ASBESTOS - RELATED DISEASES

A CHRONOLOGY

REGARDING

THE STATE OF THE ART

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November 25, 1981

PLAINTIFF'S EXHIBIT
54 301
Blumberg No. 6113

PRE 1930

As early as 1898, a Lady Inspector of Factories and Workshops in England reported " The evil effectes of asbestos dust have also attracted my attention, a microscopic examination of this mineral dust which was made by H. M. Medical Inspector clearly revealed the sharp, glass-like, jagged nature of the particles, and where they are allowed to rise and to remain suspended in the air of a room, in any quantity, the effects have been found to be injurious, as might have been expected. " [1] In that same report to the English Parliment it was noted, " Of all the dusty occupations which specially came under observation in 1898 three, in addition to china scouring, stand out on account of their easily demonstrated danger to the health of the worker, and because of ascertained cases of injury to bronchial tubes and lungs medically attributed to the employment of the sufferers. These occupations were asbestos sifting and carding... "

In 1906, Murray to a British government commission on occupational disability compensation a case of an asbestos worker who had shortness of breath and sarrification of the lungs. Murray attributed these medical conditions to the dust in the asbestos factory. [2] Several years later, in the United States, Pancoast et al [3] reported in the Transactions of the Association of American Physicians x-ray changes resembling pneumoconiosis in fifteen workers exposed to asbestos. Shortly thereafter,

in 1918, Hoffman [4] reported in the Bulletin of the US Bureau of Labor Statistics that in the practice of American and Canadian life insurance companies asbestos workers are generally declined on account of the health-injurious conditions of the industry. A detailed description of asbestosis and of the " curious bodies " seen in the lung tissue appeared in 1927 when Cooke [5] reported on a case of asbestosis in the British Medical Journal and McDonald [6] reported in the same journal on that and another case. In the same issue of the British Medical Journal, Oliver [7] presented the clinical aspects of pulmonary asbestosis in two additional asbestos factory workers.

1930 - 1939

On the basis of the reports of Cooke, McDonald, Oliver and others, the British Factory Inspectorate, in 1928 - 1929, undertook an indepth investigation of the health status of workers in asbestos factories. As a result of that investigation, Merewether and Price [8], in 1930, reported pulmonary fibrosis in 26.2 percent of 363 asbestos workers x-rayed. Among those textile workers exposed to asbestos for more than twenty years, 80 percent had abnormal x-rays. Acknowledgment of asbestos-induced pulmonary disease as an occupational hazard quickly followed in England, and in 1931 regulations were established for the control of asbestos exposure in the manufacturing processes. [9]

In 1932, Russell [10] of the United States Public Health Service reported the findings of asbestosis in an individual who was employed in a maintenance capacity where he worked with asbestos insulation products. The workers' compensation claim for occupationally induced pulmonary disease was awarded without medical challenge. A year later, Ellman [11] published in the Journal of Industrial Hygiene a series of pulmonary asbestosis cases among asbestos production workers. In a description of the clinical, radiological and pathological features of pulmonary asbestosis, Ellman stated " The slow development of a characteristic type of fibrosis distinguishes pulmonary asbestosis; it produces insidious lung changes; but the patient may be comparatively free from symptoms for several years, usually five to fifteen; in some cases, before symptoms arise, years elapse after the worker has left the industry and his exposure to asbestos dust. " In 1934, Wood and Gloyne [12] published a review of one hundred cases of occupationally induced asbestosis in Lancet. Cases of asbestosis were reported in individuals having only six months of occupational exposure to asbestos and in others having only indirect exposure, e.g., clerical and administrative work. The authors stated " ...any patient who betrays symptoms of fibrosis or in whom any evidence of fibrosis is discovered, whether by physical or radiological examination, should at once cease working in any dusty occupation. "

- In 1935, Lanza et al. [13] reported in Public Health Reports the results of a results of a study of asbestos fabricating plants which had been undertaken following an inquiry by representatives of the asbestos industry in the United States. A diagnosis of asbestosis by x-ray was reported in fifty-three percent of 126 randomly selected workers having more than three years of employment in the asbestos production industry. A definite association between duration of exposure and risk of asbestosis was demonstrated. Even among those workers with less than five years of exposure, the incidence of asbestosis was shown to be excessively high, i.e., 43 percent. Of 64 workers given physical examination and diagnosed by x-ray as positive for asbestosis, only eight (12.5%) were entirely free from symptoms (dyspnea and cough) whereas ten out of thirty-seven with doubtful and seven out of twenty with negative signs were free from clinical symptoms. On the basis of these adverse findings of asbestos-related pulmonary disease, the authors recommended that " the industry seriously face the problem of dust control in asbestos plants. " The authors also recommended that " the industry sponsor studies on known cases of asbestosis,... " This later recommendation took on added significance in 1935, when Lynch and Smith in the American Journal of Cancer and Gloyne in Tubercle first drew attention to the possibility of an association between asbestos exposure and lung cancer by reporting cases of coexistant asbestosis and lung cancer. [14,15]

In that same year, Fulton et al. [16] reported in the Special Bulletin of the Commonwealth Of Pennsylvania that twenty-five percent of fifty-six workers actively employed in the textile departments of asbestos fabricating plants in Pennsylvania had both clinical and roentgenological evidence of asbestosis. In that study, fifty-seven percent of those workers with an average dust exposure of 44 million particles per cubic foot of air (mppcf) had asbestosis. Even among those workers with the lowest average dust exposure (5 mppcf), an eight percent incidence of asbestosis was reported.

Donnelly, in 1936, [17] reported in the Journal of Industrial Hygiene And Toxicology that of 151 asbestos mill workers having been x-rayed, 52 (34.4%) showed definite evidence of asbestosis. An association between duration of employment and radiographic evidence of asbestosis was demonstrated in that study. Donnelly noted that of eleven cases of advanced asbestosis diagnosed, one had been exposed to asbestos for 8 years, two for 9, and one each for 10, 11, 12, 14, 15, 16, 17 and 20 years. The author commented on and presented data in support of the progressive nature of asbestosis in the absence of continued exposure to asbestos. Donnelly concluded " The high percentage of pulmonary asbestosis (34.4) found in this series of 151 workers, indicates unquestionably the need for more complete protection of employees in asbestos mills. "

In 1938, Dressen et al. [18] reported in the US Public Health Bulletin a high incidence of asbestosis among asbestos textile workers medically surveyed in North Carolina. The authors noted that cough and dyspnea, the " cardinal symptoms " of asbestosis, were excessive among asbestos exposed workers as contrasted with that seen in workers not so exposed (Cough: 29.8% vs. 7.0% and Dyspnea: 26.3% vs. 8.0%). When consideration was given to these symptoms according to cumulative dust exposure, an excess of cough and of dyspnea was demonstrated among asbestos workers in each cumulative dust exposure category down to and including the lowest, i.e., less than 25 million particles per cubic foot years (mppcfy). Cough was found to occur in only 7 percent of the controls, whereas it occurred in 14, 27, 35 and 61 percent of workers having less than 25, 25 - 49, 50 - 99 and greater than 100 mppcfy of total dust exposure. In like manner, dyspnea occurred in only 8 percent of workers not exposed to asbestos as contrasted with 12, 15, 33 and 59 percent in the four respective cumulative dust exposure categories.

Dressen et al. made special note of several factors leading toward an underestimate of asbestos-related respiratory disease in that study. Two specific factors discussed were: 1). Among thirty-nine active workers exposed to total dust concentrations below 2.5 mppcf, only six had been employed for more than five years. At concentrations below 5 mppcf, only five (4.6 %) had more than ten years of employment, and 2). One hundred-fifty

workers had been discharged from the asbestos textile factories fifteen months prior to the study. On the basis of a very high incidence of asbestosis among a subset of these terminated workers (34/69 = 49.3%), approximately fifty additional cases of asbestosis were estimated by the authors to have occurred but not to have been included in the study. Dressen et al. thus concluded that the percentage values in the study were necessarily minimal estimates of the prevalence of asbestosis. Having clearly identified several factor leading toward an underestimate of the risk of asbestosis, Dressen et al suggested that a total dust concentration of 5 mppcf may tentatively be regarded as the " threshold value " for asbestos-induced disease.

1940 -1949

During the 1940's, published reports continued to document asbestos exposure as an etiological factor in the induction of non-neoplastic pulmonary disease. In 1941, Kuhn[19] reported a shipyard insulator in Germany who was awarded compensation for asbestosis. In that same year, Schrumpf[20] reported in Nordisk Medicin a chemical plant worker in Norway who had been diagnosed with asbestosis. That worker had mixed asbestos insulation one day a week and spent the remainder of the week sealing turrets with insulation. In 1948, Canepa[21] reviewed in Lavoro e Medicina the numerous findings of asbestosis among workers in the Italian asbestos mining and production industry. The following year, Canepa[22] reported in Zacchia the results of a survey of insulation workers in Genoa, Italy. Of fifty-two insulators

insulators having undergone complete clinical-radiological examination, five showed clear asbestosis and another ten revealed early asbestosis. On the basis of these findings, Canepa commented on the need to broaden workers' compensation coverage to include jobs installing asbestos products.

In the 1940's, the spectrum of asbestos-induced diseases also was expanded to include cancer. Holleb and Angrist [23], in 1942, reported in the American Journal of Pathology two new cases of coexistent asbestosis and lung cancer. Microscopic study identified interstitial fibrosis and " asbestos " bodies in the lung tissue of each case. The authors also reviewed and tabulated eight additional cases of coexistent asbestosis and lung cancer previously having been published in the 1930's. The following year, Wedler [24] reported fourteen cases of coexistent asbestosis and cancer of the lung or pleura in a series of 92 autopsies on patients with asbestosis. That report, originally published in Deutsch Medizinisch Wochenschrift, was abstracted in the Bulletin of Hygiene in 1944.[25] Three years later, in 1947, Mallory et al. [26] in the New England Journal of Medicine reported finding mesothelioma of the pleura and pericardium in a thirty-seven-year-old Swedish male whose work had consisted of cutting asbestos insulating board. Two years later, Wyers [27] reported in Postgraduate Medical Journal that seventeen of one hundred -fifteen autopsied cases of asbestosis had coexistent lung cancer. In that same year, Merewether [28] in Annual Report of the Chief Inspector

of Factories for the year 1947 reported that cancer of the lung or pleura was found in 31 or 13.2 percent of 235 necropsied patients with asbestosis. Of 128 male asbestotics necropsied, 22 or 17.2 percent showed coexistent asbestosis and lung or pleural cancers. Merewether reported that this high prevalence of lung or pleural cancer was in direct contrast to the findings of only 91 or 1.3 percent of 6,884 necropsied cases of silicosis during the same time period. In 1949, an editorial [29] in the Journal of the American Medical Association following a review of both experimental and human data, stated " ... a specific factor of exogenous origin, represented by the inhaled asbestos dust, was responsible for the bronchial cancers observed. "

1950 - 1959

The finding of asbestosis among individuals engaged in the manufacture of asbestos products or in the application or removal of asbestos products was again demonstrated and reported in the 1950's by Frost [30] in *Ugerskrift fur Laeger*; Sanders [31] in Industrial Health; McLaughlin [32] in Transactions of the McIntyre- Saranac Conference on Occupational Chest Disease; Smith [33] in Archives of Industrial Health; Doll [34] in British Journal of Industrial Medicine; Frost et al. [35] in Danish Medical Bulletin; Ahlborg and Hansson [36] in Svenlak. Tidn. and Hertz and Reinwein [37] in Arztliche Wochenschrift among others.

In 1951, Stoll et al. [38] reported in the Archives of Internal Medicine a case of coexistent asbestosis and lung cancer in a man

who had been employed in the past as a pipe coverer. The authors concluded " This association emphasizes the hazards of industrial exposure, the comensability of the cancerous precess as well as the asbestosis, and the need of careful preventive measures. " In that same year, Castleman and Towne [39] presented in the New England Journal of Medicine a case of coexistent pulmonary asbestosis and adenocarcinoma of the left lower lobe bronchus. In a discussion of that case, Benedict stated " I believe ther is good evidence in the literature that carcinoma of the lung has a higher incidence in asbestosis, " and Castleman responded, " According to the papers that have been written in the last five years, between 10 and 15 percent of people with asbestosis develop carcinoma ..."

During the next eight years, cancer of the bronchus, pluera and peritoneum continued to be reported in association with exposure to asbestos by Isselbacher et al. [40] in the American Journal of Medicine; Weiss [41] in Die Medizinische; Leicher [42] in Archiv fur Gewerbepathologie und Gewerbehygiene; Breslow et al. [43] in the American Journal of Public Health; Doll [34] in the British Journal of Industrial Medicine; Bonser et al. [44] in the American Journal of Clinical Pathology; O'Donnell and Mann [45] in the American Journal of Pathology and Van Der Schoot [46] and Schornagel [47] both in Med. T. Geneesk.

1960 - 1979

In the 1960's and 1970's findings of asbestosis, pleural and pulmonary abnormalities and an excess of pulmonary disease among asbestos production workers and among workers directly or indirectly exposed to asbestos products continued to be demonstrated and to be reported. In 1961, Brugsch and Bavley [48] reported an automobile mechanic who had developed asbestosis secondary to the application of an asbestos-based undercoating to new autos. In 1963, Leathard and Sanderson [49] reported that in the United Kingdom, asbestosis, which was considered a fatal occupational disease, was still occurring 30 years after steps were taken to eliminate the disease. In 1963, Mancuso and Coulter [50] in Archives of Environmental Health that twenty-two percent of all non-neoplastic death among asbestos production workers from a plant in Pennsylvania were due to asbestosis.

Others in the 1960's and 1970's reporting a high incidence of asbestosis among individuals occupationally exposed to asbestos during its production were Enterline [51] in Annals of the New York Academy of Sciences; Enterline [52] in Archives of Environmental Health; Newhouse [53] in British Journal of Industrial Medicine; Wagoner et al. [54] in Congressional Record; Weill et al. [55] in Archives of Environmental Health; Robinson et al. [56] in Dust and Disease and Berry et al [57] in British Journal of Industrial Medicine.

Harless et al. [58] in 1978, reported in Environmental Research that a study of lung function in twenty-three men after an intense 5 month exposure to chrysotile asbestos during construction work had demonstrated a high incidence of airflow obstruction in the absence of restrictive defects. The authors reported that 17 of 23 men (74 %) had airflow obstruction and that after consideration was given to cigarette smoking, 12 (71 %) would be left with asbestos exposure as the probable major determinant in the etiology of the lung disease. The authors noted " The finding of airflow obstruction is consistent with other published data. "

Confirmatory evidence of the multi-site carcinogenicity of asbestos exposure was again provided in 1963 by Mancuso and Coulter.[50] These authors reported an excess of cancer mortality of the lung (19 obs. v. 5.61 exp.), the digestive organs (15 obs. v. 7.99 exp.) and the peritoneum (3 obs. v. 0.08 exp.) among individuals having been employed in the manufactueing of asbestos textile, friction and packing prodicts. One year later, Selikoff et al. [59] in the Journal of the American Medical Association reported that among asbestos insulation workers employed twenty or more years, the risk of cancer of the bronchus and pleura and of the stomach, colon and rectum were 6.8 and 3.1 times higher respectively than that expected on the basis of age-race- time preiod specific rates for the general population. During the 1960's and 1970's numerous additional reports were published, the results which confirm an excess of cancer (lung, pleural and peritoneal mesothelioma, colon, rectum and other sites)

among individuals employed in the manufacturing or use of asbestos products. Extensive reviews of many of these findings have been reported in 1977 by the International Agency for Research on cancer, World Health Organization [60] and in 1980 by the National Institute for Occupational Safety and Health, Public Health Service. [61]

1980's

During the 1980's published research continued to document the neoplastic and non neoplastic effects of occupational exposure to asbestos. In 1980, Selikoff et al. [62] reported that asbestos production workers had an increased risk of asbestosis and of cancer of the colon-rectum (SMR = 297), neither disease risk of which the authors could attribute to cigarette smoking.

In 1981, Berry [63] reported the results of a study of the mortality experience of 665 workers having been certified by Pneumoconiosis Medical Panels as having asbestosis but no coexistent cancer. This study demonstrated that of those asbestotics subsequently dying, 53.1 percent died due to bronchoginic cancer, mesothelioma or some other form of cancer. When consideration was given to those male asbestotics who died from causes other than asbestosis, 67.0 percent were shown to have died due to cancer of one form or other or from mesothelioma.

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