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# STATE-OF-THE-ART

# A PRIMER OF SOME OF THE MOST INFLUENTIAL ARTICLES

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## I. STATE-OF-THE-ART – A PRIMER OF SOME OF THE MOST INFLUENTIAL ARTICLES

### A. The 1930's – Asbestosis in Factory Workers

1. Merewether (1930)
   - A study of English textile mills
   - Only 2,200 people at risk, all in the textile industry
   - The disease can be controlled by reducing the dust to the levels to which spinners are exposed
   - Dust research to date has been on silicosis
   - The disease will disappear in a decade
   - British Industry Regulations soon enacted, but were not applicable to insulation workers or lagers

2. Lanza (1935; 1936)
   - A study of five asbestos textile factories in the United States
   - Prolonged exposure causes asbestosis, but milder than silicosis
   - Not resulted in marked disability
   - Not practicable to establish standards for dust content in the year at the present time

3. Dreessen, U.S. Public Health Service (1938)
   - Study of the asbestos textile industry in the United States
   - Exposure to 5 million particles per cubic foot of air during an 8 hour day at 40 hours a week was suggested as a tentative safe level

### B. 1940 – 1950 – Decade of War/Ship Building

1. Fleischer – Drinker 1946
   - First epidemiological study of insulators – 1,074 Navel Pipe Coverers

   Conclusions:
   1. Cannot apply other data from the textile factory studies
   2. Exhaust ventilation
   3. Asbestosis – 3 out of 1,074
   4. "Not a dangerous occupation"

### C. Decade of the 1950's – The Explosive Growth of Suburbia

1. Disease: Asbestosis; Lung Cancer?
   Population at risk: Factory Workers
   Solution: Dust Control; Prevent Asbestosis

2. 1955 Richard Doll Asbestosis / Lung Cancer
   Found an elevated incidence of lung cancer in asbestos factory workers in England exposed prior to the regulations enacted in the early 1930's

### D. 1960's

See PowerPoint Slides

E. **Mesothelioma**
See PowerPoint Slides

II. **DEFENSE THEMES**

A. **Utility of Asbestos** – The jury needs to understand that asbestos was an extremely valuable mineral utilized in over 3,000 different products.

"Asbestos usefulness as an industrial material must be considered in order to understand the breadth of its consequent public health impact. Since its discovery as an indestructible material centuries ago, it has found countless applications, often because no identified substance rivals its engineering or commercial performance."

"Asbestos applications result from its many unique physical attributes. Its high tensile strength stabilizes mixtures with concrete, asphalt and plastic. Asbestos also offers a stable material for frictional use, that is, as a brake surface. Because of the length and pliability of its fibers, it has been incorporated into specially manufactured products, including gaskets, pads, fabric sheets, and asbestos paper with intrinsic properties of resistance and strength. Because it blocks heat transfer and is itself fireproof, it represents an ideal insulation material." Greenburg and Darcey, "Chapter 2, Occupational and Environmental Exposure to Asbestos in Pathology of Asbestos Associated Diseases, Roggli, Greenberg & Pratt (eds.) at 19 (1992)

See generally Alleman and Mossman, "Asbestos Revisited," Scientific American 70 (July 1997):

"The magnitude of the crisis, however, clouds a crucial irony: the problem with asbestos would never have grown so bad had we not previously thought the material was so remarkably good.... Asbestos insulation products not only saved energy but also shielded workers from potential burns. Brake shoes and clutch facings improved safety on racecars and school busses; efficient asbestos air filters were used in hospital ventilators, cigarette tips and military gas masks. Indeed, a poignant paradox of the asbestos story stems from its previous image as a guardian of human safety."

B. **Place Events in Historical Perspective**

A jury needs to be brought back in time so they understand the context in which various events regarding asbestos products occurred. Some examples of events and items of interest at various points and time are set out below as examples:

**1924**

- U.S. Army Aviators complete first around the world flight; covering 26,103 miles in 351 hours and 11 minutes flying time over 175 days.
- Wheaties breakfast cereal is introduced
- First disposable handkerchiefs, later named Kleenex, are sold
- A basic Model-T Ford sells for $290

## 1930

- Stock Market Falls 50 points; Mob Boss Al Capone opens soup kitchen in Chicago
- Life expectancy is 59.7 years
- 1930 prices: average income $1,973; new car average price $610; new house $7,146; loaf of bread $.09; gallon of gas $.10
- 3M introduces Scotch Tape
- Song "Georgia On My Mind" is popular
- U.S. Veteran's Administration established
- First Bird's Eye Frozen Vegetables; few homes have electric refrigerators or freezers
- Bobby Jones "grand slams" winning all four World golf titles (British Open, U.S. Amateur, British Amateur and U.S. Open)
- Dashiell Hammett's novel, The Maltese Falcon is published, featuring Sam Spade, the cynical private eye

## 1938

- Fiberglas industry founded with the first practical process for producing fiberglass commercially
- German troops seize Austria on March 12, 1938
- Hitler's demands accepted at the Munich Conference. Chamberlain declares he has secured "peace for our time"
- H.G. Wells' War of the Worlds is dramatized on CBS' Mercury Theater Radio. Although presented as a simulated news cast, nearly two million radio listeners believed they were hearing a real news announcement and hundreds of thousands fled their homes. Terror stricken people in cars and on foot brought New York's Riverside Drive to a standstill.
- Bugs Bunny makes his screen debut
- Nylon is patented; the next year the toothbrush is the first commercial product to use nylon.
- Action Comics introduces Superman
- The 40-hour workweek is established in the U.S.

## 1946

- GI Bill helps returning veterans ease back into civilian life
- First bikini debuts in Paris
- Estimates put lives lost in war at 35 million, plus 10 million more deaths in Nazi concentration camps
- At a medical symposium at the University of Buffalo, it is suggested that smoking and lung cancer may be linked
- CIA is established
- It's a Wonderful Life, starring Donna Reed and James Stewart appears in theaters
- Tide laundry soap is introduced by Proctor and Gamble
- Benjamin Spock, M.D., new book The Common Sense Book of Baby and Child Care is published.
- Weighing in at 30 tons, a new computer called ENIAC, for Electronic Numerical Integrator And Calculator, built by researchers at the University of Pennsylvania. ENIAC had 18,000 vacuum tubes and could accomplish 5,000 steps a second, adding, multiplying, dividing and calculating square roots. IBM, aimed to design a less powerful calculator for commercial use. It weighed 30 tons and occupied 18,000 square feet.

- Churchill gives his "Iron Curtain" speech at Fulton, Missouri, declaring that "an iron curtain has descended across the continent."
- Average income: $2,500; average price of a new car - $1,125; new house $5,600; loaf of bread $.10.

**1955**

- Battery-powered Transistor Radios an instant hit
- First McDonalds' restaurant opens in Des Plaines, Illinois
- Disneyland opens in Anaheim, California
- Swanson Frozen TV dinners introduced
- Ann Landers' launches her advice column in the *Chicago Sun Times*
- Rock-n-Roll hits the big time
- Rosa Parks, a black seamstress, worn out from a long day's work, refused to relinquish her seat on a Montgomery, Alabama bus to a white man. Her arrest led to a black boycott of Montgomery's busses and the U.S. Supreme Court threw her conviction out a year later.
- Kentucky Fried Chicken is introduced
- U.S. Government approves the Sulk Polio Vaccine in April 1955

**1960**

- John Kennedy elected President, becoming the Nation's first Catholic and second youngest president
- Alfred Hitchcock's thriller Psycho keeps people out of showers
- Felt-tipped pens are marketed for the first time
- Drinks are first packaged in aluminum cans
- The Andy Griffith Show and The Flintstones air on TV
- Birth control pills first placed on the market
- American Heart Association issues a report attributing higher death rates among middle aged men to heavy smoking of cigarettes.
- Arnold Palmer wins U.S. Open Golf Championship.
- Nixon and Kennedy square off in the first televised presidential debate
- Average income: $5,199; average price of a new car $2,610; average price of a new house $12,675; life expectancy 69.7

**1964**

- President Lyndon Johnson's promise of a "Great Society" becomes the most ambitious collection of social changes since The New Deal.
- Plans for the new World Trade Center in New York City are announced
- Martin Luther King receives the Nobel Peace Prize
- The Beatles transform pop music
- America's first disco opens in Los Angeles on Sunset Strip
- Sidney Poitier becomes the first black to win the Oscar for best actor for his role in Lilies of the Field
- Ford introduces the Mustang
- Motown's Supremes are hot
- CBS airs Gilligan's Island
- U.S. Surgeon General report on smoking issued.

- Civil Rights Act of 1964 signed into law, striking down discrimination based on race, creed, national origin or sex.
- The Academy Awards: Best Picture - My Fair Lady; Best Actor – Rex Harrison for My Fair Lady; Best Actress, Julie Andrews for Mary Poppins.

## C. Optimism that dust control will reduce / eliminate asbestos related disease

This was a pervasive theme in reports, articles and textbooks published in the medical and scientific literature in the 1930s through the 1950s. Several representative quotes are included in the Power Points.

Merewether 1930; 1933; 1934
Wood and Gloyne 1934; Gloyne 1935
McPheeters 1936
Lanza 1938; 1939
Dreessen 1938
Wyers 1949
Smith 1952
Schepers (1959)

## D. Since the 1930s, there was a general consensus that a safe limit of exposure to asbestos existed and for more than 20 years, it was thought to be five million particles per cubic feet of air

1) Dreessen 1938: The U.S. Public Health Service Report by Dreessen which studied asbestos textile factory workers published in 1939 first suggested a tentative safe level of exposure to asbestos of 5 million particles per cubic foot of air.
2) 1942: An ACGIH (American Conference of Governmental Industrial Hygienists) subcommittee on threshold limits presented the 5 mppcf TLV standard, although it was not formally adopted by the ACGIH at that time.
3) 1946 – ACGIH Adopted a comprehensive list of threshold limit values (initially defined as maximum allowable concentrations) and included a safe limit for asbestos exposure of five million particles per cubic foot of air.
4) Threshold limits defined. The TLVs were published annually by the ACGIH and defined in the preamble: Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations. They represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. The values listed refer to time-weighted average concentrations for a normal workday. Threshold limits for 1961, ACGIH (1961)
5) Threshold limit values, including the safe limit for asbestos dust, were ultimately adopted by a majority of states and incorporated into safety regulations, which applied to all employers.
6) It is important to remember that TLVs were time-weighted averages for an eight hour workday. Workers could be exposed to levels above the threshold limited value so long as they were exposed to levels below the TLV such that the average remained below the 5 mppcf for an 8 hour day.
7) It was a general consensus that even insulators were exposed to concentrations of asbestos below the 5 mppcf TLV:
-Fleicher/Drinker 1946

-Marr 1964
-Selikoff 1964
-Keane and Zavon 1966
-Balzer and Cooper 1968
-Murphy 1972
-Nicholson 1972, 1976

8) The ACGIH TLV for asbestos dust remained five million particles per cubic foot of air until the late 1960s when the ACGIH proposed that it be reduced to two million particles per cubic foot of air or 12 F/CC. That was never formally adopted and the ACGIH officially reduced the TLV in the early 1970s to 5 F/CC:

| Authoritative Body | **Underlying Standard Setting Philosophy** |
|---|---|
| **ACGIH** | "...airborne concentrations of substances...under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects." |
| **OSHA Standards** | ...the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by the standard for the period of his working life. **(OSHA Act (Pub. Law 91-596)) Sec.6(b)(5)).** |

**Table 4 – Standard Setting Philosophy**

Lawrence Birkner, "Historical Perspective: The Role of Industrial Hygiene in Asbestos Products and Premises Liability Litigation" DRI Asbestos Personal Injury Seminar, November 12-13, 1998 at page C-18.

| **Year** | **<1969** | **1969** | **1971** | **1972-1973** (12/7/71)** | **1976** | **1986** | **1994** |
|---|---|---|---|---|---|---|---|
| **Accepted Safe Exposure Limit f/cc** | 5mmpcf<br>est. 30f/cc | 12 | 12/10 | 5 | 2 | 0.2 | 0.1 |
| **Accepted Safe Cumulative Exposure for 50 year working life in f/cc-years** | 1500 | 600 | 600/500 | 250 | 100 | 10 | 5 |
| **Standard formulated to prevent** | Asbestosis | Asbestosis | Asbestosis | Cancer | Cancer | Cancer | Cancer |

| Year | <1969 | 1969 | 1971 | 1972-1973** (12/7/71) | 1976 | 1986 | 1994 |
|---|---|---|---|---|---|---|---|
| **Authoritative Body** | USPHS ACGIH | Walsh-Healy ACGIH* | OSHA | OSHA ACGIH | OSHA ACGIH | OSHA ACGIH | OSHA ACGIH |
| *12f/c proposed by ACGIH – never formally adopted<br>**Adopted by ACGIH in 1973 | | | | | | | |

"Setting Philosophy," DRI Asbestos Personal Injury Seminar, Id. at p. C-19.

Ways in which to graphically illustrate the accepted safe limits of exposure to asbestos dust can be found in the power points below.

9) Its important for the jury to understand how influential the ACGIH threshold limited values were in setting worker standards with the objective of protecting workers from toxic exposures:

"Threshold limit values (TLV) had extensive use in limiting exposure of workers to toxic substances. They have evolved from crude standards designed primarily to prevent fatalities to sophisticated levels used upon detailed toxicological and metabolic considerations."

W.J. Nicholson, "Asbestos – The TLV Approach," 271 New York Academy of Sciences 152 (1976)

See generally Jeffrey Paull, "The Origin and Basis of Threshold Limit Values," American General of Industrial Medicine 5:227-228 (1984):

"In the brief time since the American Conference of Governmental Industrial Hygienists (ACGIH) first published its proposal list of TLVs in a 1950 scientific journal, the impact of these values on the field of occupational health has been enormous. The TLVs have served as useful guides to individuals within industry, labor and government: they have been incorporated into U.S. safety and health legislation and the health codes of many other countries, and provided occupational health professionals throughout the world with an invaluable mechanism to assist in the evaluation and control of occupational health hazards." Id. pp. 227-228.

E. **The role of the government (both state and federal) needs to be emphasized.** At no time prior to the 1970s did the government propose banning the use of asbestos but in fact embraced the belief that asbestos could be controlled and asbestos safely utilized in hundreds of products.

1) 1930 Merewether Report – British Inspector of Factories – led to regulation of factories, which did not include insulation workers, in Great Britain.
2) 1936 Walsh Healey Federal Act stated that contracts in excess of $10,000 must contain stipulations that the working conditions of contractor's employees must not be unsanitary, hazardous, or dangerous to health and safety.
3) 1938 U.S. Public Health Service – Dreessen study – suggested safe levels of asbestos exposure to be 5 mppcf.
4) 1946 – ACGIH adopts a comprehensive list of TLVs.

5) 1946-early 1970s - TLVs adopted by a majority of states
6) 1947 BUMED Navy safety regulations.
7) 1952 Department of Labor incorporates ACGIH TLVs into federal regulations under Walsh Healey.
8) 1955 BUMED (Bureau of Medicine and Surgery for the U.S. Navy) adopts asbestos TLV as part of Navy regulations.
9) 1960 - U.S. Maritime Commission adopts regulations for shipyards which include ACGIH TLV lists as part of regulatory scheme.
10) Through the 1970s - The United States government maintained a stockpile of asbestos and continues to sell surplus asbestos without warning labels.
11) 1970 - Occupational Safety and Health Act signed into law by President Nixon.
12) 5/29/71 – OSHA adopts Walsh Healey asbestos standard with PEL of 12 F/CC.
13) 12/17/71 – OSHA issues emergency temporary standard of 5 F/CC for a 8-hour TWA and 10 F/CC for a fifteen minute period – peak exposure limits.
14) 6/7/72 – After formal rule making, OSHA issued permanent asbestos standard with a PEL (permissible exposure limit) of 5 F/CC and 2 F/CC after four years. (1976)
15) July 1976 – TWA PEL reduced to 2 F/CC.
16) 1986 – OSHA adopted action level at .1 fiber per cc and PEL of .2 F/CC.
17) July 1989 – EPA phase out regulations published calling for a three-stage ban on further stage of asbestos products.
18) July 1991 – Fifth Circuit Court of Appeals invalidated July 1989 EPA regulations as applied to friction materials, gaskets, floor tile, coatings and mastics, etc.
19) August 1994 – OSHA reduced PEL caps to 0.1 F/cc

## F. Warning Labels

1) At no time did the ACGIH Labeling Committee recommend warning labels on asbestos products.
2) In the mid 1950s, the United States Navy adopted a program for warning labels on hazardous materials, but does not include asbestos.
3) No warning label mandated by the federal government on any asbestos containing product before 1972.
4) The 1972 OSHA warning requirement exempted products that didn't produce dust in excess of the PEL. (See PowerPoint for quotes).

## G. Fiber Types and Disease – State-of-the-Art

The common thread woven through the published medical and scientific literature since the 1930s was initially a notion that the British and American asbestos health experience was different. This later crystallized upon further evidence into a merging consensus that amphibole was more hazardous than chrysotile asbestos.

### 1. Pre-1960 Studies and Commentary

The first Canadian evaluation of the potential hazard posed by asbestos exposure appeared in the Canadian Public Health Journal in 1930. After referring to the first cases of pulmonary asbestosis reported in England, Dr. Pedley noted the absence of cases from the Quebec mining region of Canada where chrysotile was mined:

> To our knowledge, however, no case of pneumoconiosis has been reported from asbestos from Canada, and the general impression among miners is that dust is not hazardous.

After describing the mining and milling process, Dr. Pedley again emphasized:

> As mentioned above, however, it is the general impression, both among miners and physicians, that asbestos dust is not particularly harmful. There can be little doubt, however, that the disease, asbestosis, is a clinical entity, and it has been recognized by the English authorities to the extent of its inclusion as a compensable disease."

The author concluded by noting:

"From the public health standpoint, however, it seems hardly likely that asbestosis will become of importance either from the standpoint of morbidity or mortality."

**Pedley, Frank, "Asbestosis," Canadian Public Health Journal, 21:576-577 (1930).**

**Lanza, A.J., "Effects of the Inhalation of Asbestos Dust on the Lungs of Asbestos Workers," Public Health Reports, 50(1), 1935.**

In reporting the results of an epidemiological study and industrial hygiene survey undertaken by MetLife of asbestos mines and mills in Quebec, Canada and in fabricating plants in the eastern United States, Dr. Lanza made the following conclusions, among others:

(1) Prolonged exposure to asbestos dust caused a pulmonary fibrosis of a type different from silicosis and demonstrable on x-ray films. Clinically, from this study, it appears to be of a type milder than silicosis.

. . .

(3) a predisposition to tuberculosis due to asbestos dust was not indicated in the study.

(4) Asbestosis as observed in this series of cases had not resulted in marked disability in any case. **Id. at 11.**

**A.J. Lanza, "Asbestosis," Journal of the American Medical Association, 5(106):368 (1936).**

"In our studies of asbestos mines and fabricating plants, the clinical picture of asbestosis was milder than that of silicosis."

> One feature that has impressed us is that the British investigators found asbestosis more severe and more menacing that we did. This difference may be more apparent than real, but it is possible that the English factories may be more dusty than ours.

**A.J. Lanza, chapter XIII - "Silicosis and Asbestosis," in A.J. Lanza, ed., Silicosis and Asbestosis (Oxford University Press, London/New York/Toronto 1938).**

Asbestosis is found in the United States in industrial plants where asbestos is fabricated. . . . From a public health standpoint, the asbestosis problem is much less complex than silicosis. Not only is the number of persons exposed to asbestos far less, but the processes involved are much fewer, less variegated, and in the main more readily amenable to dust prevention methods. Reports of the United

States Public Health Service indicate that if the dust concentrations can be kept below five million particles per cubic foot of air, cases of asbestosis will not result.
**Id. at 386.**

The control of asbestosis in an industrial establishment is similar to that of silicosis. Unfortunately, dust control measures are practicable and have been vigorously carried out by asbestos manufacturing companies, and it is probable that there may be little opportunity for the clinician to become familiar with this occupational disease.
**Id. at 389.**

**Lanza and Goldberg, Industrial Hygiene, Oxford University Press: New York (1939).**

"From the public health standpoint, the asbestosis problem is much less complex than silicosis."
**Id. at 386.**

**Heatley, George, Tuberculosis and Asbestosis: Report of Metropolitan Life Insurance Company (1944).**

This was an epidemiologic study to determine whether there was a causal relationship between asbestos exposure and tuberculosis, after the TB mortality in the Thetford Mines chrysotile mining region of Quebec almost doubled between World War I and World War II. The study confirmed that the mortality for tuberculosis was higher in the Thetford area than in the province as a whole, but an equally high tuberculosis mortality was also found in a control area of Rimouski, where no asbestos mining or manufacturing operations were located. The investigators also found that women in the Thetford area had equal or higher tuberculosis mortality than did men, although mostly men were employed in the dusty areas of the mines. The investigators concluded that "there was no indication from this mortality study that asbestos mining per se in Thetford Mines is the cause of the high tuberculosis mortality."

**Smith, William E., "Survey of Some Current British and European Studies of Occupational Tumor Problems," AMA Archives of Industrial Hygiene and Occupational Medicine, 5:242-262 (1952).**

All of the 17 individuals with asbestosis and lung cancer were exposed before 1932. According to Dr. Merewether, the additional three cancer patients studied by Dr. Harrison were likewise exposed before 1932. **I specifically inquired of Dr. Merewether whether any cases of co-existent lung cancer and asbestosis had been reported in individuals whose exposure had taken place only since 1932. He stated that only one such case has been reported:** that of a man employed in the industry between 1935 and 1945. This single case might well be expected as part of the 'normal' incidence of lung cancer in any group as large as that employed in the asbestos industry.
**Id. at 253.**

It was the consensus that a lung tumor hazard formerly existed in this industry in Great Britain but that **there is no evidence to show that such a hazard continues to exist under the working conditions now prevailing.**
**Id. at 253.**

**A.J. Lanza, "Asbestosis," presented at the Fourth Conference of the McIntyre Research Foundation on Silicosis, Quebec (January 1952).**

Asbestosis, I would like to point out, is the only silicate dust capable of producing disability and death that does so to any marked or appreciable extent. The total number of persons involved in the industry probably does not exceed 12,000 and as far as can be borne out by clinical experience, tuberculosis is not a factor in this disease. Ever since the survey was started in 1930 the industry has carried on strenuous measures to control the dust in mine, mill, and factory with a very marked degree of success. It would seem, therefore, there will never be available the clinical experience of asbestosis that has been a marked feature of silicosis in various industries throughout the world.

I would also like to point out that the experience with asbestosis in England appears to differ sharply with that in Canada and the United States. The authorities in Great Britain regard asbestosis as a very serious disease, much more so than silicosis, and they seem to be convinced that cancer of the lungs is a frequent sequela. This is not the experience in either Canada or in the United States. A great deal of information is available from the medical departments of the various industries that have for a long time maintained constant roentgenographic examinations of asbestos workers which, coupled with the efforts at dust control, may explain the difference in clinical findings. As far as we have been able to ascertain, there does not seem to be any undue prevalence of cancer among asbestos workers in this country and, as some of the mines and fabricating plants have been working extensively for over 30 years, it would seem that if cancer was a frequent complication of exposure to asbestos dust, this fact would have become evident long ago, especially as the medical supervision of asbestos workers is both thorough and comprehensive. I have, within the last couple of months, spent several days with Dr. Kenneth Smith in Asbestos reviewing a great many films covering a period of a number of years and I understood him to say that he had seen only one case of cancer of the lungs during that time. Dr. Cartier at Thetford has found only a very small number of cases of cancer of the lungs in the asbestos clinic in Thetford.

**Dr. Paul Cartier, "Asbestos Miners," paper presented at the Pneumoconiosis and Pulmonary Cancer Section of the Seventh Saranac Symposium, Saranac Lake, New York, September 24, 1952.**

In 1950, the concept of an inhalation of asbestos fibers and pulmonary cancer was mentioned by many investigators and it was at that moment that the medical adviser of the Quebec Asbestos Mining Association, saw advantages for the employees and the employers, to recommend a company investigation composed of an epidemiological and experimental study. This report is part of this study.
**Id. at 382**

. . .

In conclusion, this paper hasn't been, by any means, the intention to bring the final answer to the problem of the final relation between of inhalation of asbestos fibers and the development of pulmonary cancer, but I think that this incomplete study, I must admit, may have found one of the most representative groups of asbestos workers, believing that the data collected in Thetford Mines do not seem to indicate a causal relationship, and that if it be so, that the data do not correlate the data of Dr. Merewether in Great Britain.
**Id. at 390**

**Remarks of Dr. A.J. Lanza at the Pneumoconiosis and Cancer Session of the Seventh Saranac Symposium, September 24, 1952.**

- I was very much impressed with what Dr. Merewether said, and there is no question but what a very careful, painstaking job has been done in Great Britain on the subject of trying to determine what the hazard might be in the asbestos industry with respect to cancer.

- There are just a couple of comments, I'm not saying one way or the other, that it may or may not influence the incidence of cancer. I would raise a couple of points which I think all of us might keep in mind, and which might possibly have some bearing on the situation in England.

- Now, I have visited somewhat extensively, I think, nearly all the asbestos plants of the United States, and the mines and mills in Canada and have spent quite a lot of time there, and have spent a lot of time reviewing films, and not long ago, spent several days with Dr. Kenneth Smith on Asbestos, reading his films.

- **I find it difficult to believe that our cancer incidence among asbestos workers could be anything like as large as it seems to be in England**, because while I am perfectly free to admit that we may have missed cancer cases which we should have not, on the other hand, I don't think we could have missed all of them if they had occurred, into the same extent that apparently they do in England.
. . . . .

- Now, back of that, there is still one more question. That is the nature of the asbestos itself. Now, when I first used to go to Canada, I used to hear frequently that, up there, that the Canadian asbestos was less damaging than the kind they used in England, I believe, and I have put that comment down to what we might call the national or local patriotism, you know, like the rivalry between towns, so that you so frequently see, but the fact remains the same, that in this country, we do use the asbestos, mostly the asbestos that we get from Canada, and I believe, from what I hear from our English friends, that a great deal, if not the major part of the asbestos used in England, is Rhodesian asbestos, which is quite dissimilar in its construction and its formation, its physical characteristics, to the kind that comes from Thetford and from Asbestos in Canada.

- Now, that may have nothing to do with it, and up until two or three years ago, I dismissed that. I thought that was just purile, but since we have in the last few years, learned that different types of silica, for instance, produce entirely distinct pathological effect, I am beginning to wonder if we have not failed to pay sufficient attention to the type of asbestos which varies even, as I am informed, there is a difference between the asbestos that is mined in the town of Asbestos and the kind that is mined not far away in Thetford. And yet both of these, in turn are quite different from the asbestos that come from Rhodesia, and possibly from other parts of the world with which I am not acquainted.

  And, having in mind the lesson we have learned in the silica dust, I think that there is something perhaps that we should pay more attention to. Now, I simply raise that point, because I think it may have a great deal more significance than we have been inclined to give it.
  **Id. at 406-408.**

**Dr. A.J. Vorwald, "Occupational & Environmental Pulmonary Cancer with Special Reference to Pneumoconiosis," South America lecture, March 1953 (Historical Achieves--National Museum of Health & Medicine, Armed Forces Institute of Pathology).**

**Smoking**

With respect to smoking, there are a number of studies which have been well set up from a statistical point of view which show a strong association between prolonged heavy smoking of cigarettes in particular and the occurrence of pulmonary cancer.

**Cancer of the Lung and its Relation to Specific Industrial Agents**

The establishment of firm causal connection between environmental influences of industrial origin and the development of cancers of the respiratory tract in industrial workers depends upon the demonstration of definite and significant statistical and causal relationship between exposure to specific environmental or occupational agents and/or working conditions and the subsequent appearance of cancers of the respiratory tract.

. . .

**Asbestos**

The coexistence of asbestosis with cancer of the lung has been observed by a number of investigators. Many investigators, particularly Merewether in England, support the view that there is a causal relationship between the inhalation of asbestos fibers and pulmonary cancer. Other investigators, however, are quite skeptical and demand unequivocal evidence of such a relationship. Studies by the Saranac Laboratory, involving a large number of asbestos workers and many experimental animals exposed to asbestos dust, failed to support a causal relationship. [emphasis added]

**Herbert E. Stokinger, "Toxicological Aspects of Occupational Hazards," chapter in Rytand, David A. and William Creger, Annual Review of Medicine, 7:177-194 (Stanford, California: Annual Reviews, Inc., 1956)**

Dr. Herbert Stokinger was the chief toxicologist for the United States Public Health Service and served as chairman of the TLV Committee for the American Conference of Governmental Industrial Hygienists. In this article, he contrasted the experience in the United States and Canada versus England insofar as lung cancer and asbestos workers was concerned:

> It is of more than passing interest that **the higher rate of cancer in asbestos workers in England is not paralleled in the United States or in Canada**, according to Lanza. The cause for this difference may lie in the type of asbestos; asbestos is a fibrous form of several different species of minerals, a point often disregarded.
> **Id. at 178.**

**Braun, D.C. and Truan, T.D., "An Epidemiological Study of Lung Cancer and Asbestos Miners," AMA Archives of Industrial Health, 17:634-653 (June 1958).**

Braun and Truan reported the results of a comprehensive epidemiological investigation including all of the asbestos mining companies in Quebec undertaken by the Industrial Hygiene Foundation in Pittsburgh with the help of the Department of Health of the Province of Quebec. Every miner of five or more years of employment was included in the resulting cohort of approximately 6,000 workers and was

compared with the whole population of the province of Quebec for the mortality of carcinoma of the lung. The authors concluded that:

> The asbestos miners in the province of Quebec do not have a significantly higher death rate from lung cancer than do comparable segments of the general population. Furthermore, the death rate from lung cancer in the areas contiguous to the asbestos operations is comparable to that in areas widely scattered throughout the province of Quebec and is lower than in some urbanized areas within the province.

B. 1960 - 1970's

**J.C. Wagner, C.A. Sleggs, and Paul Marchand, "Diffuse Pleural Mesothelioma and Asbestos Exposure in the Northwestern Cape Province," British Journal of Industrial Medicine, 17:260 (1960).**

In this seminal article, Dr. Wagner and his associates reported upon 33 cases of pleural mesothelioma in individuals with suspected exposure to crocidolite asbestos (Cape Blue). All of these case reports involve mesothelioma of the pleura. The authors noted that the observed mesotheliomas were in individuals with probable exposure to Cape Blue crocidolite asbestos. However, in the Transvaal District, they had not located any mesothelioma in either the amosite or crocidolite mines in the Transvaal area. While Wagner's study is frequently cited for establishing a causal association between crocidolite asbestos and the development of mesothelioma, Dr. Wagner was more cautious in describing the results of this study:

> The pathological evidence for associating these tumors with asbestos exposure is not conclusive. As previously stated, only in 8 of the 33 cases has evidence of asbestos been demonstrated. . . . In the remaining 25 cases we can only present circumstantial evidence of exposure to asbestos dust. Eighteen of these 25 cases were born in the vicinity of the mines and two arrived in the district as infants.
> **Id. at 269.**

**Rutherford T. Johnstone and Seward E. Miller, Occupational Diseases and Industrial Medicine (W.B. Saunders Company, 1960).**

> **In the United States, particularly since the studies of Braun and Truan, there is considerable conviction that asbestosis does not predispose to the development of lung cancer.** Until further evidence is forthcoming, we have arbitrarily placed asbestos in the unproved or doubtful group and arsenic in the suspected group.
> **Id. at 328.**

**Rutherford T. Johnstone, "Questions and Answers: Silicosis and Cancer," [Letters to the Journal], JAMA, 176:81 (April 8, 1961).**

> Of the several silicates, asbestos is held in suspicion, especially in Great Britain. **In the American literature there is no evidence that there is a relationship between asbestosis and lung cancer.** The reason for the difference between the English and American experience is not apparent. It may be due to a difference in the types of asbestos fiber or to the total dosage.

**American Medical Association, Council on Occupational Health, Committee on the Pneumoconioses, "The Pneumoconioses -- Diagnosis, Evaluation, and Management," Archives on Environmental Health, 7(2):130-71 (1963).**

In this very detailed statement issued by the Committee on the Pneumoconioses of the Council on Occupational Health of the American Medical Association, a number of pneumoconioses are discussed, including asbestosis, with Dr. Arthur J. Vorwald providing a written analysis of pathogenesis and pathology, among others. Other committee members, included Edgar Mayer, M.D., George W. Wright, M.D., O.A. Sander, M.D., and Eugene P. Pendergrass, M.D. The committee in its statement expresses reluctance to confirm a causal relationship between asbestos and lung cancer, and it vaguely points to differences in fiber type:

> The relationship between cancer of the lung and asbestosis constitutes a problem of great current interest. There is no doubt that the two diseases appear in the same lung. Whether that occurrence is one of mere coexistence, or of direct cause-and-effect relationship cannot be resolved on the basis of a single case. The total body of evidence favors a relationship, especially as it involves certain kinds of asbestos and possibly only those which contain specific chemical substances having the capacity to cause cancer. Attention is invited to experiences in the Union of South Africa where pleural mesotheliomas have been discovered in an appreciable number of persons exposed to the inhalation of crocidolite-amosite asbestos. Certainly, detailed epidemiological, clinical, and experimental studies are required for ultimate resolution of the problem.
> **Id. at 153.**

**Kenneth W. Smith, M.D., "Chapter 2 - Asbestosis," in A. J. Lanza, M.D., ed., The Pneumoconioses, Brown, Grune & Stratton: New York (1963).**

> Some observers in the past few years have associated various conditions such as lung cancer, bronchiectasis, emphysema and bronchitis with the asbestos worker. No attempt was made to associate the disease with the clinical, radiological and pathological entity known as asbestosis. The occupational title of the individual was sufficient to associate a certain disease with the asbestos fibre. Clear-thinking and diligent authors have associated other pulmonary diseases with asbestosis. It is unfortunate that less accurate authors have generalized their comments and thereby confused intelligent readers. Perhaps with more accurate reporting the alleged association of inhalation of asbestos fibre and other intercurrent disease conditions would be clearer today. It is entirely possible that the asbestos fibre may be a carcinogen, or a co-carcinogen. However, the true relationship will remain obscure until responsible reporters can evaluate the relationship between agent and disease and not just job title and disease.
>
> This author's experience has extended over a period of eighteen years, during which time over 50,000 physical examinations and chest x-ray films have been observed among workers in the asbestos mining, milling and fabricating operations. **Among these workers, who were exposed only to chrysotile fibre, there were no more cases of pulmonary malignancy than among the general population.**
> **Id. at 24.**

**"Asbestosis: Report of a Section on Nature and Prevalence, Committee on Occupational Diseases of the Chest, American College of Chest Physicians," Diseases of the Chest, 45:107 (Jan. 1964).**

The report was prepared by the Section on Nature and Prevalance, John W. G. Hannon, Chairman. Other committee members included Dr. Gerritt Schepers, Dr. Reginald Smart, Paul Cartier, and Peter Theodos, Chairman, Committee on Occupational Diseases of the Chest. In describing possible sequelae and complications, the Committee made the following observation:

> In the medical literature, there are more articles favoring a positive relationship between cancer of the lung and asbestosis than denying it. While it has been reported that there may be an enhanced prevalence of pulmonary neoplasia in some asbestos industries (e.g. crocidolite or amosite), or in some locations (e.g. South Africa, England), this does not appear to apply for the chrysotile industry in North America. This comment applies both with respect to intrapulmonary new growths and to pleural mesothelioma.
> **Id. at 109.**

**"Report and Recommendations of the Working Group on Asbestos and Cancer," International Union Against Cancer (UICC), 1964.**

This working group met at the close of the New York Academy of Sciences Symposium on Asbestos in 1964 and issued a report with recommendations on future research. Among its recommendations were a number dealing specifically with fiber type and disease:

Recommendations on problems requiring epidemiological study.

1. that the importance of fiber type on the risk of development asbestosis, carcinoma of the lung, and mesothelial and other tumors be investigated.

2. international and intranational comparative studies of mining and other populations exposed to only one type of fiber are recommended. Among the countries and between which studies should, if possible, be made are:

| | | |
|---|---|---|
| Australia | - | Crocidolite |
| Canada | - | Chrysotile |
| Cyprus | - | Chrysotile |
| Finland | - | Anthophyllite |
| Italy | - | Chrysotile |
| South Africa | - | Amosite, Chrysotile, Crocidolite |
| U.S.A. | - | Chrysotile, Tremolite |
| USSR | - | Chrysotile |

The studies of the effect of exposure to different types of fiber within a country are likely to be of special value, but studies of groups exposed to apparently similar fibers in different parts of the same country are also likely to be informative.

## The Association of Exposure to Asbestos Dust and Cancer

The main types of asbestos of commercial interest are amosite, anthophyllite, chrysotile, crocidolite, and tremolite. There is evidence of an association between exposure to asbestos and malignant neoplasia.

This has been established mainly on information from Germany, Italy, South Africa, the United Kingdom, and the United States.

Present evidence indicates that the associated carcinomas of the lung are not limited to exposure to any one type of asbestos fiber. However, further investigations are urgently needed to establish whether the degree of risk is importantly related to the type of fiber inhaled.

In the case of mesotheliomas evidence from several countries suggests that exposure to crocidolite may be of particular importance, but it cannot be concluded that only this type of fiber is concerned with these tumors, and further investigation of this problem is needed.

**"Objectives and General Plan for Occupational Health Study of the Asbestos Products Industry," Division of Occupational Health, United States Public Health Service (1964).**

While noting that asbestos workers have been the subject of numerous studies, the U.S. Public Health Service noted that many important questions remain unanswered:

> While some of the reports strongly suggest that lung cancer is an occupational hazard of asbestos workers, the literature in this respect is by no means unanimous and the data are often conflicting.
>
> Several factors may account for this apparent discrepancy in the technical literature. Diagnostic criteria for asbestosis are often poorly defined, making valid comparisons of studies difficult, if not impossible. Conclusions are too frequently applied to a broad classification encompassing all asbestos workers and are not confined to the group under investigation. . . . No clear attempt is made to define exposures to different asbestiform minerals or associated materials. Mortality studies often encompass a broad multi-exposure group and do not relate to a specific and single exposure. Despite the accumulated knowledge, the following questions remain unanswered:
>
> 1. What is the prevalence of pneumoconiosis in asbestos workers actively employed in the asbestos-products industry?
>
> 2. What is the significance of exposure to different sources and forms of asbestos and to other materials commonly employed in this industry in the development of pneumoconiosis?
>
> 3. What is the role of non-occupational respiratory disease in the development of pneumoconiosis?
>
> 4. Are malignancies occupational risks of the asbestos worker in the asbestos-products industry? If so, what are the important etiological factors?
>
> 5. What other diseases, if any, may be associated with exposure to asbestos or other materials commonly used in the asbestos products industry?
>
> 6. What are the safe levels of exposures to the various materials in this industry that constitute health risks?
>
> To secure answers for these questions, the Division of Occupational Health proposes a comprehensive study of the asbestos products industries in the United States.

**Editorial, "Asbestosis and Malignant Disease," New England Journal of Medicine, 272:590-91 (March 18, 1965).**

It is important for the physician, not trained as a geologist, to know that to date most of the exposures causing mesotheliomas have been from crocidolite, one form of asbestos. Data in the present article confirms the fact that exposures to a mixture of materials, one of which is chrysotile, another form of asbestos chiefly used in the United States, are correlated with an increase in the incidence of mesothelioma. Amosite, the third commercially used form of asbestos, has yet to be incriminated but there are not definite studies to date to confirm or deny such a connection.
**Id. at 590.**

**Ian Webster, "Mesotheliomatous Tumors in South Africa: Pathology and Experimental Pathology," Annals of the New York Academy of Sciences, 132:623-646 (1965).**

During the meeting on the biological aspects of asbestos in October 1964 sponsored by the New York Academy of Sciences, Dr. Ian Webster followed up on the incidence of mesothelioma in South Africa. A number of additional cases had been reported in the five years following Dr. Wagner's first report; however, they were also limited in association with exposure to Cape Blue crocidolite asbestos in the Northwest Cape province. In discussing causation for this tumor, Dr. Webster made special note of the fact that no mesotheliomas were found in people exposed to amosite nor to the Transvaal blue asbestos. Dr. Webster provides the following conclusions:

> Although the association of peripheral tumors of the respiratory tract appears to be related to the inhalation of asbestos, particularly crocidolite, there are sufficient points against this to suggest that the situation be reviewed continually and that other possible factors cannot yet be excluded. Although the exact classification of these peripheral tumors is difficult, this does not detract from the high incidence of such tumors in certain areas of South Africa where asbestos is mined, milled or processed.
> **Id. at 645.**

**J.C. Wagner, "Epidemiology of Diffuse Mesothelial Tumors: Evidence of an Association from Studies in South Africa and the United Kingdom," Annals of the New York Academy of Sciences 132:575 (December 31, 1965).**

A puzzling feature of the South African investigation is that although the country produces approximately the same amount of crocidolite, amosite and chrysotile (if Swaziland is included), no case of mesothelioma has been reported from either of the other areas in spite of an intensive investigation. This is particularly remarkable because on the edge of the amosite mining area, crocidolite also occurs, sometimes in the same seams. The mining and milling methods are similar and the chance of environmental exposure seems to be the same.
**Id. at 576-577.**

. . . In Britain, it has not been possible to obtain positive, clear evidence implicating a single type of asbestos as in South Africa, since the majority of cases have been exposed where several types of asbestos were used. However, definite evidence of crocidolite exposure has been established in a majority of cases, and no indisputable case of pure chrysotile exposure has yet been discovered.
**Id. at 578.**

**J.S. Harington, J.C. Gilson, and J.C. Wagner, "Asbestos and Mesothelioma in Man," Nature 232:64-65 (July 2, 1971).**

> Recent international investigations into the relationship between exposure to asbestos dust and cancers have confirmed the paradox that, although there is a clear association between the development of diffuse mesotheliomas and exposure to crocidolite dust in the Northwestern Cape, these tumors are very rare in the Transvaal where both crocidolite and the closely related amosite are mined. Sluis-Cremer has reported that none of the factors which he examined (mineralogical differences between the two areas, intensity of production, extent of environmental pollution, or asbestosis) explains satisfactorily the marked apparent difference in cancer risk from amosite and crocidolite in the Transvaal compared with crocidolite in the Northwestern Cape. The apparent lack of effect of Transvaal crocidolite led Webster and Wright to doubt that crocidolite is the important causal agent of mesothelioma in the Northwestern Cape. **Id. at 64.**

The officers then examined the possibility that there had not been a sufficient latency period since amosite had not been mined in Transvaal as long as crocidolite had been in the Northwest Cape. The officers concluded, however, that there had been a sufficient latency period. They also entertained the possibility that there had been inadequate follow-up of the population in the Transvaal region, but rejected that as an explanation for the difference in mesothelioma incidence between the two areas. The authors concluded:

> We therefore think it is highly likely that there has, in the past 10 to 20 years, been a large difference in the risk of mesotheliomas in those working in the two areas in which the closely related amphiboles are mined and milled.

**J.C. McDonald, et al., "Mortality in the Chrysotile Asbestos Mines and Mills of Quebec," Archives of Environmental Health 22:677 (1971).**

This is the first report on what has become one of the largest and most closely followed cohorts of asbestos workers in the world, namely Quebec chrysotile miners and millers, studied by researchers at McGill University led by Dr. J. Corbett McDonald. The McGill study of the Quebec chrysotile miners and millers was initiated in response to the recommendations of the UICC in 1964 and funding received from the Institute for Occupational and Environmental Health which began operation in 1966. The IOEH was established by members of the Quebec Asbestos Mining Association in 1966. An IOEH scientific committee was named which was responsible for deciding on scientific priorities to receive funding through the Institute. The McGill University epidemiologic investigation became the first project supported by the IOEH, although dozens of subsequent research projects receive funding through the auspices of the IOEH.

In this initial report, three deaths from malignant pleural mesothelioma were found among nearly 2,500 deaths from all causes in the cohort. Dr. McDonald and his colleagues noted, "This is probably more than would be expected in a comparable number of deaths in the general population, but quite out of line with the findings of Selikoff, et al., in insulation workers and those of Newhouse in a London asbestos factory." The magnitude of the difference could be inferred from comparing the percentage of deaths from mesothelioma among the three cohorts (as of this date): 5% percent of deaths in the Selikoff insulator cohort; 4.5% of deaths in the Newhouse asbestos factory cohort and .01% of deaths in the McDonald Quebec chrysotile miner/miller cohort. The authors conclude in part:

It is clear that the Quebec chrysotile workers have had nothing like the experience of the American insulation workers or the London factory workers with respect to malignant mesothelioma, and it seems unlikely that they are compatible with respect to lung cancer. These findings strongly suggest either that chrysotile is less likely to cause malignant disease of the lung and pleura than other forms of asbestos, such as crocidolite, or that workers engaged in insulation and processing are exposed to additional factors which explain the difference.
**Id. at 685.**

**Selikoff, Hammond and Churg, "Carcinogenicity of Amosite Asbestos," Archives of Environmental Health 25:183 (1972).**

Dr. Selikoff and his cohorts note that "few data exist concerning the comparative neoplastic potential in man of the several kinds of asbestos. In particular, there has been no evidence concerning whether the amosite variety is carcinogenic. The matter is of practical importance, since amosite use in the United States has sharply increased."

The authors go on to note that:

Whether or not amosite is carcinogenic is of some practical importance. Because this variety of asbestos has not been reported to cause cancer, there has been a tendency in Great Britain, for example, to substitute it for other kinds of asbestos, especially crocidolite.
**Id. at 183.**

Dr. Selikoff goes on to comment on studies in the Transvaal region of South Africa where amosite is mined:

Diligent efforts have been made to investigate the occurrence of disease in the Transvaal in South Africa, the only area in which amosite is mined, and where populations exposed to amosite could be identified. Environmental studies in this area, reported in 1964, showed no instance of mesothelioma in amosite miners and only isolated instances of carcinoma of the bronchus, although asbestosis was found.
**Id.**

Dr. Selikoff and his colleagues go on to report on the mortality experience of a group of 230 men previously employed in the Patterson, New Jersey amosite asbestos factory, noting that both lung cancer and mesothelioma were found in excess (25 lung cancer deaths where two or three were expected and five deaths from mesothelioma).

**Ian Webster, "Asbestos and Malignancy," South African Medical Journal 47:165 (1973).**

Dr. Webster reports on a series of 232 cases of diffuse pleural mesothelioma in South Africa. Almost all of those who were exposed to asbestos through work in the mining industry, had worked with Cape Blue asbestos. Two had exposure only to amosite, and one miner probably had exposure to Transvaal blue asbestos only. Dr. Webster commented:

These are all amphibole asbestos of the iron silicate type and differing only slightly in chemical composition, although the amosite fiber differs from that of crocidolite. If asbestos alone is the carcinogenic factor, surely more cases should have been found in the amosite-exposed group, which for many years must have been larger than the group exposed to Cape Blue. This suggests a peculiar property of Cape Blue asbestos, which is not shared by Transvaal Blue.

Dr. Webster concluded in part:

> It is difficult to postulate a direct relationship of crocidolite to the development of mesothelioma, where only an occasional case has been found in a population exposed to Transvaal crocidolite. Further, it is difficult to conceive of amosite in the intermediate group of the asbestos fibers causing malignancy, as suggested by Wagner, et al. [1971], when there are so few cases in employees of the amosite mines. It is even more difficult to substantiate this claim when it is realized that in the period during which exposure to these minerals first occurred in the patients with mesothelioma, the production of amosite far exceeded that of blue asbestos. It is suggested that more attention should be paid to the determination of the nature of this substance which is present in the Cape Blue areas and not in the Transvaal Blue, and apparently limited in the areas where amosite is mined. It is postulated that Cape crocidolite, and possibly amosite, must be associated with another factor before malignant change occurs. It is suggested that this factor may be another mineral, a suggestion which might account for the cases of mesothelioma in the insulation industry as the insulating asbestos may become contaminated by minerals from the hot metal with which it is in contact for many years.
> **Id. at 171.**

**Marchand, "The Discovery of Mesothelioma in the Northwestern Cape Province in the Republic of South Africa," American Journal of Industrial Medicine 19:241-6 (1991).**

Marchand first recognized the existence of mesothelioma and its apparent association with crocidolite asbestos in the Northwest cape province of South Africa, prompting the author's publication with Dr. Chris Wagner and Sleggs of the initial study in the British Journal of Industrial Medicine in 1960. In this article, the author describes his 1958 excursions with Sleggs into crocidolite mines, mills and surrounding residential areas. The high levels of environmental crocidolite are described: "The land was blue for miles around."

**Margaret Becklake, "State of the Art - Asbestos-Related Diseases of the Lung and Other Organs: Their Epidemiology and Implications for Clinical Practice," American Review of Respiratory Disease 114:187 (1976).**

In discussing the epidemiology of the association between asbestos exposure and mesothelioma, Dr. Becklake notes that there are important between-fiber differences in mesothelioma risk. With the greatest risk associated with crocidolite, less with amosite, and apparently even less with chrysotile. She also notes that with amosite and chrysotile, there appears to be a higher risk in manufacturing than in mining and milling. She notes these were the conclusions reached by the Advisory Committee on Asbestos Cancers at the Lyon, France meeting of the International Agency for Research on Cancer. (In its report of the Advisory Committee on Asbestos Cancers to the director of the IARC published as part of the Proceedings of the Biological Effects of Asbestos, IARC (1973), the Committee noted that there is evidence for an important difference in risk in different occupations and with the type of asbestos insofar as mesothelioma is concerned, with the risk greatest for crocidolite, less with amosite and apparently less with chrysotile.)

In assessing the evidence of an association between lung cancer and asbestos exposure, Dr. Becklake noted the need to pay more attention to the type of asbestos:

> As Wagner and associates point out, however, "an additional lesson to be learned from the apparent conflict of evidence is the need to pay more attention to the type of asbestos and to the

physical state of the respirable fraction of the dust" [1971] and the evidence that there are real differences in risk associated with the different fiber types, as well as the different types of exposure to the same fibers, is becoming more convincing.
**Id. at 213.**

Dr. Becklake went on to comment on the influence of fiber type and the nature of exposure on biological response:

Despite the difficulties in making between study comparisons, a consensus has emerged, outlined in a carefully reasoned paper by Kleinfeld (1973), and in the conclusion of the Advisory Committee on Asbestos Cancers (IARC, Biological Effects of Asbestos 1973), it is believed that there are gradients in the mesothelioma-producing potential, related to fiber type (greatest with crocidolite, less with amosite and with chrysotile, least with anthophyllite) and to occupation (e.g. for amosite, greatest in insulation workers compared to miners). Gradients in fibrogenic capability of the different fibers, less clear, may also be present, with crocidolite leading chrysotile, whereas gradients in lung cancer risk may be more closely related to the nature of the exposure, with production leading mining, at least for chrysotile.
**Id. at 216.**

Dr. Becklake went on to state:

At the practical level of environmental control, regulations proposed for chrysotile in 1968 by the British Occupational Hygiene Society were at a level (two fibers per cm average over three months) that it was hoped, would allow no more than 1% risk of disease (specifically asbestosis) in a 50-year working life. Evidence suggests that this would also reduce the risk of bronchogenic cancer. At the time, the British Occupational Hygiene Society was uncertain that standards for other fibers should follow "by analogy." They subsequently proposed the same standards for amosite (1973), but a standard ten times more stringent for crocidolite was promulgated by government regulation.
**Id. at 218.**

H. **Looking Back – Putting Things in Perspective**. There are a number of excellent articles which do this. A few of them are identified below:

- Alleman and Mossman, "Asbestos Revisited" Scientific America 70 (July 1997)
- Mossman, Bignon et al., "Asbestos: Scientific Developments and Implications for Public Policy," Science 247:294-300 (1990)
- R. Murray, "Asbestos: A Chronology of its Origins and Health Effect," British Journal of Industrial Medicine 47:361-365 (1990)
- William R. Barclay, "Landmark Perspective – Asbestos: An Industrial Asset with a Health Cost." JAMA 252:96 (1984)
- Selikoff, "Asbestos," Environment 11:3 (1969)
- Selikoff, "Partnership for Prevention – The Insulation Industry Hygiene Research Program," Industrial Medicine 39(4) (April 1970)
- Selikoff, "Constraints in Estimating Occupational Contributions to Current Cancer Mortality in the United States," Banbury Report No. 9, Quantification of Occupational Cancer, pp. 3-17 (Editors) R. Peton and Schneiderman, Coldspring Harbor Laboratory, 1981
- Morton Corn, "Asbestos and Disease: An Industrial Hygienist Perspective," American Industrial Hygiene Association Journal 47(9):515-523 (1986)
- William Weiss, "History of Hazards Associated with Asbestos," Pennsylvania Medicine 57-60 (June 1986)

- Phil Enterline, "Changing Attitudes and Opinions Regarding Asbestos and Cancer 1934-1965," American Journal of Industrial Medicine 685-700 (1991) (There are numerous letters to the editor which follow this publication which were also of interest)
- William Nicholson, "Remembering Irving J. Selikoff," Mt Sinai J. Med 61: (November 1994)
- J.C. Gilson, "Man & Asbestos," Annals of the New York Academy of Sciences, 132:9, 1965.

"Although pulmonary fibrosis and pleural plaques seen on chest x ray films came to be recognized as frequently being caused by inhalation of asbestos fibers, they did not necessarily correlate with disability or even with non-disabling cough and shortness of breath. Therefore, no great concern was aroused in asbestos workers, the public, industry management, or public health authorities." William R. Barclay, "Asbestos: An Industrial Asset With a Health Cost-Landmark Perspective," JAMA 252:96 (1984)

"Early reports that link exposure to a substance and the occurrence of a disease are often not generally accepted as proof of a cause-and-effect relationship. This is particularly so when a long latent period exists between exposure and the appearance of a disease. A well-designed and carefully executed study was needed to persuade physicians, public health authorities, and industrial management that asbestos was indeed a potent carcinogen. Such a study was reported by Selikoff and coworkers in 1964 and is reprinted in this issue of the journal as a LANDMARK ARTICLE." William R. Barclay, "Asbestos: An Industrial Asset With a Health Cost-Landmark Perspective," JAMA 252:96 (1984)

## I. Power Point Slides