effects and dermatitis. Protective clothing, laundry, showers, and separate lockers for street and work clothing were recommended by the doctors. In a 1948 document, Roy S. Bonsib, an industrial hygienist for Standard Oil of New Jersey stated: "Appropriate work clothes, properly fitted and maintained, play a prominent part in an industrial worker's health and efficiency. This is especially true when persons are working with more or less toxic or carcinogenic materials or where cleanliness is a factor in the maintenance of product quality. Consequently, many of the more progressive industrial organizations, such as E.I. DuPont de Nemours & Company, the American Cyanamid Company and the Borden Company, have for years supplied their employees with work clothing and have instituted a laundry service" to prevent toxic materials from being transported into a worker's home and contaminating the household environment.

Additionally, the United States Department of Labor issued safety and health guidelines in conjunction with contract work for the federal government. A 1952 document entitled Safety and Health Standards for Contractors performing Federal Supply Contracts under the Walsh-Healey Public Contracts Act required that contractors provide facilities to prevent the communication of harmful substances from work clothes by contact to street clothes. Subsequently, Walsh-Healey regulations were published in the Federal Register in 1960. These regulations provided that, "Where employees' work clothes are exposed to contamination by poisonous, infectious, or irritating material, facilities shall be provided in change rooms so that street and work clothes will not be stored in contact with each other."

The hazard of asbestos exposure to families of the workers was scientifically knowable long before it was studied directly, as illustrated by the advice of the Chrysler doctors. Dr. Wilhelm Hueper, Chief of the National Cancer Institute section on environmental cancer, charged that ambient asbestos air pollution played a role in the rising lung cancer rates in American cities (in Newsweek and a medical article) in 1950. Industry was well aware that asbestos was a mineral with high resistance to destructive forces such as heat and that asbestos did not decompose even upon prolonged storage. (One scientist borrowed from the language applied to radiation in stating that asbestos in the environment had a "half-life of infinity"). It was also obvious that, absent any safeguards to prevent it, workers typically exposed to dust from asbestos products would take the contaminant home on them, where it would accumulate in family automobiles, carpets, clothing, window curtains and furniture, and in the ambient air in the home. It was also known that the very young (the developing organism) would be most susceptible to the action of carcinogenic agents, a fact demonstrated in laboratory testing of carcinogenic agents at least as far back as 1938 (cited in Hueper, Occupational Tumors and Allied Diseases, 1942, p. 758).

Retired Monsanto chemist and industrial hygienist Jack Garrett has testified that in the 1950's, that chemical company's employee protection against asbestos from insulation products included showers and daily changes of clothes: "We went down to shoes and socks, underwear and all. We didn't want it at home." (deposition in *Schmidt*, District Court of Jefferson Co. TX, Dec. 16, 1993). In 1967, Shell Chemicals in Britain adopted a code of practice for handling asbestos products, including vacuum hoses for removing dust from clothing and shoes, separate lockers for work clothes and street clothes, and hot and cold showers. Work overalls were vacuum cleaned, bagged with warning labeling, and laundered by the company.

Work such as that of Newhouse and Thompson (1965) established that mesothelioma was causing deaths among persons with only household (and not occupational) exposure to asbestos. The contamination of workers homes and the exposure of their spouses and children was foreseeable, and with the knowledge that asbestos was carcinogenic came the possibility that household-contact exposures could have disastrous consequences for members of workers' families if not prevented. A collection of articles relevant to household contact are listed in Table 1.

## H. Railroad Companies

According to Western's own training materials, Western operated the Manufacturers Junction Railway Company ("MJRC" incorporated in Illinois in 1903) to provide links of Western's Hawthorne Works to all major railroad systems entering Chicago. The MJRC also provided rail service to Western's industrial neighbors. The railroad industry trade group, Association of American Railroads (AAR), convened annual meetings of its Medical and Surgical Section annually, starting in 1921. The proceedings of these meetings show that they were attended by doctors from the major railroads throughout the United States. The proceedings from 1935 specifically note that asbestosis was a concern to railroad industry doctors, and that education of the workers, hygiene measures, medical evaluations with chest X-ray, air sampling, and respiratory protection were advisable. Similar points were recorded in the medical section proceedings for the years 1937 and 1951-1953. The 1958 proceedings noted that asbestos dust inhalation could also cause cancer of the lungs. Historic documents of railroads operating in Illinois in 1937 record the development of a detailed list of procedures to be followed in the handling of asbestos insulation used on steam locomotives. Railway claims agents also wrote about asbestosis in the 1930s. This awareness of asbestos hazards is recorded in my book on the public health history of asbestos (Asbestos: Medical and Legal Aspects 5th Ed. Aspen, NY, 2005, pp. 646-650).

## I. Western Electric, AT&T and the Bell System.

Western Electric ("Western") began in 1869 in Cleveland, Ohio and by 1880, the company had relocated to Chicago, Illinois and become the largest electrical manufacturing company in the U.S.[1] Western was noted for its production of a variety of electrical equipment, including the world's first commercial typewriters, telegraph equipment and Thomas A. Edison's electric pen. In 1881 the American Bell Telephone Company — founded by Alexander Graham Bell and forerunner of American Telephone & Telegraph (AT&T) — purchased a controlling interest in Western and made it the exclusive developer and manufacturer of equipment for the Bell telephone companies.

According to *Western Electric and the Bell System – A Survey of Service*[2], a Western-commissioned history of Western's place in the Bell System, by the end of 1945, Western employed over 80,000 people and was growing. By 1963 Western had 147,000 employees and had manufacturing operations in Illinois, New Jersey, Maryland, Pennsylvania, Indiana, Ohio, Nebraska, Oklahoma, and Missouri. Western was diverse and operated a railroad among other endeavors.

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1 The link to the history http://www.alcatel-lucent.com/wps/portal/!ut/p/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLd4w3MfQFSYGYRq6m-pEoYgbxjgiRIH1vfV-P_NxU_QD9gtzQiHJHR0UAAD_zXg!!/delta/base64xml/L0lJayEvUUd3QndJQSEvNElVRkNBISEvNl9BXzVMSS9lbl93dw!!?LMSG_CABINET=Corporate&LMSG_CONTENT_FILE=About_Us/History/History&UNIQUE_NAME=lu.pub.corp.pg.history&lu_lang_code=en_WW

2 Albert B. Iardella, Published by Western Electric Company, 195 Broadway, New York, NY (1964).

Western had multiple government contracts to supply materials for the war effort during World War II and later during the Cold War. Many of these large government contracts required awareness of worker protection regulations including recognition and observance of the TLV for asbestos. The Walsh-Healy Act required large contractors to provide minimal industrial hygiene standards and made the 5 mppcf TLV for asbestos a legal requirement for companies like Western. Significantly, there is a large body of industrial hygiene and safety literature that indicates that when visible dust is generated from asbestos-containing products, the TLV may have been exceeded. While only measurement of the dust cloud could fully answer the question of whether the TLV was being exceeded, visible dust was a warning sign well known to industry. Some of the references indicating visible dust as a hazard can be found in Table 2.

Western, as an Illinois-based company, was subject to Illinois' worker protection laws including laws that discussed provision of uniforms, change rooms and showers to workers who were exposed to industrial poisons. By 1936, the Illinois Manufacturers' Association had published a newsletter entitled Industrial Review discussing the "occupational diseases problem" and mentioned the potential for liability for dust-related injury, including asbestosis, to workers. By the 1940s, the Illinois Department of Labor published an article entitled "Wartime Operations Emphasize Industrial Hygiene Problems of the Asbestos Industry" and recommended reducing exposures to asbestos to reduce disease. The following documents discussed Illinois concerns with asbestos hazards and would have applied to Western:

- **March 16, 1938** - Third Special Session—Illinois Act re Occupational Diseases
- **July-September, 1947** - State of Illinois Department of Public Health—What's New In Industrial Hygiene
- **June 15, 1951** - Illinois Health and Safety regulations requiring labeling of hazardous materials

Western had an active industrial hygiene department and studied workplace safety in depth. In 1943, Western employees participated in the technical committee which drafted the American Foundrymen's Association Industrial Hygiene Codes Committee. The AFA Code recommended the maintenance of washrooms and locker rooms for the protection of the health and safety of the workforce. Effective, on September 1, 1944, Part "G" of the Rules and Regulations Relating to Industrial Housekeeping and Sanitation, Wash, Locker, Rest, Toilet and Lunchroom Requirements, made clear the importance of keeping hazardous dust off the employees street clothes. Part "G" also required showers be provided "for employees regularly engaged in operations where injurious and toxic . . . dusts are produced and come into contact with the employee."

Western was a manufacturer, distributor and consumer of asbestos-containing products. Western used a number of asbestos-containing products using plastics, distributed Western-made and other companies' asbestos products, and used asbestos-containing products in its operations. Western's in-depth involvement with asbestos gave it reason to know about the hazards.

Numerous lay press articles published in the Chicago area discussed the hazards of exposure to asbestos. Table 3 lists a sampling of Chicago-area news reports regarding asbestos hazards.

Western was the supplier of almost all materials used in the Bell System including used by the Bell Operating Companies such as Southwestern Bell. Western bought asbestos-containing materials, such as transite pipe and board, in bulk. Western would often, as supplier to the Bell System, re-sell the asbestos-containing materials to Bell operating companies.

Being in Chicago, Western had unique opportunities to work with the National Safety Council (NSC), a world-renowned organization devoted to promoting safety, with an emphasis on workplace safety. Western and AT&T participated in the NSC and even gave substantial presentations on occupational diseases as far back as the 1920s. The Proceedings of the National Safety Council from 1921 indicate strong participation by AT&T Company, Illinois Bell Telephone, New York Telephone Company, and Bell Telephone Company of Pennsylvania. Western and AT&T employees were officers and directors of the NSC in 1929 at the Eighteenth Annual Safety Congress where there were presentations on "disabling a workman slowly through poisoning" with asbestos and other dust. Western's C.F. Whittemore was chairman for the presentations on occupational diseases being made to the NSC. AT&T's Dr. C.H. Watson was president of the NSC in 1935 and Western's C.W. Bergquist was on the executive committee (and listed as past president of the NSC). Other Western personnel attended the 24th Annual Safety Congress, where Dr. Watson presided over discussions of occupational disease, including asbestosis.

According to Charles Lichtenwalner, a former Bell Labs employee, Western Electric and AT&T shared the costs of supporting Bell Labs' scientific research activities for the Bell System. Lichtenwalner Dep. 23:3-8. Bell Labs provided industrial hygiene advice to Western and the Bell Operating Companies. Lichtenwalner Dep. 25:18 - 26:4. By the time Lichtenwalner started with the Bell Labs in 1975, the Bell System was already aware that asbestos exposure causes mesothelioma. Lichtenwalner Dep. 59:18-23. The Bell System had access to the knowledge base maintained by the Industrial Hygiene Foundation, through corporate and individual memberships. Lichtenwalner Dep. 60:22 – 61:15. William J. Schreibeis, Mr. Lichtenwalner's boss, was an employee of the IHF (in 1958-59) before going to work for Bell Labs. Western also had the money and resources to ensure that workers were properly warned of hazards in the workplace. Lichtenwalner Dep. 58:10-14.

## III. CONCLUSION

To summarize, the literature had largely established that asbestos was a lethal material by the early 1930s, causing disability and deaths from asbestosis. By the mid-1940s, it was widely-accepted by people writing on the matter that asbestos inhalation could cause lung cancer. There were several dozen reports of cases as well as editorials and other publications referring to the cancer risk of asbestos in the literature. Most of the authors by that time were concluding that asbestos caused cancer of the lungs, and in some cases cancers of the pleura were counted in as if they were also occupational pulmonary cancers caused by asbestos. The added hazard of cancer from asbestos was sufficiently well-known to start appearing in more general references like the New York Times and Business Week in 1948, Scientific American magazine in 1949, Newsweek in 1950, and the Encyclopedia Britannica in 1952. Further, the hazard of asbestos exposure to families of the workers was scientifically knowable since the 1950's. The risk of mesothelioma especially in individuals with environmental, non-occupational asbestos exposure became a subject of intense discussion in the early 1960's subsequent to the publication Wagner and his co-workers in 1960.

That was what was available in the medical libraries to anyone who knew how to spell the word asbestosis. You could find the information at any time by using Index Medicus, which is a subject index of worldwide medical literature. The Index Medicus has been published since 1879 and can be used to identify articles that are newly emerging on any medical subject including asbestosis. It is one of the things I used in my research. There were many medical texts on occupational diseases, pathology, internal medicine, cancer, lung diseases, and public health, which addressed asbestos hazards, published in the 1930s and thereafter. Also, the articles themselves often contained numerous references to prior articles, and so in this way one could easily find in a matter of a few hours in a library a great deal of information about a subject like asbestosis using the classical research methods. None of this would require using any kind of a computer search or any other kind of modern technique.

Signed this 5th day of July in New York, NY.

Barry Ira Castleman, Sc.D.