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JAN 18 2001
DISTRICT COURT OF TARRANT COUNTY, TEXAS
Elvira S. Ortiz DEPUTY

DISTRICT COURT OF CAMERON COUNTY, TEXAS
EMILIA S. Ortiz DEPUTY

W

CAMERON COUNTY, TEXAS

**GAF CORPORATION
HOLDINGS, INC.), ET AL.**

Defendants.

197TH JUDICIAL DISTRICT

MEMORANDUM OF LAW IN SUPPORT OF MOTION *IN LIMINE*
OF DEFENDANT UNITED STATES GYPSUM COMPANY TO EXCLUDE
ARGUMENT AND EVIDENCE RELATING TO THE SARANAC EXPERIMENTS

Defendant United States Gypsum Company ("U.S. Gypsum") submits this memorandum of law in support of its motion *in limine* to exclude argument and evidence that U.S. Gypsum participated with other manufacturers in an effort to suppress certain results of the Saranac experiments. This argument is not supported by the evidence, and allowing plaintiff to so argue would irreparably prejudice U.S. Gypsum. The documents show no such conduct by U.S. Gypsum -- indeed, the documents indicate that U.S. Gypsum never was apprised of or participated in any allegedly improper conduct. The Saranac documents are inadmissible because they are irrelevant and their admission would create a substantial danger of unfair prejudice and jury confusion.⁴⁷

The purpose of the Saranac experiments was to study the manifestation of asbestosis in laboratory animals. The first step was to induce asbestosis by injection of asbestos into and the inhalation of hundreds of millions of raw asbestos fibers by a variety of animals, including guinea

1 The documents also are inadmissible hearsay, and the evidence lacks authentication, foundation and/or identification. U.S. Gypsum reserves these objections, but does not present them fully herein.

PLAINTIFF'S EXHIBIT

USG-562

pigs, cats, rats, rabbits and mice. No attempt was made to simulate levels associated with handling of finished products containing only minor amounts of asbestos.

Plaintiff argues that the experiments proved that asbestos causes cancer in humans and that the companies that funded the experiments improperly suppressed this finding. The basis for the argument is that Dr. Gardner, who conducted the experiments, observed tumors in eleven out of the hundreds of animals he used. Plaintiff's argument is flatly contradicted by Dr. Gardner himself and numerous other eminent scientists who followed up on, spoke and wrote about, and rejected the tumor observations. Moreover, plaintiff's argument has been rejected by courts that have examined the evidence. Those courts have concluded that:

- The Saranac documents do not contain "any evidence . . . linking U.S. Gypsum to efforts to conceal the results or to pressure Dr. Gardner or his successors to limit publication of their findings."

Sealover v. Carey Canada, 793 F. Supp. 569, 577 (M.D. Pa. 1992) (Exhibit A).

- No "evil motive can be imputed to USG for following Dr. Gardner's advice" to omit the observations of the eleven mice from the final report.

Pigozzi v. United States Gypsum Co., No. 98 L 04457, slip op. at 3 (Ill. Cir., Cook Cty. Aug. 15, 1999) (Exhibit B).

- "What I saw was minimal evidence with respect to Gypsum connecting them to the study . . . in that they struck a provision relating to cancer, for perhaps good reasons and maybe perhaps for bad reasons, but that it was done in a fair exchange of ideas at the time."

Davis v. Armstrong World Indus., 86-CIV-763 (W. Va. Cir., Monongalia Cty. June 30, 1988) (Exhibit C).

The data allegedly concealed was determined by Dr. Gardner and other eminent scientists to be of no value, and was omitted from the final report of the Saranac experiments for reasons consistent with good science. From his earliest interim report on the asbestosis work, Dr. Gardner

himself expressed doubt as to whether his tumor observations were any evidence of a cancer causing action. Dr. Gardner wrote that his observations on this issue "are suggestive but not conclusive" and that his methodology was "open to several criticisms." *See Outline of Proposed Monograph on Asbestosis at 7-8 (Exhibit D).* He stated that he felt that the dubious tumor observations "*would better be omitted from the present report.*" *See Cover Letter to Report, February 24, 1943, at 1 (emphasis supplied) (Exhibit E).*

Consistent with its marginal role, U.S. Gypsum did not receive a copy of Dr. Gardner's Outline. Nor did U.S. Gypsum participate in or receive the voluminous correspondence between and among the lead sponsors and Dr. Gardner during the late 1930s and early to mid-1940s.

Contrary to the argument plaintiff urges, the companies that funded the experiments did not prohibit Dr. Gardner from sharing his observations. Dr. Gardner applied to the National Cancer Institute ("NCI") for a grant to study the issue of asbestos as a cancer-causing agent.^{2/} Summarizing the discussion of the eminent cancer specialists who reviewed the application, one doctor stated that he did not "believe that this information would be of any tremendous value." *See Transcript of Proceedings at 26 (Exhibit F).* Others, too, voiced significant doubt as to the scientific importance of Dr. Gardner's observations. Dr. Gardner's grant application was put to a vote and was denied. *Id.* The transcript of that proceeding has been a matter of public record for over 55 years.

Dr. Gardner died suddenly in October 1946, without finishing a final report on the asbestosis experiments. His materials were sent to Dr. Kenneth Lynch of the Medical College of the State of South Carolina, whose own work had indicated a possible link between high-level asbestos exposure

^{2/} The NCI was established by the National Cancer Institute Act of 1937. As defined by Congress, its duties included "conducting researches, investigations, experiments, and studies relating to the cause, diagnosis, and treatment of cancer; assisting and fostering similar research activities by other agencies, public and private; and promoting a coordination of all such researches and activities and the useful application of their results, with a view to the development and prompt wide-spread use of the most effective methods of prevention, diagnosis and treatment of cancer."

and cancer. Dr. Lynch cited Dr. Gardner's tumor observations in speeches and published articles.^{1/}

On each occasion Dr. Lynch opined -- bolstered by his own research -- that "[a]nimal experimentation has not yet provided any conclusive evidence" of a possible relationship between asbestosis and lung cancer.^{1/}

After Dr. Gardner's death, and after his successors at Saranac had reviewed his research, the Saranac researchers stated in a draft report that the nature of the tumors observed Dr. Gardner was unknown, and noted that Dr. Gardner's own laboratory notes referred to the development of non-cancerous tumors or "adenomas." See Interim Report, Sept. 30, 1948, at 49 (Exhibit K).^{1/} It is the omission of these equivocal descriptions of Dr. Gardner's chance observations, pending further study, from the final report published in the *American Medical Association Archives of Industrial Hygiene and Industrial Medicine* in 1951 that plaintiff argues somehow caused the entire medical, scientific and regulatory communities to remain ignorant of the hazards of asbestos for decades, thereby causing injury to plaintiff.

Based upon the myriad problems identified by Dr. Gardner regarding his tumor observations in a few mice, numerous courts have recognized that the data U.S. Gypsum is alleged to have

^{3/} See Address to the Gordon Research Conferences, August 31, 1950, at 3 (Exhibit G) ("we also have knowledge of an unexpectedly high incidence of lung tumors in mice that had been experimentally exposed to asbestos dust. Since this experiment was not designed with the possible production of cancer in mind, it was not controlled in such a manner as to permit any conclusion"); Summary of Presentation at Seventh Saranac Symposium, September 24, 1952, at 9 (Exhibit H) (describing Gardner's work as an "uncompleted experiment" that was "uncontrolled" as to tumor susceptibility of mice used); Lynch, McIver & Cain, "Pulmonary Tumors in Mice Exposed To Asbestos Dust," 15 A.M.A. Arch. of Ind. Health 207, 213 (March 1957) at n. 13 (Exhibit I);

^{4/} Lynch and Pratt-Thomas, "Carcinoma of the Lung in Asbestosis: Report of Two Additional Cases," 48 So. Med. J 565, 568 (June 1955) ("[m]ice exposed to concentrations of asbestos dust having the proper specifications as regards particle volume and size do not develop asbestosis or carcinoma, although the ubiquitous pulmonary adenoma is frequently present") (Exhibit J); Lynch, McIver & Cain, "Pulmonary Tumors in Mice Exposed To Asbestos Dust," 15 A.M.A. Arch. of Ind. Health 207, 213 (March 1957) ("[n]o significant histological or cytological difference was observed between tumors in the control and dusted groups" and "[n]o clear-cut proof of malignancy was found in any of the tumors studied") (Exhibit I).

^{5/} One of Dr. Gardner's successors at Saranac, Dr. Philip Pratt, has stated under oath that based upon Dr. Gardner's notes and his own independent analysis of the tissue slides, he concluded in 1948 and believes at present that the lesions were adenomas and not malignant cancers. See Affidavit of Philip Pratt ¶ 9 (Exhibit L) (exhibits omitted).

concealed was of no scientific value. In *Lammers v. OwensCorning Fiberglas Corp.*, No. 97CV005649, Tr. at 56-57 (Wis. Cir., Milwaukee Cty. Jan. 29, 1999) (Exhibit M), the court excluded all reference to Dr. Gardner's speculative observations regarding cancer based upon

- just a simple analysis of relevance based upon the scientific -- really I don't mean to be unkind about the plaintiff's position here, but the scientific worthlessness of the minuscule information that U.S. Gypsum had or at least that plaintiffs can establish that U.S. Gypsum had. . . .
- [W]e've got a rule of law that requires that scientific evidence be treated with honesty and applying intellectual honesty in this case, the information about possible cancer producing effects of long fibre asbestos noted by Dr. Gardner in 1943 and reported as a question in 1948 that that is again applying the legal standard here not relevant. . . .

Other courts have reached similar conclusions:

- The Saranac experiments reveal "a lack of sound research."

Pigozzi, slip op. at 2 (Exhibit B).

- "Dr. Gardner found only a possible relationship between exposure to massive amounts of asbestos and malignant tumors in white mice. He himself stated that the implications were unclear. . . ."

Sealover v. Carey Canada, 793 F. Supp. 569, 575 (M.D. Pa. 1992) (Exhibit A).

- "When you look at Dr. Gardner's report there is no credibility attached to that issue. He says there isn't. He says it is suspect. There just isn't anything there."

Board of Educ. of City of Detroit v. Celotex Corp., No. 84-429-634-NP, Tr. at 23-24 (Mich. Cir., Wayne Cty. Oct. 20, 1989) (Exhibit N).

- "I am satisfied that there was no scientific validity or no scientific basis then based upon Gardner's studies for the conclusion that there was a tie in with cancer."

Board of Educ. of City of Detroit, Tr. at 18-19 (Mich. Cir., Wayne Cty. Sept. 4, 1992) (Exhibit O).

As noted by these courts, Dr. Gardner's data were, by his own admission, of highly dubious

scientific value. Even had any concealment occurred, it could have had no effect on the medical community's knowledge regarding a link between high level exposure to raw asbestos and the development of lung cancer.

Regardless of the scientific validity of Dr. Gardner's data, the Saranac documents are not probative of concealment because no concealment occurred. It was *Dr. Gardner's* suggestion that the data not be included in the final report because it was both unreliable and inconclusive. In addition, the data was disseminated widely. In 1943, Dr. Gardner himself sent the data to the NCI where it was openly discussed by cancer specialists from around the country, and Dr. Lynch referred to the observations at major symposia in 1950 and 1952, and in articles published in 1955 and 1957.

Even if it were true that some sponsors of Dr. Gardner's work attempted to suppress his findings, U.S. Gypsum was not a party to such efforts. There is no evidence that U.S. Gypsum either sent or received the majority of the Saranac documents, including the 1943 report and voluminous correspondence among other funders of the experiments, which has been produced in asbestos litigation. U.S. Gypsum was not informed of and never participated in any attempt to improperly suppress Dr. Gardner's observations. Accordingly, the documents are not admissible to show the conduct or motivation of U.S. Gypsum. *Wesley Theological Seminary of the United Methodist Church v. United States Gypsum Co.*, No. CA-85-1606, Order at 3-4 (D.D.C. March 25, 1988) (Exhibit P), *aff'd in relevant part, rev'd in part*, 876 F.2d 119, 123 (D.C. Cir. 1989), *cert. denied*, 494 U.S. 1003 (1990).

Whatever its motivation, the omission of Dr. Gardner's speculative cancer findings could not have caused any injury to plaintiff. As the court held in *Board of Educ. of City of Detroit*, Tr. at 19 (Mich. Cir., Wayne Cty. Sept. 4, 1992) (Exhibit O): "[T]here certainly couldn't be any proximate cause from it because the information was disseminated, there wasn't any secret kept about it."

Information regarding the hazards of asbestos dust exposure, as understood by the science of the time, including Dr. Gardner's inconclusive results, was published in the scientific literature both before and during the time in which plaintiff alleges concealment. Indeed, plaintiff's own state of the art experts routinely opine that a link between asbestos exposure and cancer was well-established and accepted before 1951, when the final report of the Saranac experiments was published.^{1/}

Thus, any assertion that the omission of a reference to tumors in the final report of Dr. Gardner's asbestosis experiments in 1951 somehow concealed the cancer issue is absurd. Even more absurd is the suggestion that plaintiff, whose first alleged exposure to asbestos-containing products occurred years later, was harmed by the failure to include a questionable finding of non-cancerous tumors in the report on the Saranac experiments.

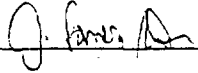
Plaintiff will attempt to present bits and pieces of the Saranac story out of context, and U.S. Gypsum will be forced to respond by presenting extensive scientific and medical evidence to the contrary. The evidence is highly inflammatory and bears no relevance to causation, which is plaintiff's burden in this liability case. See *Perlmutter v. United States Gypsum Co.*, No. 87 M 510, Tr. at 595-99 (D. Colo. May 6, 1991) (Exhibit S); *J.H. Snyder Co. v. Carey Canada, Inc.*, No. C 728 816, Order (Cal. Super., L.A. Cty. Apr. 18, 1994) (Exhibit T).

For the foregoing reasons, U.S. Gypsum respectfully requests that this Court enter an order *in limine* precluding plaintiff from introducing any argument or evidence concerning animal experiments conducted by Dr. LeRoy Gardner at the Saranac Laboratory in the late 1930s and early 1940s.

^{6/} See, e.g., *Wigley v. United States Gypsum Company, et al.*, Cause No. 98-10710-B (Dallas Cty., Texas) July 29, 1999 Tr. 88, 18-89:1 ("[C]ertainly there was a general consensus, if not a complete consensus, that by 1949, based on that JAMA editorial that was in the medical community, that asbestos could cause Cancer [sic].") (Exhibit Q); *Sanchez v. United States Gypsum Company, et al.*, Cause No. 96-2807 (El Paso Cty., Texas) July 29, 1999 90:22-24 ("Q: We are talking about lung cancer now and the development of that relationship? A: By the end of the '40s.") (Exhibit R).

Respectfully submitted,

POWERS & FROST, L.L.P.

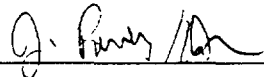


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**ATTORNEYS FOR DEFENDANT UNITED
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CERTIFICATE OF SERVICE

I hereby certify that a true and correct of Defendant United States Gypsum Company's Motion in Limine has been forwarded to Plaintiffs' counsel of record, either by first class mail, return receipt requested, delivery or facsimile on this the 12th day of January, 2001.



Exhibits for:

**Memorandum of Law in Support of
Motion *In Limine* of Defendant
United States Gypsum Company to
Exclude Argument and Evidence
Relating to the Saranac Experiments**

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MEMORANDUM OF LAW IN SUPPORT OF MOTION *IN LIMINE*
OF DEFENDANT UNITED STATES GYPSUM COMPANY TO EXCLUDE
ARGUMENT AND EVIDENCE RELATING TO THE SARANAC EXPERIMENTS

APPENDIX OF EXHIBITS

Alma M. SEALOVER, individually, and in her
capacity as Administratrix of the
Estate of Donald Sealover, deceased, Plaintiff,
v.

CAREY CANADA, et al., Defendants.

No. CV-88-0643.

United States District Court,
M.D. Pennsylvania.

April 3, 1992.

Widow of deceased construction worker brought products liability action, both individually and as administratrix of her husband's estate, seeking to recover damages from asbestos manufacturers. On manufacturers' motions for summary judgment on widow's punitive damages claim, the District Court, McClure, J., held that: (1) to recover punitive damages from asbestos manufacturers, widow had burden of showing that manufacturers had actual knowledge, prior to worker's exposure, of the serious health risks posed by their products, and (2) manufacturers' knowledge that asbestos fibers might cause cancer in laboratory animals exposed to massive quantities of asbestos could not be equated with knowledge that construction workers would suffer same ill effects to same degree.

Motion granted.

[1] DAMAGES ⇨ 91(1)
115k91(1)

To recover punitive damages from asbestos manufacturers, widow of deceased construction worker had burden of showing that manufacturers had actual knowledge, prior to time of construction worker's exposure, of the serious health risks posed by their products.

[2] DAMAGES ⇨ 91(1)
115k91(1)

Widow of deceased construction worker failed to show that asbestos manufacturers had actual and not just constructive knowledge of health risks posed by their products, so that manufacturers were not liable for punitive damages, where only evidence of causal connection between asbestos and cancer involved laboratory mice and manufacturing or mining employees, each of whom was exposed to asbestos

dust in far greater quantities than typical construction worker.

[3] DAMAGES ⇨ 179
115k179

Evidence regarding asbestos manufacturer's knowledge of dangers associated with their products at time subsequent to construction worker's exposure thereto was inadmissible, as irrelevant to punitive damages issue and as to whether manufacturers had actual knowledge of dangers associated with their product at time of worker's exposure.

[4] DAMAGES ⇨ 94
115k94

Any limitation on extent of asbestos manufacturer's liability for punitive damages, in order to preserve fund for payment of subsequent compensatory asbestos claims, was matter more properly addressed to legislature than to district court.

*569 John McN. Broadbus, Deborah K. Hines, Shepard A. Hoffman, Connerton, Ray & Simon, Washington, D.C., for plaintiff.

Robert B. Lawler, Beth Evans Valocchi, Wilbraham & Coleman, Philadelphia, Pa., for defendant U.S. Gypsum Co.

James P. Gannon, Barnard and Gannon, Media, Pa., for defendant W.R. Grace & Co.

MEMORANDUM

McCLURE, District Judge.

BACKGROUND

Plaintiffs Alma M. Sealover and Donald E. Sealover filed this products liability action *570 against defendants W.R. Grace Company, ("W.R. Grace"), United States Gypsum Company ("U.S. Gypsum") [FN1] among others. Plaintiffs alleged that as a result of Donald Sealover's exposure to asbestos during his sojourn in the Merchant Marines and during his forty-year career as a carpenter, he contracted mesothelioma, [FN2] asbestosis and other asbestos-related diseases which ultimately led to his death on May 2, 1988. Alma Sealover, acting both individually and as Administratrix of her husband's



estate, sought to recover for her husband's illness and for his death.

FN1. U.S. Gypsum is part of a group of defendants, affiliated for purposes of defending actions such as this, which are known as the Center for Claims Resolution Defendants or "CCR defendants." The other defendants which are part of that group are: (a) GAF Corporation (b) National Gypsum Company and (c) Turner & Newall Of the four, plaintiff seeks punitive damages only against U.S. Gypsum. (Record Document No. 232, filed Sept. 11, 1991)

FN2. Mesothelioma is a terminal cancer of the lining of the lung.

The trial was bifurcated with the first phase on strict liability only. The first phase of the trial concluded with the jury awarding compensatory damages of \$400,000 to the estate and \$210,000 to Alma Sealover. The negligence and punitive damage claims have yet to be tried. Defendants W.R. Grace and U.S. Gypsum have moved to defer indefinitely trial of plaintiff's punitive damage claim.

Before the court are: (1) a motion (Record Document No. 234, filed October 29, 1991) by U.S. Gypsum to bar plaintiffs from proceeding with their punitive damage claim or, in the alternative, to defer indefinitely the trial on punitive damages; (2) a motion (Record Document No. 238, filed November 15, 1991) by W.R. Grace for summary judgment on the punitive damage claim; (3) and a motion by U.S. Gypsum to exclude evidence on punitive damages. [FN3] For the reasons set forth below, the court will grant all three motions and direct entry of summary judgment in defendants' favor on the punitive damage claims. [FN4]

FN3. Also outstanding are plaintiff's motion for delay damages; defendants' motions for a new trial or j.n.o.v.; plaintiff's motion to sever the case against GAF; and defendants' motions to treat Johns-Manville as a settled defendant and mold the verdict. These motions will be addressed in a separate memorandum.

FN4. The parties have agreed that the court should treat the motions filed by W.R. Grace and U.S. Gypsum as motions for summary judgment on

plaintiff's punitive damage claims.

DISCUSSION

Summary judgment standard

The parties have agreed that the court should treat the motions to bar plaintiff from trying the punitive damage claim as a motion for partial summary judgment. We will, therefore, apply the summary judgment standard in determining the sufficiency of plaintiff's evidence.

Summary judgment is appropriate if the "pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to judgment as a matter of law." Fed.R.Civ.P. 56(c) (Emphasis supplied).

... [T]he plain language of Rule 56(c) mandates the entry of summary judgment, after adequate time for discovery and upon motion, against a party who fails to make a showing sufficient to establish the existence of an element essential to that party's case, an on which that party will bear the burden of proof at trial. In such a situation, there can be 'no genuine issue as to any material fact,' since a complete failure of proof concerning an essential element of the nonmoving party's case necessarily renders all other facts immaterial. The moving party is 'entitled to judgment as a matter of law' because the nonmoving party has failed to make a sufficient showing on an essential element of her case with respect to which she has the burden of proof.

Celotex v. Catrett, 477 U.S. 317, 323-24, 106 S.Ct. 2548, 2553, 91 L.Ed.2d 265 (1986).

*571 The moving party bears the initial responsibility of stating the basis for its motions and identifying those portions of the record which demonstrate the absence of a genuine issue of material fact. He or she can discharge that burden by "showing ... that there is an absence of evidence to support the nonmoving party's case." *Celotex*, supra, 477 U.S. at 323 and 325, 106 S.Ct. at 2553-54.

Issues of fact are "genuine only if a reasonable jury, considering the evidence presented, could find for the non-moving party." *Childers v. Joseph*, 842

F.2d 689, 694 (3d Cir.1988), citing *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 249, 106 S.Ct. 2505, 2510, 91 L.Ed.2d 202 (1986). Material facts are those which will affect the outcome of the trial under governing law. *Anderson*, supra, 477 U.S. at 248, 106 S.Ct. at 2510. In determining whether an issue of material fact exists, the court must consider all evidence in the light most favorable to the non-moving party. *White v. Westinghouse Electric Company*, 862 F.2d 56, 59 (3d Cir.1988).

Evidentiary issues

Defendants contend that: (1) plaintiff will be unable to meet the high standard of proof Pennsylvania law requires for an award of punitive damages; (2) plaintiffs in personal injury asbestos actions have in the past been unable to muster such evidence and the Pennsylvania courts [FN5] have consistently precluded plaintiffs from proceeding to trial on punitive damage claims; and (3) the plaintiff in this case has offered no new evidence which would warrant this court reaching a different conclusion.

FN5. All parties agree that Pennsylvania law applies under *Erie R.R. v. Tompkins*, 304 U.S. 64, 58 S.Ct. 817, 82 L.Ed. 1188 (1938) and its progeny.

In *Martin v. Johns-Manville Corp.*, 508 Pa. 154, 494 A.2d 1088, 1096 (1985), the Pennsylvania Supreme Court held that to recover punitive damages, a plaintiff must show, by a preponderance of the evidence, [FN6] that the defendant's conduct met the requirements of Section 908(2) of the Restatement (Second) of Torts:

FN6. Although some courts require a higher standard of proof, the Pennsylvania courts have rejected that approach and require plaintiff to prove entitlement to punitive damages by a preponderance of the evidence only. *Martin*, supra, 494 A.2d at 1098 n. 14 ("We believe the goal of limiting punitive damage awards in the context of products liability litigation is best served by focusing on the nature of the defendant's conduct instead of increasing the plaintiff's burden of persuasion.")

(2) Punitive damages may be awarded for conduct that is outrageous, because of the defendant's evil motive or his reckless indifference to the rights of

others. In assessing punitive damages, the trier of fact can properly consider the character of the defendant's act, the nature and extent of the harm to the plaintiff that the defendant caused or intended to cause and the wealth of the defendant. The court's holding was stated in a plurality opinion written by Justice Hutchinson. Justice Hutchinson rejected a constructive knowledge (i.e. reasonable man) standard in favor of a standard requiring actual knowledge of the hazard on the part of the defendant. Although a majority of the other justices joined in the result, they did not specifically adopt the actual knowledge standard endorsed by Hutchinson, generating confusion as to the appropriate standard.

In *Burke v. Maasen*, 904 F.2d 178, 181 (3d Cir.1990), the Third Circuit analyzed in considerable detail the state of Pennsylvania law on punitive damages:

... [the plurality in *Martin*] held that a jury may award punitive damages only where the evidence shows the defendant knows, or has reason to know, of facts which create a high degree of risk of physical harm to another, and deliberately proceeds to act in conscious disregard of, or indifference to, that risk.... (Citation omitted.) ... [I]t is not sufficient to show that a reasonable person in the defendant's position would have realized or appreciated the high degree of risk from his actions ... (Citation omitted.) ... The *Martin* plurality opinion rejects Restatement § 500's general definition of 'reckless disregard of safety' as the standard for imposition of punitive damages. *572 That section states, 'In order that an actor's conduct may be reckless, it is not necessary that he himself recognize it as being extremely dangerous.... It is enough that he knows or has reason to know of circumstances which would bring home to the realization of the ordinary reasonable man the highly dangerous character of his conduct.' ... Restatement § 500, comment c. Instead, *Martin* requires the more culpable mental state of conscious indifference to another's safety as the test for mental state of conscious indifference to another's safety as the test for 'reckless indifference' under Restatement § 908. There must be some evidence that the person actually realized the risk and acted in conscious disregard or indifference to it.... (Citation omitted.) ...

The opinion announcing the judgment of the court

In *Martin* is not clearly the law of Pennsylvania on this issue. Only Justices Hutchinson and Flaherty joined in the reasoning of the plurality opinion.... Thus, a majority of the Supreme Court has not decided whether punitive damages may be awarded only where there is proof of conscious disregard of a known risk, or whether disregard of a risk that would be obvious to a reasonable person would suffice.... [I]n subsequent cases, Pennsylvania's Superior Court has not applied a 'reasonable man' standard, but followed the lead of Justices Hutchinson and Flaherty, adopting and applying the 'conscious disregard' formulation.... (Citations omitted.).... [T]he rule of the opinion announcing the judgment of the court in *Martin* furthers the purpose of punitive damages, which is to punish and deter 'conduct involving some element of outrage similar to that usually found in crime.'In sum, we predict the Pennsylvania Supreme Court would adopt the standard set forth in the *Martin* plurality opinion were it to confront the issue today.

Burke, supra, 904 F.2d at 181 (Emphasis original). Accord: *Villari v. Terminix International, Inc.*, 663 F.Supp. 727, 734 (E.D.Pa.1987).

The only post-*Martin* Pennsylvania Supreme Court decision on this issue is *SHV Coal, Inc. v. Continental Grain Co.*, 526 Pa. 489, 493, 587 A.2d 702, 704-05 (1990). There, the Court excerpted the portion of the Hutchinson opinion in *Martin*, supra, which adopts the actual knowledge standard. *SHV Coal*, coupled with the Third Circuit's analysis in *Burke*, supra, leave no doubt that the actual knowledge standard applies to this case. See also: *Tunis Brothers Company, Inc. v. Ford Motor Company*, 952 F.2d 715, 740 (3d Cir.1991).

[1] Thus, to recover, Sealover must prove that W.R. Grace and U.S. Gypsum were aware, prior to Donald Sealover's exposure, that the exposure of construction workers to asbestos released during the installation of their products was a health hazard and failed to warn of that risk.

In *Smith v. Celotex Corp.*, 387 Pa.Super. 340, 564 A.2d 209, 211-13 (1989), the Pennsylvania Superior Court discussed the quantum of evidence necessary to prove such knowledge. Using *Martin* as the foundation for its analysis, the court stated:

The evidence deemed insufficient in *Martin* was testimony by two doctors concerning what the

medical profession knew of the risks posed to applicers of finished asbestos products and when they knew it.... Justice Hutchinson ... emphasized that plaintiff had not produced sufficient evidence of the awareness of the defendants of the specific risks associated with application of finished asbestos products, as opposed to risks associated with the manufacture of asbestos products. Justice Hutchinson distinguished those cases where the plaintiffs were employees of manufacturers of asbestos products and produced evidence of the specific knowledge of the defendants as to the risks posed to manufacturing employees such as the plaintiffs long before the defendants took any measures to protect the employees. See, e.g., *Neal v. Carey Canadian Mines, Inc.*, 662 F.Supp. 64, 70-71 (E.D.Pa.1987).

*573 *Smith*, supra, 564 A.2d at 211 (Emphasis supplied.) Finding such evidence lacking, the Superior Court reversed the jury's award of punitive damages, stating:

[h]ere, the evidence submitted ... did not establish either that the management of appellant knew or had reason to know of facts indicating that appellant's conduct posed a substantial risk of physical harm to an applicer of finished products like plaintiff.... There is no [medical] testimony specifically relating to knowledge by the medical profession as to the risks posed by finished asbestos products to those who installed or applied them. We, therefore, conclude that Dr. Sturgis offered no testimony in any way probative of outrageous conduct by appellant vis-a-vis plaintiff.

Smith, supra, 564 A.2d at 211. (Emphasis supplied.) The court dismissed as immaterial evidence of workmen's compensation claims filed against the manufacturer, explaining that:

[t]he existence of those claims alone, with no evidence demonstrating anything relating to how they were ultimately resolved, does not indicate anything regarding appellants' knowledge of the risks posed to applicers of asbestos products for numerous reasons. Most importantly, we note that the claimants were manufacturing employees and not applicers. Thus we do not see how the mere fact that these workers' compensation claims were made is relevant to plaintiff's punitive damages claim.

Smith, supra, 564 A.2d at 212 (Emphasis supplied.). See also: *Carasaugua Area School*

District v. Raymark Industries, Inc., 662 F.Supp. 64, 70-71 (E.D.Pa.1987) (evidence of punitive damages insufficient where plaintiff failed to demonstrate defendant's awareness of risks associated specifically with the installation of finished asbestos products in schools).

In *Moran v. G. & W.H. Corson, Inc.*, 402 Pa.Super. 101, 586 A.2d 416, 422-26 (1991), the outcome was the same. The Pennsylvania Superior Court overturned a verdict assessing punitive damages against Corson, finding insufficient evidence that Corson, an asbestos supplier, was aware of the hazard asbestos posed to construction workers prior to the exposure of plaintiff's husband. There was, the court stated, "no support in the record for the assertion that officials or managerial employees of G. & W.H. Corson were aware in the mid 60's that exposure to asbestos fibers could result in cancer." Plaintiff had attempted to prove such knowledge through: (1) testimony from G. & W.H. Corson Vice President John Evans about general discussions he had, prior to 1969, with business colleagues about the hazards of asbestos; (2) Evans's testimony that he took no action to relay this information to his customers or warn them of the potential danger, but relied instead on the manufacturer, Baldwin Hill, to take such action; (3) Evans's testimony that he had never discussed the issue of asbestos with Baldwin Hill; and (4) articles about the hazards of asbestos published in medical and trade journals circulated in Europe and the United States since the turn-of-the-century. Noting, among other things, the absence of any proof that "anyone at Corson knew or had reason to know of these articles or any medical research studies on the risks involved in the use of insulation materials containing asbestos", the Superior Court found that such evidence did not prove knowledge on the part of Corson that asbestos exposure posed a threat to Moran. *Moran*, supra, 586 A.2d at 425.

Pennsylvania is not unique in adhering to the "actual knowledge" standard. Missouri follows the same standard and its courts have likewise rejected punitive damage claims against asbestos suppliers and manufacturers in cases in which there was insufficient evidence that the defendant actually knew that even exposure to relatively moderate levels of asbestos posed a serious health risk. In *Angotti v. Celotex Corp.*, 812 S.W.2d 742 (Mo.Ct.App.1991), the Missouri Court of Appeals

found insufficient evidence that Celotex actually knew, at the time of plaintiff's exposure, of the hazard asbestos posed to construction workers, stating:

....The record here shows that information in regard to the harmful effect of "574 asbestos was still developing, but it does not establish that, at the relevant times ... there was already information available to show that Philip Carey's finished products were actually known to present a health hazard to insulators. In other words, the record does not reflect that scientific knowledge even existed, at the relevant times [from 1951 through 1973] ... to establish legal causation sufficient to submit punitive damages against Celotex for the injuries of William Angotti as a result of his exposure, as an insulator, to Celotex's products. Without even a showing of scientific knowledge sufficient to establish legal causation, Celotex can not be held to have had actual knowledge of the danger to William Angotti on the basis of the record in this case.

Angotti, supra, 812 S.W.2d at 746-47. See also: *School District of the City of Independence v. U.S. Gypsum*, 750 S.W.2d 442, 446-48 (Mo.Ct.App.1988), (Court found insufficient evidence that U.S. Gypsum had actual knowledge at the time of sale that the ceiling tiles sold for installation in schools would release asbestos fibers if abraded [rubbed against or scraped], thereby posing a health risk to school employees and students).

Evidence proffered by Sealover

Plaintiff's principal witness on Sealover's exposure to defendants' asbestos products was Martin Brehm. Brehm was Sealover's brother-in-law and, like Sealover, worked as a carpenter in the Harrisburg, Pennsylvania area. Brehm and Sealover worked on the same construction projects on several occasions during the late 1950's and early 1960's. It was during that time that Sealover was exposed to defendants' asbestos products. Brehm testified that Sealover was exposed to (1) Zonolite, a W.R. Grace fireproofing spray, [FN7] during construction of the Cumberland County Courthouse in Carlisle, Pennsylvania in 1960-61; [FN8] (2) Red Top plaster, a U.S. Gypsum product, and to Zonolite, during construction of the Archives Building in Harrisburg, Pennsylvania in 1961-62; [FN9] and (3) Red Top plaster, during construction of the William

Penn Museum [FN10] in Harrisburg, Pennsylvania in 1962-61. [FN11] As a carpenter, Donald Sealover was not involved in the actual installation of asbestos products, but worked near locations where such products were used.

FN7. W.R. Grace acquired the assets of the Zonolite Company in April, 1963 and argues that punitive damages should not be assessed against it because it was not a manufacturer of asbestos products prior to 1963. Plaintiff argues W.R. Grace is liable as a successor corporation to Zonolite. Our ruling on the sufficiency of the evidence disposes of plaintiff's claim and eliminates the need to consider this issue.

FN8. N.T., July 8, 1991, pp. 23-31 and 64 (Brehm, M.).

FN9. N.T., July 8, 1991, pp. 32-35, 38-39 (Brehm, M.).

FN10. N.T., July 8, 1991, pp. 36-41. (Brehm, M.).

FN11. Brehm testified that Sealover was also exposed to Gold Bond products manufactured by National Gypsum on the three construction projects: the Cumberland County Courthouse, the Archives Building in Harrisburg, and the William Penn Museum. Plaintiff is not seeking punitive damages against National Gypsum.

To recover on her punitive damage claim, the plaintiff must prove that W.R. Grace and U.S. Gypsum had actual knowledge, before 1960 and 1961 respectively, that the installation of their products presented a serious health risk to construction bystanders and failed to warn of the danger.

Plaintiff bases her case against U.S. Gypsum on information derived from two sources: [FN12] (1) experiments performed on animals at Lake Saranac laboratory in New York during the 1930's by Dr. Leroy Gardner and the reports generated by those experiments (the "Lake Saranac" evidence); and (2) a suit filed by a bookkeeper formerly employed in one of its plants who alleged that he had contracted asbestosis as a result of working in an asbestos plant. [FN13]

FN12. We assume, without deciding, that for

purposes of ruling on defendants' motions, that all evidence which plaintiff proffers would be admissible at trial.

FN13. The bookkeeper worked at an asbestos factory owned by the National Asbestos Manufacturing Co., and the suit was filed against that company. U.S. Gypsum plant acquired the factory in 1936.

*575 Plaintiff bases her case against W.R. Grace on the Lake Saranac evidence as well as on other information allegedly available to it through its acquisition of two companies in the 1950's and 1960's. W.R. Grace did not become involved in manufacturing asbestos-containing products until December, 1954 when it acquired the Dewey and Almy Chemical Company ("Dewey and Almy"). [FN14] Dewey and Almy had been involved in manufacturing products which incorporated asbestos since the 1930's when its acquired Multibestos, a company which manufactured brake linings. During the 1930's, Multibestos plant employees exhibited symptoms of asbestosis and their conditions and symptoms were reported in two articles published in medical journals.

FN14. Because we find the evidence proffered by plaintiff legally insufficient, we need not address W.R. Grace's contention that it cannot be held liable for punitive damages as a successor corporation to Zonolite, the corporation which manufactured the asbestos products to which Sealover was exposed.

In April of 1963, W.R. Grace acquired a second company involved with asbestos products, the Zonolite Company ("Zonolite"). Zonolite operated a vermiculite mine in Libby, Montana, a vermiculite mine in South Carolina, and several processing plants at which the ores mined at Libby were used to manufacture fireproof plaster, among other products.

The vermiculite ore mined at Libby was contaminated with asbestos, and Zonolite employees had exhibited problems stemming from their exposure to asbestos during mining and processing operations. Zonolite was aware of such problems since at least the early 1950's, when it implemented regulations requiring Libby employees to wear respirators. Despite precautionary



measures, such as the use of respirators, x-rays of Libby employees taken in the late 1950's revealed a high incidence of abnormal lung conditions. The conditions observed included pleural thickening, interstitial fibrosis and pneumonocosis or possible asbestosis. Troubling dust conditions in the Libby mine were noted and reported by public health officials. For example, a report generated during a 1956 inspection of the Libby mine by the Montana Board of Health found "the asbestos dust in the air" to be "of considerable toxicity."

Saranac Lake experiments

[2] The Saranac Lake experiments are the cornerstone of plaintiff's case against U.S. Gypsum. The experiments were performed in the late 1930's and the early 1940's by Dr. Leroy Gardner. Dr. Gardner exposed to mice, rabbits, cats and other animals to asbestos dust and other types of dust and documented the effect on their lungs. His initial intent was to study whether the animals exposed to asbestos developed asbestosis, the conditions under which it developed, etc. He was surprised when the results in mice revealed a high incidence of lung tumors which he believed to be cancerous. The population of mice exposed to the asbestos dust was small, numbering only eleven.

The significance of certain aspects of Dr. Gardner's experiments is vigorously disputed, but one point is clear. The experiments did not establish a definite causal relationship between asbestos exposure at levels comparable to those experienced by construction bystanders and cancer. Dr. Gardner found only a possible relationship between exposure to massive amounts of asbestos and malignant tumors of the lung in white mice. He himself stated that the implications were unclear and that the matter required further study before any clear conclusions could be drawn.

Further, possible flaws in the methodology were identified by Dr. Gardner and by others who later reviewed the results. Among the flaws was the fact that the strain of white mice studied was thought to be particularly susceptible to lung tumors. In February of 1943, Dr. Gardner released an "Outline of Proposed Monograph on Asbestosis", in which he characterized the significance of his findings as follows:

These observations are suggestive but not

conclusive evidence of a cancer stimulating action by asbestos dust. They are open to several criticisms. The strain of mice was not the same in the *576 asbestos experiment as in many of the other cited; apparently, the former were unusually susceptible. Not enough animals survived in the dust for longer than the 15 months apparently necessary to produce many tumors. There were no unexposed controls of the same strain and age, and no similar controls exposed to other dusts. It is hoped that this experiment can be repeated under properly controlled conditions to determine whether asbestos actually favors cancer of the lung.

(Record Document No. 245, filed December 11, 1991, p. 19 referencing plaintiff's exhibit USG-152 at 126-66-(7) through 126-66-(8) (emphasis supplied)). See generally: Angotti, *supra*, 812 S.W.2d at 746-49 (Responding to the alleged significance of a prediction by a physician working for the company that someday "even the minor use of asbestos may ... be considered ... dangerous to the general populace", the court stated: "A forecast of what may be determined in the future does not establish present knowledge that a health hazard existed for those working as insulators.")

In a letter and report to Johns-Manville dated February 24, 1943, Dr. Gardner again described the results as inconclusive and noted the need for further study on the question of a possible link to cancer:

The question of cancer susceptibility now seems more significant than I previously imagined. I believe I can obtain support for repeating it from the cancer research group. As it will take two or three years to complete such a study, I believe it would be better to be omitted from the present report. If it should become possible to make this study, I hope I any [sic] count on some of your members to supply me with enough pure, long fiber asbestos for the purpose ...

(Record Document No. 245, filed December 11, 1991, p. 23, referencing plaintiff's exhibit USG-152 at 126-66-(7) through 126-66-(8)).

Plaintiff argues that the results of the Saranac Lake research were more definite than this and, as support for that assertion, points to a statement in a letter dated August 13, 1936 from W.L. Keady, a U.S. Gypsum executive. Keady summarizes the contents of a report by Dr. Gardner on conditions at a Jersey City plant which U.S. Gypsum had

purchased from another asbestos manufacturer. Dr. Keady states at one point that "there was no safe level of exposure to asbestos." Plaintiff argues that, by this, he meant that exposure to any amount of asbestos, however minute, posed a hazard. Plaintiff's interpretation is inconsistent with the rest of the passage. The entire passage reads:

Dr. Gardner points out that various authorities have tentatively suggested a concentration of five million particles of free silica per cubic foot of air as limits above which a silicosis hazard might exist, and this value has met with some recognition. There is no standard for safe concentration of asbestos dust comparable to the value just given for free silica dust.

(Record Document No. 245, filed December 11, 1991, Exhibit "N").

We are not the first court to consider the import of the Keady letter. The Court of Appeals for the District of Columbia Circuit considered the letter in *Wesley Theological Seminary v. U.S. Gypsum Co.*, 876 F.2d 119, 123 (D.C.Cir.1989), and rejected plaintiff's proposed interpretation. The court explained:

Dr. Gardner concluded that a serious asbestos dust hazard existed in the plant. He discussed other studies which proposed a maximum safe level of 'five million particles of free silica per cubic foot of air.' He distinguished silica dust from asbestos dust, however, and concluded that this standard was not necessarily applicable to asbestos dust. Wesley seeks to treat as a smoking gun the letter's observation that "[t]here is no standard for safe concentration of asbestos dust comparable to the value just given for free silica dust." In context, however, this is simply a statement that, due to the absence of enough research, no one could yet identify the safe level for occupational exposure. Similarly, the letter's discussion of an *577 asbestos dust study which found a 10% asbestosis rate among workers exposed to five million particles per cubic foot of dust was of remote relevance at best. While it suggests that U.S. Gypsum was on notice that the safe level for occupational exposure to asbestos dust on a full-time basis was less than five million particles per cubic foot of air, it does almost nothing to establish Wesley's central thesis—that the defendant was aware that asbestos-containing ceiling tiles, once installed, created hazardous concentrations.

Wesley Theological, supra, 876 F.2d at 123 (Emphasis supplied.)

We are aware of the controversy concerning the alleged attempts of the Saranac study sponsors, a group of asbestos manufacturers which included U.S. Gypsum, to conceal the suspected link to cancer revealed by Dr. Gardner's study. It is not clear from the documents we have reviewed that U.S. Gypsum knowingly participated in any conspiracy to conceal the results by pressuring Dr. Gardner or his successors to omit any mention of cancer from the published reports of the study. This distinguishes its position from that of other asbestos manufacturers, such as Johns-Manville, with respect to which there is clear direct evidence of knowing participation in efforts to block publication of results linking asbestos-exposure in animals to cancer. Moreover, the Pennsylvania courts have found even such knowing participation an insufficient basis for imposing punitive damages. See: *Martin*, supra, and *Angotti*, supra, 812 S.W.2d at 746-49 (Efforts to keep a medical advisor's "observations and evaluation confidential does not show actual knowledge of a health hazard to an individual working as an insulator.") Cf. *Neal v. Carey Canadian Mines, Ltd.*, 548 F.Supp. 357, 365 (E.D.Pa.1982).

Plaintiff has not pointed to any evidence that U.S. Gypsum was directly or knowingly involved in attempts to conceal Dr. Gardner's finding of a suspected cancer link or to curtail publication of his findings. The Lake Saranac experiments were sponsored by a group of asbestos manufacturers which included U.S. Gypsum. [FN15] Dr. Gardner was in contact with officers of Johns-Manville and Raybestos-Manhattan about his experiments, and such evidence, as well as attempts by the principals of those companies to suppress the study results, has been the basis for an award of punitive damages against them in a number of cases. Plaintiff has not, however, directed our attention to any evidence similarly linking U.S. Gypsum to efforts to conceal the results or to pressure Dr. Gardner or his successors to limit publication of their findings. Without such direct evidence, U.S. Gypsum cannot be tarred with the same brush as Raybestos or Johns-Manville.

[FN15] W.R. Grace was not one of the sponsors. At the time the experiments were conducted, it was

not involved in the mining or processing of asbestos. It did not acquire asbestos-related industries until the 1950's.

Further, without the underpinnings of evidence establishing actual knowledge of the hazard asbestos posed to those who even indirectly came into contact with their products, plaintiff's evidence of alleged attempts to conceal the Saranac Lake experiments, as well as its alleged failure to use alternatives to asbestos has no probative value. Such evidence alone does not establish culpable conduct.

U.S. Gypsum employee

The other evidence on which plaintiff relies to establish actual knowledge on the part of U.S. Gypsum is evidence that in the 1930's a bookkeeper employed at one of its manufacturing plants in Jersey City, New Jersey contracted asbestosis as a result of his employment. Plaintiff argues that this proves U.S. Gypsum knew that exposure to even relatively moderate levels of asbestos posed a significant health hazard. Such evidence does not equate to knowledge that construction bystanders were at risk. As the court pointed out in *Angotti*, supra, asbestos-plant workers were exposed to far greater quantities of asbestos dust than the average construction worker, because their work environments differed. The manufacturing processes generated enormous *578 quantities of dust. Day-after-day, each worker labored in the same location and was exposed to the same, extremely dusty conditions. Ventilation was oftentimes non-existent during the early manufacturing days, and the worker had no reprieve from the repetitive accumulation of asbestos dust. Knowledge that workers laboring under such conditions suffered from a cumulative exposure to asbestos cannot be equated with knowledge that construction workers, presumably laboring under less disagreeable conditions and less dusty conditions [FN16] would suffer the same ill-effects to the same degree. In *Angotti*, supra, the court commented:

FN16. See, e.g., Record Document No. 245, filed December 11, 1991, referencing plaintiff's exhibit USG-16 at p. 2.

... While there was evidence that sawing of asbestos products by insulators produced dust in

varying degrees, depending on the type of material and the size of the cut, there was no evidence to show that the exposure of the plant employees with asbestosis was to the same degree as the exposure of an insulator. There are many products and environmental conditions that are known to create a health hazard to individuals exposed to a given degree which do not create a hazard to one exposed to a lesser degree....

.... [T]he fact that workers at the Philip Carey plant exposed to high volumes of asbestos dust within the manufacturing process contracted asbestosis does not show actual knowledge by Philip Carey that a health hazard existed from the exposure of an insulator, who did not work in the manufacturing process and within the confines of its plant, but who worked with its finished products. The evidence did not establish that Philip Carey had actual knowledge that insulators were exposed to a dangerous level of asbestos fibers by use of their products or that Philip Carey was put on notice and consciously chose to ignore information that showed its products were actually known to be harmful to insulators.

Angotti, supra, 812 S.W.2d at 747-748 (Emphasis supplied.). See also: *Martin*, supra, 494 A.2d at 1099 n. 15 (noting the distinction between articles and research studying the risks associated with mining and manufacturing raw asbestos and the risks associated with installing or applying asbestos-containing products), and *Smith*, supra, 564 A.2d at 212. Clearly, then, evidence that U.S. Gypsum was on notice that a bookkeeper in one of its manufacturing plants contracted asbestosis does not equate to knowledge that construction bystanders, such as Donald Sealover, were equally at risk.

Libby mine workers

Of all of the evidence which plaintiff proffers against W.R. Grace, that which brings her closest to proving actual knowledge of the hazard asbestos posed to construction workers is proof that the workers who experienced problems were, purportedly, exposed to only relatively small amounts of asbestos contained in the vermiculite. Plaintiff argues that this served as notice that even casual or indirect exposure to relatively small amounts of asbestos can cause serious lung problems. She contends that this also distinguishes this case from others decided by the Pennsylvania courts in which the courts refused to equate long-

standing knowledge of lung problems in plant workers with knowledge that asbestos would have an equally devastating effect on construction workers exposed to lesser quantities and lower concentrations. [FN17] See, e.g., *Neal v. Carey Canadian Mines and Martin*, supra. The conclusion which plaintiff seeks to draw from the problems experienced by the Libby mine and plant workers does not follow. Knowledge of their health problems does not equate under Pennsylvania law to actual knowledge that construction bystanders would suffer like problems from exposure on construction sites to asbestos-containing products. It stands to reason that exposure during the manufacturing process and during mining, when asbestos-containing *579 raw materials were being crushed, sorted, and otherwise manipulated, would pose a greater risk of more extensive exposure than would the installation of the manufactured product. See, e.g., *Angotti*, supra, 812 S.W.2d at 746-49 ("[A]rticles from medical literature relating to the 'hazards of asbestos exposure in industrial employment, and to the surrounding population,' and warnings by a medical advisor of 'possible liability to persons other than employees' does not establish actual knowledge and it does not establish that information was available to show that ... [defendant's] products were actually known to constitute a health hazard to insulators.") Further, the reports upon which plaintiff relies indicate that workers and miners were exposed to a large volume of dust. For example, a 1956 report from the Montana Board of Health states: "dust vibrates almost continuously off the rafters which have become loaded and are continuously loaded with dust generating from many sources." (Record Document No. 248, filed December 11, 1991 at p. 22, referencing W.R. Grace Exhibit 2). A letter written in 1961 by a Zonolite official expresses similar concerns, stating: "There is a relatively large amount of asbestos dust present in our mill and this is difficult to control." (Record Document No. 248, filed December 11, 1991 at p. 23). Thus, even though the dust workers were exposed to may have contained only trace amounts of asbestos, the fact that it was generated continuously and allowed to accumulate day after day distinguishes their situation from that of construction workers, where one would reasonably expect the volume of dust to be less. Once installation was completed installers move to a new location, so that one would assume that there is not the same opportunity for dust to accumulate day

after day in the same location and endanger the health of bystanders. Cf. *Wamrock v. Celotex Corp.*, 835 F.2d 818, 822 (11th Cir.1988) (punitive damages award against National Gypsum upheld based, inter alia on evidence that National Gypsum was aware of hazards asbestos exposure posed to miners, plant workers and others exposed to high concentrations of the dust and could be found to be "consciously indifferent" to the threat posed to construction workers by failing to act on that information to protect such workers from exposure).

FN17. (See: Record Document No. 248, filed December 11, 1991 at p. 17. Emphasis supplied.)

Post-1961-1962 evidence

[3] Plaintiff's reliance on post-1961-1962 evidence is misplaced. Evidence that W.R. Grace and U.S. Gypsum learned of the hazards of asbestos sometime after Sealover's exposure is in no way probative of what they actually knew prior to Sealover's exposure. Although such evidence is relevant in some cases, depending upon the claims raised, it is not relevant to the issues before this court. Cf. *Rowan County Board of Education v. U.S. Gypsum*, 103 N.C.App. 288, 407 S.E.2d 860 (1991) (post-exposure evidence relevant to refute defendant's assertions that asbestos ceiling tiles it marketed were suitable for installation in schools) and *Eagle-Picher Industries, Inc. v. Balbos*, 84 Md.App. 10, 578 A.2d 228, 249-50 (1990) (post-exposure evidence relevant to prove a duty to alert plaintiff after exposure and avert possibility of him worsening his condition by continuing to smoke cigarettes and/or to prompt the persons exposed to seek treatment earlier and thereby perhaps prolong their lives).

Cases cited by plaintiff

Plaintiff urges the court to follow *Ivins v. Celotex Corporation*, 115 F.R.D. 159 (E.D.Pa.1986), in which Judge Newcomer found the Saranac documents sufficient to support a claim for punitive damages against Owens-Illinois and Owens Corning Fiberglas. *Ivins* is inapposite, because the court did not follow what we now know to be the Pennsylvania standard for imposing punitive damages. Although the court stated that liability had been established under both *Martin* and the line of cases which preceded it (cases which did not

require the plaintiff to prove actual knowledge), its holding was framed in terms of what the defendants should have or could have inferred from the Saranac findings, not in terms of what they actually knew "580 about the effect of asbestos on construction workers. The court stated:

[T]he Saranac documents could indicate that Owens-Illinois and OCF had knowledge of the danger sometime between 1948 and 1958. Second ... testimony with respect to OCF's familiarity with asbestos and the contemplated publication of the 'asbestos file' may support the inference that OCF was aware of the hazards of asbestos in mining and factory settings. Such evidence could also show that OCF knew or should have known of such facts as would cause a reasonable person to realize the existence of a serious danger. Since plaintiffs' proofs may support the inference that defendant OCF—long before it took ameliorative action—(1) knew of the risks associated with asbestos or (2) knew or should have known of facts which would cause a reasonable person to realize that exposure to asbestos caused significant health risks, it would be inappropriate to dismiss plaintiff's claim for punitive damages as a matter of law.

Ivins, *supra*, 115 F.R.D. at 166.

City of Greenville v. W.R. Grace & Co., 827 F.2d 975, 981-83 (4th Cir.1987) is distinguishable on its facts. The City of Greenville, South Carolina sued W.R. Grace to recover the cost of removing a fireproofing product called Monokote from the Greenville City Hall. The city was awarded compensatory and punitive damages on its negligence and breach of warranty claims. On appeal, the award was upheld by the Fourth Circuit Court of Appeals. Unlike the case before us, W.R. Grace sold the asbestos-containing Monokote to Greenville in 1971 to 1972, at a time when it was fully aware of the hazards associated with asbestos products, knew that the asbestos-containing Monokote was not suitable for the purposes for which it was sold because of its tendency not to bond to the surfaces to which it was applied, and, acting in response to well-publicized concerns about the health risks associated with asbestos exposure, had developed and was marketing commercially a non-asbestos Monokote product.

Repeated punitive damage awards

Defendants raise several policy reasons for not permitting punitive damages in this case, which we will address briefly. Defendants cite: (1) the compensatory and punitive damage judgments assessed against them in prior cases; (2) pending asbestos claims; [FN18] (3) the dire financial straits of other asbestos manufacturers as reasons for disallowing punitive damages in this case; and the fact that plaintiff has been fully compensated for her injuries. They argue under the circumstances, subjecting them to punitive damages would serve no purpose and "unreasonably endanger future litigants' chances to recover compensatory damages" by further draining defendants' limited financial resources. If their coffers are further depleted by large punitive damage awards in cases such as this, they argue, the injuries of future claims will go uncompensated. Other injured parties, having an equal right to receive full compensation for their losses, will receive nothing. By allowing plaintiffs to proceed to trial on the punitive damage issue, defendants argue, the court would be sanctioning a practice contrary to the interests of other injured parties.

FN18. Unfold numbers of asbestos personal injury actions have already been litigated to conclusion and statistics indicate that the stream of litigation is far from waning. Court records indicate that "presently in the federal system nearly two new asbestos actions are being filed for every action terminated, and that at the current rate, there will be more than 48,000 actions pending in the federal courts at the end of three years." *In re: Asbestos Products Liability Litigation* (No. VII), 771 F.Supp. 415, 418 (J.P.M.L.1991) (citing Report of the Judicial Conference Ad Hoc Committee on Asbestos Litigation, 8 (1991)).

The Third Circuit Court of Appeals has recognized the legitimacy of the concerns which defendants raise. In *In Re School Asbestos Litigation*, 789 F.2d 996, 1003-04 (3d Cir.1986), the court commented on the inappropriateness of punitive damages in mass tort litigation, stating:

In the era when most tort suits were 'one-against-one' contests, a single act triggered a single punishment. The increasingly "581 prevalent mass tort situation, however, exposes a defendant to repetitious punishment for the same culpable conduct. The parallels between the assessment of exemplary damages and a fine levied in criminal

courts have led to suggestions that the concepts of double jeopardy and excessive punishment should be invoked in the civil field as well.... (Citations omitted.)....

Similar concerns have prompted highly respected judges to comment on the possibility that the due process clause might contain some constitutional limitation on the amount of exemplary damages to be awarded. 'Unlimited multiple punishment for the same act determined in a succession of individual lawsuits and bearing no relation to the defendants' culpability or the actual injuries suffered by victims, would violate the sense of "fundamental fairness" that is essential to constitutional due process.' In *re* Federal Skywalk Cases, 680 F.2d 1175, 1188 (8th Cir.1982) (Heaney, J. dissenting). 'There must, therefore, be some limit, either as a matter of policy or as a matter of due process, to the amount of times defendants may be punished for a single transaction.' In *re* 'Agent Orange' Product Liability Litigation, 100 F.R.D. 718, 728 (1983). In addition to a possible federal constitutional limitation, state substantive tort law could place restraints on repetitive punitive damage awards....

....
Thus powerful arguments have been made that, as a matter of constitutional law or of substantive tort law, the courts shoulder some responsibility for preventing repeated awards of punitive damages for the same acts or series of acts.

....
... [T]he tens of thousands of personal injury suits in which punitive damage verdicts have been and continue to be assessed ... are satisfied from the same pool of assets to which the school districts now look. If a limit is ever placed on the total punitive damages to be imposed on the asbestos defendants, then that limit probably would apply to all claims whether they arise in property damage or personal injury suits.

....
... [D]espite strong arguments favoring limitations on punitive damages and the increasing number of bankruptcies, the 'business as usual' attitude still prevails.... (Citations omitted.)

School Asbestos Litigation, *supra*, 789 F.2d at 1003-05 and 1007. Although the Third Circuit recognized the need for controls, it has not thus far adopted a rule limiting the number of punitive damage recoveries against a single defendant for a single product or course of action. The United

States Supreme Court has also acknowledged that there are Fourteenth Amendment due process constraints on punitive damage awards. *Pacific Mutual Life Insurance Co. v. Haslip*, 499 U.S. 1, 111 S.Ct. 1032, 113 L.Ed.2d 1 (1991).

Defendants further argue that allowing plaintiff to proceed with her punitive damage claim would be inconsistent with the order of the Judicial Panel on Multi-District Litigation (the "Panel") dated July 30, 1991 consolidating the pre-trial proceedings of all federal personal injury and wrongful death asbestos cases. In its decision to consolidate, the Panel made reference to concerns along these lines expressed in the March 1991 report of the Judicial Conference Ad Hoc Committee on Asbestos Litigation:

The ... five years [since 1985] have seen ... increased filings, larger backlogs, higher costs, more bankruptcies and poorer prospects that judgments—if ever obtained—can be collected.

....
The most objectionable aspects of asbestos litigation can be briefly summarized ... exhaustion of assets threatens and distorts the process; and future claimants may lose altogether.

In *re*: Asbestos Products Liability Litigation (No. VI), 771 F.Supp. 415, 418-19 (J.P.M.L.1991) (quoting Report of the Judicial Conference Ad Hoc Committee on Asbestos Litigation, 1-3, 9 (1991)).

[4] *582 Although the defendants raise legitimate concerns, this court is not the proper forum for redress. [FN19] If restrictions are to be imposed on the number of punitive damage awards which may be assessed against a single defendant for the same product or course of action, they must be established by the Pennsylvania legislature or "a higher judicial authority", but not by this court. See: *Glasscock v. Armstrong Cork Co.*, 946 F.2d 1085, 1096-97 (5th Cir.1991) ("If there is to be further control of repeated punitive damage awards, the solution must be found through legislation."); *King v. Armstrong World Industries, Inc.*, 906 F.2d 1022, 1031-33 (5th Cir.1990), *cert. denied*, 500 U.S. 942, 111 S.Ct. 2236, 114 L.Ed.2d 478 (1991); *McCleary v. Armstrong World Industries, Inc.*, 913 F.2d 257, 260-61 (5th Cir.1990). Cf. *Juzwin v. Amtorg Trading Corp.*, 718 F.Supp. 1233, 1235 (D.N.J.1989) ("[T]his court does not have the power or the authority to prohibit subsequent [punitive damage] awards in other courts

notwithstanding its opinion that such subsequent awards violate the due process rights of the defendants against whom such verdicts are entered. Until there is uniformity either through Supreme Court decision or national legislation, this court is powerless to fashion a remedy which will protect the due process rights of this defendant or other defendants similarly situated.") and *Gogol v. Johns-Manville Sales Corp.*, 595 F.Supp. 971, 975-76 (D.N.J.1984).

FN19. Commentators have recognized the legitimacy of these concerns, but have also urged a legislative solution. See: Robert E. Scott, Jr., *Punitive Damages: Constitutionality, Elements and Defense--The Defense Perspective*, 387 PLI 425 (March 1, 1990). Commentators have urged the need for a restraint on the number of punitive damage awards that may be imposed on any one company for injuries arising from a single product or line of products. See: Jack B. Weinstein and Eileen B. Hershenov, *The Effect of Equity on Mass Tort Law*, 1991 U.ILL.Rev. 269 (1991).

ORDER

For the reasons stated in the accompanying memorandum, IT IS ORDERED THAT:

1. The motions [FN1] (Record Document No. 234, filed October 29, 1991 and Record Document Nos. 245 and 246, filed December 11, 1991) by U.S. Gypsum to bar plaintiffs from proceeding with their punitive damage claim and to exclude evidence of punitive damages are granted.

FN1. Also outstanding are plaintiff's motion for delay damages; defendants' motions for a new trial or j.n.o.v.; plaintiff's motion to sever the case against GAF; and defendants' motion to treat Johns-Manville as a settled defendant and mold the verdict. These motions will be addressed in a separate memorandum and order.

2. The motion (Record Document No. 238, filed November 15, 1991) by W.R. Grace for summary judgment on plaintiff's punitive damage claim is granted.

3. The parties having agreed that the court should treat the above motions filed by W.R. Grace and U.S. Gypsum as motions for summary judgment on

plaintiff's punitive damage claim, summary judgment is granted in defendants' favor on that claim.

4. The Clerk is directed to defer entry of final judgment until further order of court.

END OF DOCUMENT



2000 112 1200

IN THE CIRCUIT COURT OF MONONGALIA COUNTY, WEST VIRGINIA

JOHN DANIEL DAVIS, et al.,

Plaintiffs

v.

ARMSTRONG WORLD INDUSTRIES, INC.,
et al.,

Defendants

CIVIL ACTION FILE
NO. 86-C-763

1 THE COURT: I have seen conspiracy charges
2 abused, I think, particularly in recent years in the
3 federal courts in RICO action and things like that,
4 and I am really wary of them. And I think it denies
5 people the right of fair exchange of ideas preliminary
6 to make all sorts of decisions.

7 I just don't feel that this kind of
8 activity, and assuming every bit of it is true that
9 has been presented to the Court, can possibly rise to
10 the level of a conspiracy.

11 What I saw was minimal evidence with respect
12 to Gypsum connecting them to the study -- and I can't
13 recall the evidence in the H. K. Porter, maybe because
14 it wasn't reminded to me, I suppose -- in that they
15 struck a provision relating to cancer, for perhaps
16 good reasons and maybe perhaps for bad reasons, but
17 that it was done in a fair exchange of ideas at the
18 time.

19 I think that you have to put this in the
20 perspective of the time it was done and as intelligent
21 businessmen and scientists.

22 Whether or not the appropriate follow-up was
23 done or what was done subsequent to that in terms of
24 warnings, it is of a greater concern.

1 I mean some of the language I saw concerning
2 warnings shows me that there was somewhat of a
3 calloused view of trying to let people know the danger
4 of the product that they were dealing with.

5 I don't see anything that would have been an
6 illegal act save the general common law, I suppose,
7 that you owe a duty from one person to another not to
8 do things harmful to them.

9 But accepting that as being the common law
10 of the time, I don't see how you can say that the
11 fact that they chose to delete a section of a report
12 at that time would constitute a conspiracy. I just
13 really don't. I mean I really don't.

14 And I have to say that I started thinking on
15 this with the idea of trying to leave it in and trying
16 to right things there, but I don't see it that way.
17 I really don't see a conspiracy.

18 The motion for a directed verdict is granted
19 verdict with respect to conspiracy on H. K. Porter and
20 United States Gypsum.
21
22
23
24



Class

OUTLINE OF PROPOSED MONOGRAPH ON ASBESTOSIS
San Francisco Laboratory Study under Grant from Asbestos Association

PART I HUMAN ASBESTOSIS

- 1 Human Pathology - a study of 25 autopsy cases, Illustrated
- 2 X-ray Patterns in Asbestosis, Illustrated
- 3 Ash and Mineral Values in Human Asbestosis
- 4 Complications of Asbestosis
 - (a) Susceptibility to infection
 - i Tuberculous
 - ii Non-Tuberculous
 - iii Cancer of the lung
- 5 Disability, causes and comparison with silicosis
- 6 Diagnosis
 - (a) History of adequate exposure
 - (b) X-ray film pattern
 - (c) Physical examination
 - (d) Asbestos bodies in sputum, their significance

PART II Experimental Asbestosis

1 Methods

- (a) Inhalation exposure to plant dusts.
- (b) Injection into lungs through trachea of pure mineral.
- (c) Injection of pure minerals into other organs.

2 Species Susceptibility

Man, guinea pigs, rabbits, cats, white mice and rats.
Cogs.

3 Peculiar Characteristics of Asbestosis

- (a) Unusual localization of chrysotile fibres in lungs.
- (b) Rate of resultant tissue reaction more rapid than to quartz.
- (c) Reaction to chrysotile not progressive after exposure ceases; again the reverse of the situation in silicosis.
- (d) Asbestosis Bodies

- i Composition and methods of formation.
- ii Occurrence in different species.
- iii Formation does not parallel development of fibres.
- iv Gradual disappearance after exposure ceases.

4 Comparative Effects of Different Asbestiform Minerals.

- (a) Canadian Chrysotile.
- (b) Arizona Chrysotile, low iron.
- (c) Crocidolite
 - i Bolivian specimen, stiff and elastic.
 - ii South African, soft and flexible.
- (d) Anthrophyllite
- (e) Actinolite.
- (f) Tremolite.

5 Effects of Control Minerals

- (a) Granular Serpentine, same chemical composition as chrysotile.
- (b) Glass Wool, a synthetic silicate fibre.
- (c) Brucite, a fibrous magnesium hydroxide almost free of silica.

6 Chemical Composition of Asbestiform Minerals in Relation to Irritation.

- (a) Nothing in composition correlated with relative irritant capacity.
- (b) Preliminary acid treatment
 - i Hydrochloric acid
 - ii Carbonic acid

(c) Effects of Aluminum

7 Physical Properties in Relation to Irritation

- (a) Length of fibre
- (b) Effect of crushing
- (c) Heat treatment

8 Nature and Significance of Asbestosis Body

- (a) Formation
- (b) Protective effect preventing further irritation
- (c) Ultimate solubility in tissue

9 Theories of Action of Asbestiform Minerals

- (a) Chemical - reasons for considering invalid
- (b) Mechanical - experimental demonstration of.

10 Complications

- (a) Infection, tuberculosis and other varieties
- (b) Cancer of lung - experimental data suggestive but not proven

11 Disability

12 Essential Features of Hazardous Exposure

- (a) Nature of dust - fibrous component and size factors
- (b) Atmospheric Concentrations - probably lower than for quartz

- 1 Inadequacy of standard impinger sampling method which does not collect the dangerous fibres
- 11 Electrostatic precipitator sampling preferable but method must be modified

(c) Duration of Exposure

13 Recommendations for a New Standard of Safe Atmospheric Concentrations of Asbestos Dust

- (a) The quasi-official standard of 4 to 5 million particles per cu. ft.
- (b) Work upon better method of sampling
- (c) Necessity for comparison of results with X-ray findings in employee.

14 Prevention

- (a) Chemical means not practical

(4)

- i Acidosis necessary to dissolve fibre in lungs worse than Asbestosis
- ii Aluminum Therapy inapplicable
- iii Chief reliance still upon dust prevention with special emphasis upon the fibrous components

ASBESTOSIS - ATTACHED OUTLINE INDICATING RESULTS

PART I - HUMAN ASBESTOSIS

1 Histology and X-ray Patterns - Description

Based upon 23 human autopsies

2 Ash and Mineral Values in Human Lungs.

3 Complications of Asbestosis

(a) Susceptibility to Infection

i Tuberculous- High incidence in English experience not duplicated in surveys of American Plants. Available autopsy statistics deceiving because of selection of material.

ii Non-Tuberculous- The same reason probably applies should be checked by analysis of asbestosis among asbestos workers.

iii Cancer of Lung Ditto, but there are now on record 10 cases of lung cancer in asbestos worker. Compared to the total number of autopsies on asbestosis, this incidence is excess. No such frequency has been discovered in silicosis or other forms of pneumoconiosis except the Schneeberg mine's of radioactive ores. The evidence is suggestive but not conclusive that asbestosis may precipitate the development of cancer in susceptible individuals.

4 Disability

Clinical experience suggests that truly disabling asbestosis is manifested by less striking X-ray changes than a corresponding degree of silicosis. Such disability in asbestosis is due to disease within the lungs and not to secondary heart disease. As in silicosis, associated pulmonary infection increases the amount of severity of the dust fibrosis with resultant accentuation of disability. There is urgent need for a careful physiological study of pulmonary function in asbestosis of varying severity. Undoubtedly, there are many diagnosable cases with no significant disability.

5 Diagnosis depends upon three factors.

(a) History of adequate exposure, usually 5 to 8 years, sometimes longer, at work where both the concentration and character of the "asbestos" dust are hazardous.

- (b) Evidence of disease in a characteristic X-ray pattern.
- (c) A physical examination which reveals certain characteristics alone may reveal evidences of disability if present.
- (d) Asbestos bodies in the sputum are confirmatory, when the previous factors are all positive. However, the bodies may be absent, particularly in the absence of bronchitis infection. Asbestos bodies unsupported by other evidence do not make a diagnosis. Occasional ones have been found in about 15 autopsy specimens of persons with no known exposure and no fibrosis, probably of non-occupational origin.

PART II Experimental Asbestosis

I. Methods

- (a) Inhalation Exposures to Plant Dust - Specific fibrosis in lungs, but no changes elsewhere.
- (b) Injections of Suspensions of Pure Minerals into Trachea - Similar results.
- (c) Injection of Suspensions of Pure Minerals into other organs - Fibres dissolved; no asbestos bodies; tissue reaction confined to phagocytosis and encapsulation. Compare the asbestos corpus of human subjects.

II. Susceptibility

Free silica, asbestos does not produce its specific effect in any organ of any species of animal. It causes fibrosis only in the lungs of man and those of a few of the species tested.

Species	Fibrosis	Asbestos Bodies	Species	Fibrosis	Asbestos
Man	+	+	Guinea Pig	+	+
Guinea Pig	+	+	Rabbit	+	+
Rabbit	+	+	White Mouse	+	+
White Mouse	+	+	White Rat	+	+

(Note: Some small atypical asbestos bodies in Dog, Cat, etc.)

III. Peculiar Characteristics of Asbestosis

- (a) Localization of fibrous minerals in lungs differs from that of granular dust particles.

1. Fibres like chrysotile having a certain degree of flexibility and elasticity accumulate within the finest air tubes granular dust is carried and is widely scattered through the terminal air spaces.
- (b) Rate of tissue reaction to asbestos is much more rapid than to an active dust like quartz. Evidences of formation appear as soon as sufficient concentration of fibres has localized in specific areas; with quartz, there is a latent period of months.
- (c) Reaction to asbestos does not progress on cessation of exposure. Young scar tissue that may have formed, contracts and becomes more dense but the area of involvement decreases in size. In silicosis, the young nodules become larger after exposure ceases.
- (d) Asbestosis Bodies are a specific concomitant of this form of pneumoconiosis. They are due to a deposit of protein and iron upon the surface of inhaled fibres. In guinea pigs they form after about 60 days of contact with the tissue. They are abundant in man and guinea pigs, (See paragraph 2 above) but much larger in the former probably because the larger sized air tube admit larger fibres. In cats, rabbits and mice, there is an atypical coating of a few of the fibres after much longer residence in the lungs; in rats and dogs no bodies could be discovered. From paragraph 2 it is apparent that their occurrence does not parallel development of fibrosis. In lung injection experiments, the bodies have not developed until after fibrosis is well advanced. The number of bodies seems to decrease several years after exposure ceases.

7 Comparative Effects of Different Asbestos Minerals

- (a) Canadian Chrysotile - highly irritating.
- (b) Arizona Chrysotile (low in iron) equally irritating and produces just as many asbestosis bodies as the Canadian product with over 11 times as much iron.
- (c) Crocidolite - The South-African blue asbestos is known to cause asbestosis. Only a limited supply of this material in pure form was available, most of it was used earlier in the work in non-productive experiments. For the later critical injection tests into the lungs, a Bolivian variety was substituted because of its high purity. Its fibres were much straighter, stiffer and more elastic than the cottony South African variety. Perhaps because of these peculiarities, it has not given reactions comparable to chrysotile. It produced asbestosis bodies but did not localize in the terminal air tubes nor cause any fibrosis. Tests now being repeated with a typical South African crocidolite with physical characteristics simulating chrysotile.

- (d) Anthophyllite - stiff, needle-like fibres - atypical asbestos bodies form slowly but no localization of fibrils in lungs.
- (e) Annite - Ditto.
- (f) Archibute - Ditto.
- (g) Tronolite - Ditto but very few asbestos bodies - Observation being continued.

V Control Mineral

- (a) Granular Sennentine of same chemical composition as chrysotile is inert causing no fibrosis in lungs or other organs. It attracts iron from the lungs but of course, no 'bodies' develop.
- (b) Glass Wool (a synthetic silicate) fibres are not inhalable from air-borne suspensions, apparently because of their stiffness (the diameter is not responsible as some used were less than 1 micron thick). On injection into the lungs, they do not localize in the air tubes but are widely scattered. They cause no fibrosis. After 3 or 4 months in contact with lung fluid, a few glass fibres take up iron but remain smooth. They never show the swollen ends and lateral projections of the true asbestos bodies.
- (c) Erinite of interest because it is a fibrous mineral practically free of silica (0.95). Crystallographically the arrangement of its Mg and OH groups in each unit cell is similar to that in chrysotile. The sample used also contained about 1% iron, probably from contaminating magnetite. The fibres are stiff and needle like. Observations not yet completed but after 2 months in the lungs, typical asbestos bodies develop but there is as yet no fibrosis. The fibres are scattered through the lung instead of being localized inside the terminal air tubes and tissue reaction occurs around, instead of within the tubes.

VI Chemical Composition in Relation to Irritation

- (a) Varying in the following chemical compositions can be correlated with variation in capacity to provoke tissue reaction.

(See Table Next Page)

	Chrysotile	Crocidolite	Anthophyllite	Amphibole	Amphibole	Amphibole	Amphibole
SiO ₂	57.43%	54.89%	47.45%	48.2%	53.04%	55.7%	55.05%
Fe ₂ O ₃	2.35%	15.27%	0.81%	2.4%	0.5%	7.21%	8.75%
FeO	0	4.20%	0.7%	33.83%	0	0.4%	8.35%
Al ₂ O ₃	0.36%	1.07%	0.25%	1.09%	1.80%	0.58%	0.45%
CaO	0.03%	0.79%	0.44%	2.01%	12.22%	4.43%	0.40%
MgO	35.77%	12.23%	29.84%	8.85%	23.20%	20.82%	23.89%
MnO	0.29%	4.92%	0.52%	0.33%	0.40%	6.78%	0.91%
K ₂ O	0.08%	0.57%	0.13%	0.10%	0.12%	0.99%	0.16%
Loss < 105°	4.30%	0.02%	0.62%	0.65%	0.32%	0.34%	0.23%
> 105°	14.92%	2.55%	2.42%	1.51%	3.59%	2.78%	25.66%

(b) Acid treatment of chrysotile fibres

- 1 One hour in dilute or concentrated HCl does not alter appearance of fibre but after such treatment it rapidly dissolves and disappears on injecting into living tissues.
- 2 Treatment with CO₂ bubbled through water or lung juice suspensions of chrysotile fibres causes partial solution with liberation of silica and magnesia.

- (c) Colloidal alumina does not neutralize the effects of asbestos as it does quartz. On injecting chrysotile suspended in aluminum hydrate solution, fibrosis and asbestos bodies develop at the usual rate. It remains to demonstrate whether the fibres become coated with a layer of aluminum monohydrate as has been proved in the case of quartz. If they have, the acid does not affect their capacity to irritate tissue.

VII Physical Properties in Relation to Irritation of Lung Tissue

(a) Length of Fibre

Short chrysotile fibres under 3 microns are practically inert. 20 to 50 micron fibres cause typical fibrosis. The effects of longer ones could not be tested for technical reasons.

- (b) Crushing completely destroys the fibrous structure of chrysotile. With loss of structure, all capacity to irritate disappears.

- (c) Heat: At ignition temperatures, water is driven off and the fibre-structure is preserved. Fibres become extremely brittle. The physical change alters typical localization within the lungs, no fibrosis develops, reaction limited to phagocytosis. No asbestosis bodies formed.

VIII Nature and Significance of Asbestosis Bodies

- (a) Bodies probably result from deposition of iron and organic matter on a slowly dissolving fibre of asbestos. The source of the iron is more likely to be the lung tissue than the mineral itself as the coating is just as heavy on fibrous minerals of low iron content as upon those high in iron.
- (b) The effect of asbestosis body formation is assumed to be protective although it has not been possible to isolate a large enough quantity of these structures in unaltered form for purposes of test. The smooth rounded ends presented by the bodies would not be mechanically irritating.
- (c) If they were capable of causing irritation, the fibrosis in the lungs should progress after exposure ceases which it does not.
- (d) The gradual disappearance of bodies (and fibres) long after exposure points to ultimate solubility in tissue fluids.
- (e) The bodies are probably a fortuitous concomitant rather than a cause of fibrosis.

IX Theories of Irritant Action of Asbestiform Minerals

- (a) Chemical These experiments do not confirm the theory that asbestosis is merely a form of silicosis resulting from free silica liberated in the solution of a silicate molecule. If this were true asbestos, like quartz, should cause fibrosis in any organ of any species for the experiments have shown that injected asbestos dissolves in these locations. However, it does not cause such reaction in any location but the lungs of a few species.
- (b) Mechanical Irritation

We are proposing the theory of mechanical irritation which is manifested only in the lungs because this organ is the only one whose normal physiological functions involve a high degree of mobility. Experiment, designed to prove the necessity for motion in this tissue have failed for technical reasons. For this theory to be applicable, it is necessary that the fibres be concentrated in the fine terminal air tubes. It has been shown that only c. vestile of the asbestiform minerals thus far has the proper physical characteristics to insure such localization. It is also essential that the fibre shall persist long enough before it dissolves in the lungs of species like mice, rats, dogs. It apparently dissolves so rapidly that it exerts no irritation. Similarly rapid solution may explain in part the lack of fibrosis in organs other than the lungs.

The fibres must be long enough so that they cannot be completely surrounded by phagocytic cells which would prevent contact of the round, broken ends with the delicate cells supporting the air sacs. Observation has demonstrated that these conditions are realized in guinea pigs treated with long fibre chrysotile and fibrosis results. With the other asbestiform minerals that have been tested, some of all of the prerequisites were lacking and no fibrosis developed.

- (c) If the irritation were chemical, fine serpentine which has the same chemical composition as chrysotile should have also caused fibrosis. The crushed chrysotile should have been more active than intact fibres, because of the greater surface area exposed to body fluids. On the assumption that chrysotile, like quartz, becomes coated with a very thin layer of aluminum on treatment with colloidal aluminum hydroxide, capacity to cause fibrosis should be destroyed if the action were chemical but such is not the case.
- (d) The heavy coating resulting from asbestosis body formation apparently does stop tissue reaction but here the effects are probably mechanical for reasons cited.
- (e) Heat sufficient to alter chemical structure & destroys power to irritate but it also alters essential physical characteristics that affect localization of the fibres in the lungs.

X Complications

(a) Susceptibility to Infection

- i Tuberculous - Asbestos behaves like most other minerals in this respect and not like quartz which specifically increases native susceptibility to the tubercle bacillus. This infection may spread for a time but then heals. The resulting fibrosis accentuates that caused by the mineral fibre.
- ii Non-Tuberculous - of no greater frequency than in animals inhaling dusts of other kinds. Occasional epidemics of pneumonia occur in our dust rooms, but these are due to methods of housing rather than to dust; they can also occur in unexposed animals.

iii Cancer of Lungs

No experiments were designed to elucidate this point but certain evidence suggests that asbestosis may actually favor development of tumors in susceptible species.

- 1 In guinea pigs, rabbits, rats, cats and dogs lung tumors are rare.
- 2 When these species were subjected to 2 to 3 years inhalation of asbestos dust, the incidence of lung tumor was not increased.

- 3 Some strains of white mice do develop tumors without apparent cause.
- 4 Such a strain of white mice was unintentionally used in three inhalation experiments with asbestos.
- 5 Of 11 mice inhaling long fibre asbestos for 15 to 24 months developed malignant tumors in their lungs and 6 of these had tumors in other organs. The incidence rate 54.5% is excessive.
- 6 Of 22 mice inhaling short fibre asbestos for not longer than 12 months only 3 developed lung tumors. Rate 13.6%
- 7 As controls, we have only the experience with mice in other dust experiments.
For short periods, there were 51 mice exposed to 4 other kinds of dust for 10 to 12 months. Incidence of lung tumors 1.5%.
For long periods, there were 143 mice exposed to 4 different kinds of dust, including pure quartz, 23 to 31 months. For all this group of mice the average incidence of lung tumors was 15.4%; the highest rate (23%) was in a subgroup exposed to flint dust.

Thus the incidence of lung cancer in the long fibre asbestos mice was over 16 times the average for mice inhaling other dusts for comparable periods and over 3 times the maximum for any other group. Mice exposed to the practically inert short fibre asbestos showed fewer lung tumors although 7 times more than those in short exposure to other dusts.

These observations are suggestive but not conclusive evidence of a cancer stimulating action by asbestos dust. They are open to several criticisms. The strain of mice was not the same in the asbestos experiment as in many of the others cited; apparently the former were unusually susceptible. Not enough animals survived in the dust for longer than the 15 months apparently necessary to produce many tumors. There were no unexposed controls of the same strain and age and no similar controls exposed to other dusts. It is hoped that this experiment can be repeated under properly controlled conditions to determine whether asbestos actually favors cancer of the lung.

XI Disability

Cannot be determined in animals. The accidental deaths were from the same causes as with in all our dust inhalation experiments.

XII Essential Factors of Hazardous Exposure

(a) Nature of Dust

- i The hazard increases with the proportion of intact fibres in the dust. Granular material and crushed fibres are inert diluents.
- ii The long fibres must be thin enough (1-3 Microns) and short enough (under 30 Microns?) to be inhaled.
- iii Very short fibres (under 3 Microns) are practically inert.

(b) Atmospheric Concentration Still under study.

Apparently this factor is lower than in the case of dusts composed of granular minerals but methods of estimation are misleading.

- i The average standard Public Health Service impinger count in the long fibre asbestos dust room was 40 million particles per cu. ft. of air. This concentration caused fibrosis visible to the naked eye in 20 to 24 months. For comparison: the average impinger counts in an experiment with pure quartz was 120 million particles per cu. ft. and fibrosis developed at about the same rate.
- ii However, impinger counts are deceptive because by this method of sampling very few fibres, which are the significant elements in the dust are collected.
- iii Sampling with an electrostatic precipitator is a much more efficient means of collecting fibres from air-borne suspensions. Samples from our long fibre asbestos room showed that the dust in the air contained 32.5% of fibres few of which had been collected or counted in the impinger sample. The latter sampled largely the inert granular part also.
- iv An ordinarily employed precipitator samples are weighed and the results expressed in mg. per cubic foot of air. There is no means of converting such values into numbers of particles particularly when these vary in size, shape and specific gravity.
- v Simultaneous sampling with precipitator and standard impinger yielded the respective values of 0.65 mg and 80 million particles per cubic foot of air.
- vi Theoretically the best index of hazard would be either the number or weight of fibrous elements in the dust.

(c) Duration of Exposure

i Fibrosis visible to the naked eye after 12 months exposure increases in extent in subsequent 12 months.

ii The span of life of our most susceptible laboratory animal the guinea pig has prevented continuing exposure longer than three years. In this period only the comparatively early stages of asbestosis have been produced. With the knowledge that we have gained, it is probable that more extensive disease could have been produced with a purer long fibre chrysotile. The long lived species, like cats, dogs are unfortunately not susceptible.

iii For these reasons X-ray changes have been minimal and we were not able to fulfill one of the objectives of this program.

XIII Recommendation for a New Standard of Safe Atmospheric Concentration of Asbestos Dust.

- (a) While there is no official standard, the tentative one of 4 or 5 million particles per cubic foot of air is frequently quoted.
- (b) This is probably unreliable because it is based upon sampling with a standard impinger which we have shown does not collect most of the fibres that are the source of hazard.
- (c) We now think that a standard should be based upon samples collected with an electrostatic precipitator if it is feasible to determine readily the relative proportion of fibres in such material.
- (d) Work is still in progress upon the latter point.
- (e) To be of value the new standard would have to be correlated with the X-ray findings upon employees exposed to different concentrations of dust.

XIV Prevention of Asbestosis

The experiments have failed to develop any practical chemical means of neutralizing the action of fibrous asbestos.

- (a) To alter the human metabolism so that it would dissolve asbestos fibres rapidly like a stone would necessitate creating an acidosis which would be worse than the effects of the fibrosis.

- (b) Apparently asbestos, which is an effective agent, has little incidence upon fibrous components.
- (c) However, it would be of great interest to know the results upon advanced silicosis and the relation of quartz to the lung. The general pharmacological effect of such dusts is still a matter of controversy.
- (d) Chief reliance must still be based upon control air and, in view of these experiments, the fibrous components of such dust.