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Personal Injury Hazardous Waste Litigation: A Proposal for Tort Reform

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PERSONAL INJURY HAZARDOUS WASTE LITIGATION: A PROPOSAL FOR TORT REFORM

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I. INTRODUCTION

This article will propose a framework for personal injury hazardous waste litigation that would make it easier for exposed victims of hazardous waste contamination to maintain a prima facie tort case for damages in state courts. Under existing case law, persons exposed to hazardous waste pollution have not received compensation through the state court system. Public law has proved similarly unreceptive to private parties with hazardous waste damage claims.[1] In recognition of the scientific, medical, and legal problems unique to hazardous waste injuries, this article suggests a reduction of the evidentiary and substantive legal burdens that a potential plaintiff must bear in seeking compensatory relief.

A. The Hazardous Waste Problem

Every year millions of tons of hazardous wastes are discarded into the environment.[2] The United States Environmental Protection Agency (EPA) estimated that in 1980 alone 57 million metric tons of hazardous waste were generated throughout the nation.[3] It was

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1. *See infra* text and notes at notes 32-36.

2. OFFICE OF WATER & WASTE MANAGEMENT, U.S. ENVIRONMENTAL PROTECTION AGENCY, EVERYBODY'S PROBLEM: HAZARDOUS WASTE 1 (SW-826) (1980). *See* Senkan & Stauffer, *What To Do With Hazardous Waste,* 84 TECH. REV. 34 (November/December 1981).

3. COMPTROLLER GENERAL OF THE UNITED STATES, HAZARDOUS WASTE MANAGEMENT PROGRAM WILL NOT BE EFFECTIVE: GREATER EFFORTS ARE NEEDED 1 (CED-79-14) (Jan. 23, 1979) (Report to Congress). The source of this projection is given as the EPA. That agency estimated that 35 million metric tons per year of hazardous waste will be subjected to regulation. 43 Fed.

predicted that 90 percent of that was disposed of improperly, thereby presenting "significant imminent hazards" to the public health.[4] Experts estimate that of the approximately 50,000 hazardous waste disposal sites in the country, between 1300 and 34,000 sites contain substantial amounts of hazardous wastes which could damage human health or the environment.[5]

The existence of hazardous waste sites near residential communities has gradually added to the public health burden and risk of disease.[6] Environmental exposure to chemical carcinogens and toxins emanating from hazardous waste sites has become so widespread that environmentally-induced cancer and disease is now considered a major public health problem.[7] Some epidemiological studies have concluded that environmental factors cause from 70 to 90 percent of all cancers.[8]

Reg. 58,946, 58,946-47 (1978). *See* EPA, HAZARDOUS WASTE INFORMATION 2 (3d ed. 1980). *See also* B. BROWN, LAYING WASTE — THE POISONING OF AMERICA BY TOXIC CHEMICALS 293 (1980). The author estimates that if current trends continue, 400 million tons of hazardous waste will be released into the environment in 1984. *Id.*

4. B. BROWN, *supra* note 3, at 293. *See* COUNCIL ON ENVT'L QUALITY, TENTH ANNUAL REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY 181 (1979); AD HOC COMMITTEE ON THE EVALUATION OF LOW LEVELS OF ENVIRONMENTAL CHEMICAL CARCINOGENS, REPORT TO THE SURGEON GENERAL, *Evaluation of Environmental Carcinogens (1970)* [hereinafter cited as REPORT TO THE SURGEON GENERAL]; Fisher, *The Toxic Waste Dump Problem And A Suggested Insurance Program,* 8 B. C. ENVT'L AFF. L. REV. 421, 425 (1980).

5. *See* Fred C. Hart Associates, Preliminary Assessment of Cleanup Costs for National Hazardous Waste Problems 22 (E.P.A. Contract No. 68-01-5063) (1979); SUBCOMM. ON OVERSIGHT AND INVESTIGATIONS, HOUSE COMM. ON INTERSTATE AND FOREIGN COMMERCE, 96TH CONG., 1ST SESS., HAZARDOUS WASTE DISPOSAL 1 (Comm. Print 96-1 IFC 31, 1979). Wolf, *Public Opposition to Hazardous Waste Sites,* 8 B. C. ENVT'L AFF. L. REV. 463, 469-70 (1980).

6. Interview with Dr. Larry Brown, Director of the Community Health Improvement Program, Harvard University (Jan. 12, 1982). *See, Cancer Deaths Tied to Wastes in Jersey Study,* N.Y. Times, July 8, 1982, at B1; Lennet, *Handling Hazardous Waste,* Environment, Oct. 1980, at 7; HOUSE COMM. ON ENVIRONMENT AND PUBLIC WORKS, ENVIRONMENTAL RESPONSE ACT: REPORT TO ACCOMPANY S. 1480, H.R. DOC. NO. 848, 96th Cong., 2d Sess. 3 (1980).

7. S. EPSTEIN, THE POLITICS OF CANCER 2 (1978). In his State of the Union Address to Congress, President Carter cited improper disposal of hazardous wastes as "one of the most important environmental and public health issues" facing the United States. President's State of the Union Address 1980, *quoted in* [1980] 10 ENV'T REP. (BNA) 1895. According to Tennessee Congressman Albert Gore, the unsafe disposal of hazardous wastes is "the single most important environmental health issue of the decade." Costle, *Taming Chemical Wastes,* 5 EPA JOURNAL 2-3 (1979). With the dearth of private litigation of potentially legitimate claims by hazardous waste victims, it is difficult to measure the significance of the hazardous waste problem in unpaid damages to potential plaintiffs, particularly where no successful suits have been brought. *See* CONGRESSIONAL RESEARCH SERVICE OF THE LIBRARY OF CONGRESS, COMM. ON ENVIRONMENT AND PUBLIC WORKS, U.S. SENATE, 96TH CONG., 13TH SESS., SIX CASE STUDIES OF COMPENSATION FOR TOXIC SUBSTANCES POLLUTION 496-97 (June 1980) [hereinafter cited as SIX CASE STUDIES OF COMPENSATION].

8. S. EPSTEIN, *supra* note 7. B. BROWN, *supra* note 3, at 329.

In Woburn, Massachusetts, a dangerous hazardous waste site exists which exemplifies the problematic environmental and health consequences which can result from the dumping of hazardous wastes.[9] On October 23, 1981, the EPA identified the site, known as the Mark-Phillips Trust, as one of the ten worst dumpsites in the United States[10] and targeted it for federally subsidized cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).[11] Earlier, the agency had discovered waste deposits on the site containing high concentrations of two known human carcinogens, arsenic and chromium, as well as other chemical contaminants.[12]

In May, 1979, two municipal drinking water wells near the site were closed after high levels of several toxic contaminants were found in the water.[13] Previously, the wells had been the principal

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9. The site covers approximately 300 acres. It was used for over a century as a disposal area for industrial hazardous wastes. Woburn is a city of 35,000 located about 12 miles northwest of Boston. It was a major leather processing and chemical production center in the 19th and early 20th centuries. Today, Woburn is both a residential community and an industrial center. *See* Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass., filed June 15, 1982).

The EPA has proposed an expanded list of the 418 most dangerous hazardous waste sites in the nation. National Priorities List, 47 Fed. Reg. 58,476 (Dec. 30, 1982). The Mark-Phillips Trust site ranked fourth on the list; Woburn Wells G and H ranked 39th. *Id.* Woburn residents have publicly charged that the EPA cleanup efforts have been delayed without justification. Boston Globe, Feb. 23, 1983, at 6, 8.

10. The ranking of the 114 top-priority hazardous waste sites was based on a hazardous scoring system with greatest emphasis placed on potential threat to public health. Pollution via three "pathways" — air, ground water, and surface water — was measured for potential impacts. Announcement of Anne M. Gorsuch, Administrator, EPA (Oct. 23, 1981) *reprinted in* [1981] ENV'T REP. (BNA) 1028.

11. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Pub. L. No. 96-510, 94 Stat. 2767, 42 U.S.C. §§ 9601-9657 (1980), commonly known as Superfund, provides a $1.6 billion fund, financed by industry and the federal government, to clean up improperly disposed hazardous wastes where responsible parties cannot be determined or cannot afford to pay for cleanup. In instances where responsible parties can be identified and are solvent, the legislation permits the government to recover the cleanup costs from the party that caused the damage.

12. DEP'T OF URBAN AND ENVT'L POLICY, TUFTS UNIVERSITY, HAZARDOUS WASTES IN WOBURN, 11 (May 1980) [hereinafter cited as HAZARDOUS WASTES IN WOBURN]. EPA officials learned that there was an open pit — a dry lagoon — covering nearly an acre of land in which arsenic was piled in a caked white powder several feet thick. "So concentrated were the arsenic, lead and other chemicals that a mere 45 pounds of the soil would be enough to administer a lethal dosage to 100 adults." B. BROWN, *supra* note 3, at 115.

13. Wells G and H of East Woburn were closed after they were found to contain tricholoethylene (TCE), a known carcinogen, transdicloroethylene, tricholoethane, benzene, and chloroform. The wells are a half-mile to three-quarters of a mile from the waste site. HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 11. *See* Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass. filed June 15, 1982). The concentration of TCE found in wells G and H is 148 times the level of lifetime exposure to TCE which can be expected to cause one additional

source of water for East Woburn.[14] Stockpiles of uncovered animal hides discovered at the site were leaching toxic chemicals into both ground and surface waters.[15] Methane gas, a by-product of the waste materials, seeped into buildings constructed on the site in such explosive concentrations as to force evacuation.[16] In addition, residents of the nearby Town of Reading, which is downwind from the site, have complained of noxious fumes released into the air from the waste piles.[17]

Residents living near the Woburn site have alleged that the contaminants emanating from the area have caused substantial injuries.[18] Independent evidence indicates that since 1969 a significant outbreak of death and disease has occurred in Woburn. In January, 1981, the Commonwealth of Massachusetts Department of

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cancer in an exposed population of one million people. *Id.* The concentration is also twice the guideline amount established by the EPA to protect against acute illness from a 10-day exposure. *Id.*

14. Written Statement of Rev. Bruce A. Young, Priest, Trinity Episcopal Church, Woburn, Massachusetts, *reprinted in Hearings Before the Subcomm. on Health and Scientific Research, Committee on Labor and Human Relations, Comm. on the Judiciary,* U.S. Senate, 96th Cong., 2d Sess. (June 6, 1980) [hereinafter cited as *Health Hearings*]. *See* Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass., filed June 15, 1982).

15. HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 11. It is alleged that these chemical toxins have also percolated down into the local watertable aquifer, which runs directly underneath the hazardous waste site, thereby exposing a principal source of local domestic water supply in the region (and previously for contaminated Wells G and H) to the hazard of contamination from the disposal pits. *Id.*

The arsenic has been scattered widely by winds and rain and has contaminated a river watershed known as the Aberjona which passes through the site and flows into the Mystic Lakes and River. Much of the land area at the site is, or was at one time, wetlands which contributed to the river system. Many of these wetlands and a pond were used as receptacles for waste materials and now no longer exist. Towns downstream in these disposal areas are threatened by runoff or leachate from the toxic deposits. *Id.*, at 2. *See* Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass., filed June 15, 1982).

16. In December 1979, buildings in the industrial park had to be evacuated when methane gas was discovered coming in through the foundation. Methane gas is combustible and officials were concerned that an explosion would result; no explosion did occur. *See* HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 9-11.

17. Memorandum in Opposition to Entry of Final Judgment at 3, Dep't Envt'l Quality Eng'g, Att'y Gen. Commw. Mass., Town of Reading v. Trustees of Mark-Phillip Trust, No. 22690 Mass. Sup. Ct. (1980).

18. *Health Hearings, supra* note 14, at 20 (statement of Mrs. Anne Anderson, Woburn homeowner and mother of three-year-old leukemia victim); *id.* at 22 (statement of Mrs. Broderick, Reading resident and homeowner).

In Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass. filed June 15, 1982). Plaintiffs allege that due to their consumption of substantial quantities of contaminated drinking water "over the course of many years" from wells G and H, each plaintiff has contracted or "faces an increased risk" of leukemia, other cancers, liver disease, central nervous system disorders, and "other unknown illness and disease." *Id.* at 2.

Public Health (DPH) reported that the incidence of childhood leukemia and renal cancer in Woburn had significantly increased over the rates expected based on statewide experience.[19] DPH also confirmed an earlier study that found Woburn's cancer mortality rates to be significantly higher than rates for the state as a whole.[20] Three miles south of the Woburn waste site a cluster of eight childhood leukemia cases was reported within a half-mile radius in an East Woburn neighborhood.[21] For that half-mile census tract, which encompasses the southern portion of the town, less than one case would be expected over a fifteen-year period.[22] Seven of the eight children have since died.[23]

In response to the contamination, various governmental authorities, including federal agencies,[24] have taken broad remedial action

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19. COMMONWEALTH OF MASSACHUSETTS DEP'T OF PUBLIC HEALTH, STUDY OF WOBURN CANCER INCIDENCE AND ENVIRONMENTAL HAZARDS 1969-1978, at 2 (Jan. 23, 1981) [hereinafter cited as DPH STUDY].

In the Town of Woburn, for the years 1969 through 1978, at least 14 cases of acute childhood leukemia, blood cancer, have been identified where only seven cases would be expected. This excess is statistically significant, as the likelihood of such a large difference occurring by random chance is less than 6 in 1,000. Thirty cases of renal cancer were observed for the period 1969 to 1978, whereas 19.4 were expected. RESOURCE LOSSES FROM SURFACE WATER, GROUNDWATER AND ATMOSPHERIC CONTAMINATION — A CATALOG, 96TH CONG., 2D SESS. 99-100 (1981) [hereinafter cited as RESOURCE LOSSES STUDY]; Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass. filed June 15, 1982).

20. Of the 70 largest Massachusetts communities, Woburn's cancer mortality rate is 13 percent higher than expected for the years from 1969 to 1978. In the 1974 to 1978 period alone, deaths from cancer in Woburn were elevated by 23 percent, which is statistically significant; it is a higher rate than any other community rate in the state. Examined by specific cancer type, for the 10-year period 1969 to 1978, more deaths than would have been expected also occurred from cancer of the liver, female organs, kidney, prostate, breast, bronchus, lung, pancreas, and stomach. Also, the overall death rate in Woburn was 8 percent higher than expected. DPH STUDY, *supra* note 19, at 4.

The Community Health Improvement Program at the Harvard University School of Public Health is conducting a health survey of the entire Woburn community to determine morbidity rates, focusing on the incidence of stillbirths, miscarriages, birth defects, and illnesses ranging from asthma to hives. Interview with Dr. Larry Brown, *supra* note 6.

21. These figures represent the years between 1966 and 1978. RESOURCE LOSSES STUDY, *supra* note 19, at 100.

A Boston pediatric hematologist, Dr. John Truman, reported to the United States Center For Disease Control that he has observed six cases of acute leukemia in the same six-block area of Woburn since 1972. This is a statistically anomalous rate since some other nearby neighborhoods were nearly normal in cancer incidence. DPH STUDY, *supra* note 19, at 2.

22. RESOURCE LOSSES STUDY, *supra* note 19. The random probability of this discrepancy occurring is less than 2 in 10,000. Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass. filed June 15, 1982).

23. Interview with Rev. Bruce Young, Priest, Trinity Episcopal Church, Woburn, Massachusetts (Nov. 24, 1981).

24. At the federal level, there are two agencies primarily involved with the Woburn hazard-

to clean up the sources of the pollution. State[25] and local[26] authorities

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ous waste site: the EPA and the U.S. Army Corps of Engineers. Already the EPA has received a quarter of a million dollars in pre-Superfund money for testing and assessment. Schaplowsky, *Studies Shed Light on Woburn's Woes,* Not Man Apart, July, 1981, at 13. In addition, the EPA and Corps of Engineers together administer the section 404 wetlands provisions of the federal Water Pollution Control Acts amendments of 1972 (P.L. 94-500, 86 Stat. 816, 33 U.S.C. § 1151), which authorizes the Corps to issue permits for the discharge of dredged or fill materials into all U.S. waters and adjacent wetlands. The Act was invoked by both agencies in response to the fill deposited in wetland areas of the site and unsuitable flood storage provided for the upper Aberjona River. HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 13.

25. Public remedial action at the state level involved successive legal actions by jurisdictionally overlapping state agencies, intervening local governments, and private interests over a three-year period, culminating in a final judgment agreement certified on December 30, 1980, by the Suffolk Superior Court of Massachusetts. Agreement For Judgment, Dep't of Env'tl Quality Eng'g, Att'y Gen. of the Commw. of Mass., City of Woburn, and Town of Reading v. D'Annolfo, et al., Mass. Sup. Ct., No. 22690.

The myriad of actions grew out of the noxious odors and airborne pollutants released into the air by the waste material at the Mark-Phillips Trust dumpsite. The release was said to violate an array of state regulations, including the Massachusetts Clean Air Act, MASS. GEN. LAWS ANN. ch. 111, §§ 142A-142I (West 1981), the Massachusetts Clean Waters Act, MASS. GEN. LAWS ANN. ch. 21, §§ 26-53 (West 1981), the Solid Waste Disposal Act, MASS. GEN. LAWS ANN. ch. 111, § 150A (West 1981), and the Wetlands Protection Act, MASS. GEN. LAWS ANN. ch. 131, § 40 (West 1981). In addition, the provisions of the Massachusetts Environmental Policy Act (MEPA), MASS. GEN. LAWS ANN. ch. 30, § 62A (West 1981), were invoked to require the Trustees of the site to file an Environmental Notification Form regarding activities "which may cause significant damage to the environment." HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 13-14.

Three principal state agencies, the Department of Environmental Quality Engineering, the Attorney General, and the Executive Office of Environmental Affairs, have administered the state's enforcement of regulatory compliance at the site. The City of Woburn, the Town of Reading, and the Boston Edison Company intervened in the principal state suit against all the current owners of the site. The two municipalities were also included in the final state judgment agreement with the Trustees of the Mark-Phillip Trust. *Id. See also* Memorandum of Law in Support of Motion For Preliminary Injunction, Dep't of Envt'l Quality Eng'g, Att'y Gen. of the Commw. of Mass. v. D'Annolfo, Mass. Sup. Ct., No. 22690.

26. *See,* Memorandum in Opposition to Entry of Final Judgment, Dep't of Envt'l Quality Eng'g, Att'y Gen. of the Commw. of Mass., Town of Reading v. D'Annolfo, Mass. Sup. Ct., No. 22690.

At the local level, the Woburn Conservation Commission, Board of Health, and Board of Selectmen, as well as the Town of Reading, are involved in either litigation or regulatory action concerning the site. The Woburn Conservation Commission administers in the locality those provisions of the Wetlands Protection Act which require a permit for dredging, filling, or altering any wetland. Following a public hearing, the commission may issue or disapprove an "Order For Conditions" for the work. Appeal is made to the state. MASS. GEN. LAWS ANN. ch. 131, § 40. The Woburn Board of Health holds the authority to close down the site if it is found to be a hazard to public health, safety or welfare, as well as to seek abatement of the odor as a public nuisance pursuant to the Massachusetts Clean Air Act, MASS. GEN. LAWS ANN. ch. 111, §§ 142A-142I. In addition, the Woburn Board of Selectmen would handle citizen complaints under mandamus. The Town of Reading can, and has sought abatement of the odor as a public nuisance pursuant to the Massachusetts Clean Air Act. HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 13-14.

have taken such action as well. Nevertheless, these regulatory systems are not designed to provide compensatory relief to injured parties. Thus, independent of the public remedies instituted, private litigation has been started by some affected residents of the Woburn area for personal injury damages.[27]

B. Background: Legislation

The Woburn hazardous waste incident is not atypical. Nationwide, the legal system is inadequate to provide compensation to victims injured by exposure[28] to hazardous wastes[29] released[30] into the environment. No private party suffering from such an injury has suc-

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27. On May 14, 1982, 23 plaintiffs representing the families of four Woburn children who died of leukemia and of two persons who have leukemia, brought suit in Massachusetts Superior Court against defendants Cryovac, Inc., W.R. Grace Company, Inc., John J. Riley Company, Inc., and Beatrice Foods, Inc. (plaintiffs also named XYZ Company as a presently unknown company or companies which may have contributed to the alleged grounds for liability). Anderson, et al. v. Cryovac, Inc., No. 82-2444 (Mass. Sup. Ct. filed May 14, 1982). Plaintiffs, citing four causes of action — negligence, wrongful death, conscious pain and suffering, and nuisance — seek compensatory and punitive damages, and an injunction.

Defendant Cryovac, Inc., is a division of the W.R. Grace Company and is doing business in East Woburn. The W. R. Grace Company is doing business in Massachusetts through Cryovac. Defendant John J. Riley Company, Inc., a division of Beatrice Foods, Inc., operates a tannery at the Woburn site. Beatrice Foods, Inc., is doing business in Massachusetts through the Riley Tannery. Beatrice Foods also owns an undeveloped site, bordering the Aberjona River, which has allegedly been used as a dump for chemical wastes.

Plaintiffs allege that defendants deposited chemicals which contaminated the ground water in the area. Each plaintiff claims injury or the risk of injury due to direct exposure to the contaminated water supply.

On petition for removal filed by defendants, the action was removed to the United States District Court for Massachusetts on grounds of diversity jurisdiction. (Copy of Petition For Removal Filed Pursuant to 28 U.S.C. § 1446(e), Anderson v. Cryovac, Inc., No. 82-2444 (Mass. Sup. Ct. filed June 16, 1982).

28. "Exposure," for purposes of this article, is not the occupational form which occurs solely in the workplace, but includes environmental exposure that occurs by living, working, or perhaps even traveling in the path of migration of hazardous waste.

29. The term "hazardous wastes," as used in this article, refers to the incidental or intentional hazardous by-products or the manufacture of toxic substances and products produced in the workplace and offered for sale or use in the marketplace. "Hazardous waste" does not include nuclear material from a nuclear accident, emissions from engine exhaust, or waste generated from the normal application of plant fertilizer. Hazardous waste may:

A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of or otherwise managed.

Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901, 6903(5) (1976 & Supp. IV 1980).

30. The term "release," means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment.

cessfully litigated a fully adjudicated law suit for compensatory damages.[31] Neither the federal statutory structure enacted by Congress,[32] nor state statutory law[33] creates a private cause of action for

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31. *See* SIX CASE STUDIES OF COMPENSATION, *supra* note 7, at 497; *Toxic Ills "No-Fault" Plan Urged,* Washington Post, August 13, 1982, at C9; *Lawyers to Ask Changes in Toxic Waste Suits,* N.Y. Times, Sept. 28, 1982, at A20; SOUTHWESTERN UNIVERSITY SCHOOL OF LAW TOXIC WASTE SYMPOSIUM 1981 (Address by Barry Trilling, Trilling & Kennedy) [hereinafter cited as TOXIC WASTE SYMPOSIUM].

In the Love Canal litigation, approximately $2.8 billion in private claims filed by victims against Occidental Petroleum Corporation, Hooker Chemical Corporation and the State of New York went uncompensated. *See,* Mervak v. City of Niagara Falls, 101 Misc.2d 68, 69, 420 N.Y.S.2d 697, 698 (Sup. Ct. Niagara County 1979); Snyder v. Hooker Chemicals & Plastics Corp., 104 Misc.2d 735 (Sup. Ct. Niagara County 1980).

32. *See* Meyer, *Compensating Hazardous Waste Victims: RCRA Insurance and a Not So "Super" Fund Act,* 11 ENVT'L L. 689 (1981). Existing federal statutes dealing with air and water pollution and statutes dealing with wastes are "regulatory," i.e., they seek to control the behavior of the polluter rather than to compensate the victims of polluting conduct. *See, e.g.,* Clean Air Act, 42 U.S.C. §§ 7401-7642 (1976 & Supp. IV 1980); Clean Water Act, 33 U.S.C. §§ 1251-1376 (1976 & Supp. IV 1980); Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601-2629 (1976 & Supp. IV 1980); Resource Conservation and Recovery Act (RCRA) 42 U.S.C. §§ 6901-6987 (1976 & Supp. IV 1980).

33. In an apparent misreading of state statutory law, some commentators have stated that many states now compensate private victims of hazardous waste exposure. *See* S. REP. NO. 848, 96th Cong., 2d Sess. 36 (1980); Hinds, *Liability Under Federal Law for Hazardous Waste Injuries,* 6 HARV. ENVT'L L. REV. 1 (1982). In fact, only the California "Superfund" bill has created a state fund to compensate persons injured by hazardous waste contamination. *See infra* text and note at note 43. Further, the State of Alaska alone has expressly recognized a right of recovery in state court for personal damages suffered by private persons as a result of hazardous substance releases. Strict Liability for the Discharge of Hazardous Substances ch. 122, § 1 (Alaska 1972); amend. ch. 260, § 13 (Alaska 1976). *See* Title 46, art. 7, sec. 46.03. 822 (Alaska 1982). The statute creates a strict liability system under which persons injured by the "entry of a hazardous substance in or upon the waters, surface, or subsurface lands of the state" may bring suit for compensatory damages. *Id.* Potential damages include injury to persons or property, loss of income, loss of the means of producing income, or the loss of an economic benefit. *Id.* ch. 122, § 1 (Alaska 1972). *See id.* § 46.03.824 (Damages).

Despite the absence of the fault component in the required prima facie cause of action, victims are not guaranteed of recovery in state court; potential plaintiffs still must overcome other evidentiary and substantive obstacles implicit in personal injury hazardous waste litigation, including proof of causation and injury, and the statute of limitation problem. *Id.*

The Massachusetts Citizen Suit statute, MASS. GEN. LAWS ANN. ch. 214, § 7A (West 1981) allows any group of 10 citizens of Massachusetts to enforce procedural and substantive requirements of state and local environmental law by getting court injunctions or declaratory judgments. It is of no avail, however, in providing the basis for private damage actions for compensation of hazardous waste-related injuries.

Florida legislation provides for remedial action and the payment of damages from pollution that arises from the transfer of certain materials between vessels or between vessels and the land. Pollutant Spill Prevention and Control Act, FLA. STAT. ANN. § 376.12 (Supp. 1981). The statute does apply to hazardous materials. The Florida law provides for private parties who have suffered damages to apply to the fund within six months after the cause of action arises. However, the state can, if good cause is shown, waive the statute of limitations. *Id.* § 376.12(2) (Supp. 1981).

a victim who suffers injury from hazardous waste. Furthermore, federal common law actions are likely to be of little or no avail.[34]

The lack of a victim liability clause in federal statutes prevents private parties from collecting damages for a statutory violation. Relevant federal statutes merely provide an aggrieved person with standing to sue for enforcement of federal regulations, and authorize governmental reimbursement of site cleanup costs incurred by private parties.[35] The "Superfund" provisions of CERCLA, for in-

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The New Jersey Spillage Compensation Fund provides for cleanup costs and property damage resulting from the discharge of hazardous substances on water or land. N. J. STAT. ANN. § 58:10-23.11a-z (West Supp. 1980). Compensation, however, does not include medical costs or loss of income, unless the loss of income is due to damage of real or personal property. Private claims against the fund must be made within one year after discovery, but no later than six years after the pollutant discharge originally occurred.

New York law, similar to the New Jersey statute, is applicable only to discharges of petroleum. N.Y. NAV. LAW § 170-2-4 (McKinney Supp. 1980).

Maine has also created a compensation fund. Maine Coastal Protection Fund, ME. REV. STAT. ANN. tit. 38, §§ 551-552 (1978 & Supp. 1979). The revenues are generated by license fees for oil transferred, penalties, and other fees and charges. Polluters are held strictly liable for the damages they cause. Private parties can collect from the fund for damages to real and personal property and for loss of income directly or indirectly caused by an oil discharge.

Maryland has created the State Hazardous Substance Control Fund, Title 7, § 7-218 - 7-221 (1982), MD. ANN. CODE ch. 240, § 2 (1982), which reimburses the Department of State Hazardous Substance Control Fund for the costs incurred in "cleanup, removal or mitigation of the effect of any controlled hazardous substance that endangers the public health, safety or welfare; or endangers or damages natural resources." *Id.* The fund does not compensate private persons for damages or response costs resulting from the "effect" of hazardous substances. *Id.*

New Hampshire has created the Hazardous Waste Cleanup Fund, ch. 147-B (1981) which subsidizes the State Bureau of Solid Waste Management in the containment, cleanup or removal of hazardous wastes or materials which have been improperly discharged, disposed of or spilled. *Id.* The fund does not pay compensation for private damage claims or the response costs incurred by any private person. *Id.*

The North Carolina Oil Pollution Control Act of 1973, N.C. GEN. STAT. § 143.215.76 to 143.215.94 (1978), restricts private damage recovery, including cleanup costs and damages to public resources, to the discharge of oil. *Id.* § 143. 215.93 - 94.

A federal study has characterized these state statutes, limited as they are, as "exceptions to the general pattern of inaction which characterizes state response to this problem." INTERAGENCY TASK FORCE ON COMPENSATION AND LIABILITY FOR RELEASES OF HAZARDOUS SUBSTANCES, THE SUPERFUND CONCEPT 27 (1979). A congressional study of compensation statutes in six states concluded that the "legal mechanisms in the states studied are generally inadequate for redressing toxic substances-related harms." SIX CASE STUDIES OF COMPENSATION, *supra* note 7, at 500 (Alabama, California, Michigan, Missouri, New Jersey and Texas).

34. Under existing case law, potential private litigants would be preempted by the federal statutory system if they sought to bring federal common law actions for hazardous waste injuries. *See* City of Milwaukee v. Illinois, 451 U.S. 304 (1981); Middlesex Cty. Sewerage Auth. v. Nat'l Sea Clammers Ass'n, 453 U.S. 1 (1981).

35. *See e.g.,* 1980 Superfund Act, § 111(a)(2), Pub. L. No. 96-510, 94 Stat. 2767, 2789, codified at 42 U.S.C. § 9601 (1980); Clean Air Act, 42 U.S.C. § 1857h-z, as amended by Clean Air Act amendments of 1977, 42 U.S.C. § 7401 (1978 & Supp. IV 1980); Clean Water Act, 33 U.S.C. § 1365(a) (1976 & Supp. IV 1980); RCRA, 42 U.S.C. § 6972 (1976 & Supp. IV 1980); 40 C.F.R. § 254 (1980).

stance, contain no provision compensating human victims of hazardous waste pollution.[36] While failing to provide an explicit compensatory right of action to private individuals, Superfund—like other relevant federal statutes—expressly preserves the private litigant's right to seek relief under existing state common law in state courts.[37] The Superfund legislation does create a right of action, justiciable in federal court, for private and nonfederal plaintiffs to recover necessary "response" costs resulting from a release of hazardous substances.[38] This provision, however, only provides for compensation of limited response costs, specifically precluding money damages for medical expenses, property loss, and so-called health prophylactic damages.[39]

It is unlikely that the scope of existing statutory remedies will be expanded in the near future to include an administrative system for compensation of hazardous waste victims.[40] Indeed, Congress has

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36. CERCLA (Comprehensive Environmental Response, Compensation, And Liability Act) (Superfund) 42 U.S.C. §§ 9601-9657 (1980); 38 CONG. Q. WEEKLY REP. 3435 (Nov. 29, 1980).

Under RCRA, 42 U.S.C. §§ 6901-6987 (1976 & Supp. IV 1980), although private citizens may sue for response costs incurred in carrying out the Act's provisions, the Act does not provide victims of hazardous waste with a right of action for compensation.

Like RCRA, the Toxic Substances Control Act of 1976 (TSCA), 15 U.S.C. §§ 2601-2629 (1976 & Supp. IV 1980), does not provide individuals with a compensatory right of action.

The Clean Water Act of 1977, Pub. L. No. 95-217, 91 Stat. 1566 (1977) (amending Federal Water Pollution Control Act (FWPCA) 33 U.S.C. §§ 1251-1376 (1976)), current version at 33 U.S.C. §§ 1251-1376 (1976 & Supp. IV 1980), also fails to provide the hazardous waste victim with a private right of action to sue for compensation.

The Safe Drinking Water Act of 1974, 42 U.S.C. § 300f-j(10) (1976 & Supp. IV 1980), does not provide victims of hazardous waste with a right of action for compensation.

For a further discussion of pertinent environmental legislation enacted over the decade, *see* Trilling, *"Potential For Harm" As The Enforcement Standard For Section 7003 of the Resource Conservation And Recovery Act,* 2 U.C.L.A. J. ENVT'L L. 43 (1981).

For a discussion of nonenvironmental federal statutes that may provide some form of relief to hazardous waste victims, see Trauberman, *Compensating Victims of Toxic Substances Pollution,* 5 HARV. ENV'T L. REV. 1 (1981).

37. 126 CONG. REC. S 14,974 (daily ed. Nov. 24, 1980) (remarks of Sen. Mitchell). CERCLA (Superfund), Pub. L. No. 96-510, § 107(i)(j), 94 Stat. 2767, 2784 (1980). *See* Clean Air Act, 42 U.S.C. § 7604(e) (1976 & Supp. IV 1980); RCRA, 42 U.S.C. § 6972(f) (1976 & Supp. IV 1980); Clean Water Act, 33 U.S.C. § 1365(e) (1976 & Supp. IV 1980), *construed* in City of Milwaukee v. Illinois, 451 U.S. 304 (1981). *See also* Costle, *Introduction,* 9 ST. MARY'S L.J. 661 (1978); Skillern, *Private Environmental Litigation: Some Problems and Pitfalls,* 9 ST. MARY'S L.J. 675, 685 (1978).

38. CERCLA (Superfund) Title I (Hazardous Substances Releases, Liability, Compensation), Pub. L. No. 96-510, § 111(a)(2), 94 Stat. 2767, 2789 (1980).

39. *Id.* § 111(d)(2), 94 Stat. 2790.

40. Provided with a national mandate to reduce the coverage of the federal regulatory system, the Reagan administration has cut regulations governing the disposal of hazardous wastes, preferring a "nonconfrontational" relationship with hazardous waste generators. *See*

been unable to pass legislation authorizing private citizens' suits for personal injuries due to hazardous waste exposure. Senator George Mitchell (D-Me.), on July 15, 1981, proposed amendments to the Superfund law which would allow victim compensation.[41] The amendments, by establishing a private cause of action, would reimburse medical expenses incurred when persons are harmed by hazardous substances, and also would permit recovery for the costs of cleanup when natural resources are damaged by those same substances.

The proposed amendments would also create a private cause of action against the responsible party, but would do so without easing the obstacles inherent in maintaining the hazardous waste claim in court. The legislation is pending before the Senate Committee on Environmental and Public Works, and the prospects for passage through Congress appear dim, particularly in light of President Reagan's stated emphasis on limiting federal intervention into environmental disputes.[42] Nor is it likely, should such legislation pass, that the Reagan Administration would increase the resources necessary to maintain a national compensation fund, either by levying an exclusive tax on the waste generating industry, or by increasing the federal budget.

The State of California alone has pioneered legislation authorizing compensation for a private injury caused by the release of hazardous waste. The Carpenter-Presley-Tanner Hazardous Substance Account Act of 1981,[43] commonly known as the California Superfund, compensates persons under certain circumstances for all uninsured, out-of-pocket medical expenses and 80 percent of uninsured lost wages or business income for up to three years from the onset of treatment, for injuries proximately caused by exposure to the release of a hazardous substance. Actual lost wage recoveries are

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Shabecoff, *Environmental Cases Off Sharply Under Reagan,* N.Y. Times, Oct. 15, 1981; Bownstein, *Armand Hammer: The 'Perfect' Man for the Job,* Boston Globe, Nov. 7, 1981, at 11; *Justice's Special Waste Litigator Resigns, Citing 'Disastrous' EPA Enforcement Policy,* [1981] ENV'T REP. (BNA) 1027. *See also* Shabecoff, *Witnesses Clash Over Rule on Burying of Toxic Waste,* N.Y. Times, March 12, 1982, p. A12, col. 1; *Poison at the EPA,* New Republic, March 24, 1982, p. 7. In fact, EPA's response to hazardous waste problems is "slowing" and the agency "can't maintain current levels of activities." 12 ERC 97 (May 15, 1981).

41. S. 1486, 97th Cong., 1st Sess. §§ 2-6 (1981). The bill proposed amendments to CERCLA, Title I (Hazardous Substances Releases, Liability, Compensation), 42 U.S.C. §§ 107(a), 107(c)(i), 111(b), 101(6), 111(e)(2), 303 (1980).

42. Trauberman, J. *"Superfund — A Legal Update,* 23 ENV'T 25 (1981).

43. Ch. 756, 1981 Cal. Legis. Serv. 2609, 2619-2620 (West) (to be codified at CAL. HEALTH & SAFETY CODE §§ 25186, 25300-25395).

limited to $15,000 per year for three years. There is also no recovery for claims which are the result of long-term exposure to ambient concentrations of air pollutants. As a precondition, a claimant must show either that the identity of the liable party is unknown or cannot be determined with reasonable diligence, or that there is no liable party, or that the liable party cannot satisfy the judgment. The account is funded by a tax imposed on the disposal of hazardous wastes in order to maintain an average annual balance of $10,000,000 in the fund. To date, other states have not followed California's example.[44]

The common law offers a potential alternative remedy to a federal and state statutory system which is unable to provide compensation to hazardous waste victims. This article suggests that the reason aggrieved parties do not initiate and cannot maintain private damage actions in state courts is that the prevailing legal standards of proof are nearly impossible to meet in the context of hazardous waste injuries. Most critically, the medical understanding of causation does not conform with the standards for judicial acceptance of legal causation. A valid scientific demonstration of causation may frequently be insufficient to meet the quantum of proof required by tort law for a court to conclude that hazardous waste exposure has caused particular adverse health symptoms. Thus, a potential hazardous waste plaintiff who satisfies medical standards of injury and causation may still be unable to establish legal causation and, therefore, will suffer a directed verdict or ultimately fail to convince the jury to find in his favor.

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44. *Id. See supra* note 33. The Commonwealth of Massachusetts recently enacted legislation which mirrors the federal Superfund. Mass. H.R. 1503 (1983). Like Superfund, it does not authorize private victim compensation. The "Massachusetts Oil And Hazardous Material Release Prevention And Response Act" provides reimbursement for response costs — incurred by the Massachusetts Department of Environmental Quality Engineering (DEQE) or any private party — resulting from the release or threat of release of oil or hazardous material. Recovery is limited to the reasonable costs of assessment, containment and removal of the waste. The bill also authorizes compensation for injury to natural resources and damages to real or personal property due to the release or threat of release. In addition, the legislation applies strict, joint and several liability to any party who caused or is legally responsible for the release or threat of release; section 5 of the bill specifically names hazardous waste site operators, transporters, disposers and generators as potential liable parties. In the case of multiple defendants, the bill expressly apportions response costs according to pro rata shares. It also subjects liable parties to treble damages. The bill directs DEQE to expend twenty-five million dollars to fulfill the reimbursement function of the program, funded by the sale of state notes and bonds. In addition to liability for response costs, the bill authorizes civil penalties for violation of provisions of the legislation.

The state superfund program was enacted in March 24, 1983. *See Mass. Senate OK's $25m Cleanup Fund,* Boston Globe, March 8, 1983, at 1,21; *Mass. 'Superfund' Signed Into Law,* Boston Globe, March 25, 1983, at 1, 16.

This article proposes an adjustment in the evidentiary and substantive burdens incurred by plaintiff and defendant in hazardous waste injury litigation. The objective of this proposal is to enable injured parties who bring suit for compensatory damages in state courts to overcome the principal obstacles to obtaining relief—obstacles which arise from the inability of current law to address hazardous waste problems rather than from the legal insignificance of such problems. This article will first describe the characteristics of hazardous waste injuries which make these injuries uniquely difficult to isolate and prove. The section will also analyze the methods medical scientists have developed to respond to the complexities of causation, latent manifestation of injuries, and the assessment of probabilities of risk from exposure.

Second, this article will examine the legal problems faced by hazardous waste plaintiffs, including causation, proof of injury, and statutes of limitations. Third, this article will discuss the common law standard of probability adopted by some courts as an alternative to the rule of legal causation. Under this rule, a plaintiff must establish that a present injury was "more probably than not" caused by a particular act or material.[45] Currently, most courts apply a "but for" standard of causation, under which the "defendant's conduct is not a cause of the event if the event would have occurred without it."[46] Judicial solutions to the problem of "at-risk" injury—where no injury is yet manifest—will also be considered.[47] As an indication of the need to allow compensation for at-risk injuries, a minority of courts have lessened the degree of probability of future harm that a plaintiff must show in order to obtain relief. Finally, this article will propose that, because of the unique problems involved in establishing the prima facie case of injury, certain evidentiary and substantive burdens borne by plaintiffs be altered and imposed on defendants.

II. HAZARDOUS WASTE INJURIES: THE UNIQUE NATURE OF THE PROBLEM

Medical scientists have been unable to prove empirically that specific environmental pollutants directly cause particular health ef-

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45. W. PROSSER, THE LAW OF TORTS § 41, at 241 (4th ed. 1971); Estep, *Radiation Injuries and Statistics: The Need For a New Approach to Injury Litigation,* 59 MICH. L. REV. 259, 274-275 (1960).

46. W. PROSSER, *supra* note 45, § 41 at 238-39.

47. The term "at-risk" injury, as used in this article, refers to the situation where human exposure to hazardous waste has occurred but harm has not in fact been sustained. For a discus-

fects.[48] In fact, it is the very nature of hazardous waste pollution-related diseases that the causal links in the chain between exposure and injury are seriously attenuated.[49] It is virtually impossible for scientists to identify the precise causes of environmental cancer.[50]

Not all persons exposed to chemical toxins or carcinogens will contract disease or cancer. There is no method, medically or otherwise, to predict in advance which persons exposed to chemical pollutants will develop diseases.[51] Moreover, scientists are unable to establish an absolutely "safe" level of human exposure to chemical carcinogens.[52] Instead, most scientists agree that no human exposure to carcinogens is safe.[53] Thus, whether a resident living near a hazardous waste site is drinking 267-parts-per-*billion* of trichloroethylene or 267 parts-per-*million* is immaterial—both levels may cause cancer, although higher concentrations of carcinogens may be more likely to cause cancer.

This problem of epidemiological uncertainty[54] is a result of the complex characteristics of hazardous waste injury in general. For example, injuries may be latent, the "cause" of injury may be a product of multiple contributing factors, and the effects of hazardous waste exposure may vary among potential plaintiffs. Most hazardous waste injuries manifest themselves after long latency periods, following months or years of chronic or routine exposure to relatively low levels of chemical toxins.[55] At hazardous waste disposal sites where

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sion of "at-risk" injury in the context of the Agent Orange Product Liability cases see Brief for Plaintiffs-Respondents at 36-40, In re "Agent Orange" Product Liability Litigation, No. 80-7079 (2d Cir. 1978).

48. Davis, *Cancer In The Workplace — The Case For Prevention,* 23 ENV'T 29 (July/August 1981).

49. Senkan & Stauffer, *The Difficulties of Defining Hazardous Wastes,* 84 TECH. REV. 40 (November/December 1981).

50. NEW YORK STATE DEP'T OF PUBLIC HEALTH, *The Benefit of Reducing Risk* (1979), cited in EPSTEIN, *supra* note 7, at 326. *See also Environmental Carcinogenesis: Regulations on the Frontiers of Science,* 7 ENVT'L L. 83, 94-96 (1976). Scientists have failed to attribute single cases of cancer to exposure to a single carcinogen. *See* Miller v. Nat'l Cabinet Co., 204 N.Y. Supp. 2d 129 (N.Y. Ct. App. 1960), Miller v. Olin Mathieson Chem. Corp., 398 S.W.2d 472 (Ky. 1966); Small *Gaffing About A Thing Called Cause,* 31 TEX. L. REV. 630 (1953).

51. S. EPSTEIN, *supra* note 7, at 296.

52. B. BROWN, *supra* note 3, at 119; REPORT TO THE SURGEON GENERAL, *supra* note 4, at 5.

53. S. EPSTEIN, *supra* note 7, at 3.

54. *See* Kennedy, *The Politics of Preventive Health,* 84 TECH. REV. 58 (November/December 1981). "We are terribly good . . . at finding small amounts of something we think may be dangerous, but we are terribly bad at whether it is in fact dangerous, and even worse at estimating how dangerous it might be." *Id.* at 59.

55. S. EPSTEIN, *supra* note 7, at 296. "Chronically toxic compounds can take 15 to 20 years or longer to produce adverse health effects," after exposure. Senkan & Stauffer, *supra* note 49, at 40.

toxic chemicals and carcinogens have entered the atmosphere and the ground or drinking water, an individual's initial contact with contaminants may not produce any injurious effect. Thus, an individual may be exposed to chemical toxins or carcinogens without ever knowing it or having an opportunity to discover it in the exercise of the utmost diligence. Rather, the onset of physical or mental illness may not occur until after substantial quantities of contaminants have been ingested or otherwise encountered over time.[56] Even after exposure to medically dangerous levels of contamination, symptoms of disease may develop slowly and may be difficult to identify at their early stages.[57] In fact, an individual exposed to hazardous waste contaminants may lead a normal, healthy life for years without apparent physical damage and then suddenly experience visible effects from the chemical exposure.

Contamination of the environment from carcinogens occurs well before cancer becomes evident in man.[58] Epidemiological studies indicate that carcinogenic disease may take fifteen to twenty years to develop.[59] This long latency period demonstrates that hazardous waste-induced cancer can develop in humans well after the causative agent or group of agents has been released into a residential community and, perhaps, even after the waste has been removed from the environment.[60]

Further compounding the problem of understanding and proving hazardous waste injuries is the fact that most hazardous waste-related diseases and cancers have no single cause.[61] Injured parties are faced with the "immense, possibly insurmountable, scientific problem of proving causation where there are multiple" exposures to a wide variety of chemicals released into the environment which may cause cancer alone or in combination with other pollutants or natural elements.[62]

The phenomenon of multiple intervening causes can also be attributed to the fact that at each stage of a chemical's migratory

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56. COUNCIL ON ENVIRONMENTAL QUALITY Environmental Quality 1979, The Tenth Annual Report of the Council on Environmental Quality 194-230 (1979).

57. *Id.*

58. Statement of Dr. Umberto Saffiotti, National Cancer Institute, former Director for Carcinogenesis, in THE CANCER CONNECTION 60 (1979).

59. S. EPSTEIN, *supra* note 7.

60. *Id.*

61. DIV. OF LABORATORIES AND EPIDEMIOLOGY, NEW JERSEY STATE DEP'T OF HEALTH, AN EPIDEMIOLOGIC INVESTIGATION OF CLUSTERS OF LEUKEMIA AND HODGKINS DISEASE IN RUTHERFORD, NEW JERSEY 17 (1979).

62. Esposito, *Air and Water Pollution: What to Do While Waiting for Washington,* 5 HARV.

pathway to the victim—whether through ground water or the atmosphere, food or skin contact—chemical transformation, dilution, and recombination with other new compounds may occur.[63] This process creates a wide variety of contaminants to which the victim may be exposed, preventing the identification of a single responsible pollutant.[64] The complexity of causation is even more problematic in cases where a person's health may be influenced by factors beyond the association with the nearby waste site or ambient exposure. These factors include diet, smoking, genetic predispositions, age, and prior exposure to chemicals.[65]

The human effects of exposure to hazardous waste are diverse, complicated, and difficult to assess. Effects of exposure may involve all the human organ systems.[66] The responses which a single contaminant can produce after ingestion, inhalation, or direct skin contact may vary in time and effect from individual to individual, making it difficult to attribute a particular illness to a specific chemical or combination of chemicals.[67]

One last set of factors unique to hazardous waste injury claims is the problem of finding a responsible and solvent defendant. Potentially liable parties can range from chemical manufacturers and the producers of the chemical by-product, to transporters and disposers. This involvement of multiple participants in the hazardous waste

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C.R.-C.L.L. REV. 32 (1970).

The multiple environmental exposures to hazardous waste can result from a variety of events, including wind-borne spread, water runoff, underground seepage, migration to the surface of chemical liquids by capillary action, or migration of chemicals under schools, houses, community, and commercial structures. SOUTHWESTERN UNIVERSITY SCHOOL OF LAW TOXIC WASTE SYMPOSIUM 1981 (Address by Ira Monson, Chief Medical Officer, CAL-OSHA).

63. Soble, *A Proposal for the Administrative Compensation of Victims of Toxic Substances Pollution: A Model Act,* 14 HARV. J. LEGIS. 683, 738 (1977).

64. For the potential plaintiff to avoid the problem of isolating the responsible contaminant, the party must identify the so-called "background" concentration of chemicals in ground water, surface water, and in the air and soil. Such a background analysis will facilitate identification of the causative agents. TOXIC WASTE SYMPOSIUM (address by Jeffrey Driver, General Council, Waste Management Corp., Inc.).

65. These are known as "symptom-modifying" factors. Ginsberg & Weiss, *Common Law Liability For Toxic Torts: A Phantom Remedy,* 9 HOFSTRA LAW REVIEW 859, 922 (1981). Hazardous waste victims may be tobacco users or workers in a chemical plant or waste site.

66. TOXIC WASTE SYMPOSIUM, *supra* note 62, at 30 (address by Ira Monson, Chief Med. Officer, CAL-OSHA). Chemicals may contain carcinogens, brain and other nervous system toxins, agents that scar the lungs preventing breathing, mutation causing chemicals increasing the number of sterilizing agents that sterilize both males and females. Poisonous chemicals may also cause — not exclusively — miscarriages, stillbirths, poisoning of fetuses and birth defects. *Id. See also* NAT'L WILDLIFE FEDERATION, THE TOXIC SUBSTANCES DILEMMA 1 (1980).

67. Soble, *supra* note 63, at 738.

generation chain may impede the identification of a defendant even by the use of a manifest system.[68] Of course, assuming that a defendant party is discovered, there is no guarantee that the party will be found liable.

Site owners may also avoid responsibility for hazardous waste injury. In some instances, the site owner may have purchased the landfill property subsequent to the period of waste disposal and may be unconnected with the past waste generation and dumping activities. Further, the owner may be unaware that his property contains hazardous waste. In short, mere ownership of hazardous waste dumpsites, without unreasonable conduct, does not by itself confer liability for pollution generated by third parties. Even if the owners of the disposal site are responsible for the contamination and the resulting injury, as private residents or small businessmen they may be incapable of meeting substantial damages judgments. This is not the case in Woburn, where the site owners' activities can be linked directly to the contamination of the surrounding environment. In addition, as successful real estate developers, the owners apparently are solvent to meet the burden of paying money damages.

Due to the myriad of human effects that may result from hazardous waste contamination, it is difficult to classify persons injured by releases from a disposal site or other source. A list of potential claimants in Woburn, for example, would include a broad spectrum of people who have been exposed in several ways to a wide range of substances which may have caused a variety of both ascertainable and unascertainable injuries. This can be attributed to the multiple environmental exposures that residents have undergone: they may have ingested contaminated water; inhaled polluted air; or come into contact with wastes in contaminated soil or at the site itself. In addi-

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68. Congress created a comprehensive manifest system with the passage of RCRA under which all generators, transporters, and disposers of hazardous substances must keep detailed records of hazardous substance storage. 43 U.S.C. §§ 6922-6924 (1976 & Supp. IV 1980). Under the permit system enacted, each owner or operator of a treatment, storage, or disposal facility is required to apply for and obtain a permit to operate the facility. *Id.* § 6925(a). RCRA authorizes the EPA to promulgate regulations requiring record keeping, labeling, use of appropriate containers, reporting, and use of "manifests" to assure that the management of hazardous waste is brought within regulatory compliance. 45 Fed. Reg. 33,139, 33,142-48 (1980) (to be codified in 40 C.F.R. § 262) (standards applicable to generators of hazardous waste). The manifest document itself must contain information about both the generator and the hazardous waste, and must be shipped with the waste. 45 Fed. Reg. at 33,143. Once the waste is with the disposer, the information must be verified and a copy of the manifest must be retained for at least three years. *Id.* at 33,226, 33,238 (to be codified in 40 C.F.R. §§ 264.70-264.77, 265.70-265.77).

tion, some injuries may be acute and become immediately apparent to the victim, while others may be latent and time-delayed.[69]

Claimants with unascertainable injuries are also endangered by the Woburn contamination due to the risk of suffering future harm. Those residents who have been exposed to the toxic substances may have incurred nonidentifiable injuries with extended latency periods. Potential victims may include residents who live near the site, persons not in proximity who have nevertheless been exposed to the environmental contaminants, and the workers involved in the cleanup of the site and the construction of a commercial park on the dumpsite land.[70]

The characteristics of hazardous waste injury make it nearly impossible to prove the causal link between exposure and specific ill health effects. The causal uncertainty of injury may be a product of multiple causes and the attendant variety of human health effects, the long latency periods for manifestation of disease symptoms, and the fact that exposures are difficult to reconstruct. In addition, the diverse number of activities and parties potentially responsible for any given pollution exposure incident make proof of a causal connection even more problematic.

Medical scientists have acknowledged the need to isolate and examine epidemiological cause-effect relationships despite the existence of causal uncertainty. While science ultimately seeks to demonstrate a precise "fit" or cause-effect link between events, scientific analysis proceeds on the basis of experimentation, reformulation, and inherent uncertainty. Indeed, scientists often quantify the degree of uncertainty in a given epidemiological study in order to assess its overall accuracy. Thus, a scientist's "proof" is often tentative, since it contains inherent uncertainties; yet such proof may represent our best understanding of disease-exposure causation.[71] While the legal approach to cause-effect appears to be similarly logical, it cannot tolerate causal uncertainty as the scientific method

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69. *See* Baurer, *Love Canal: Common Law Approaches to a Modern Tragedy,* 11 ENVT'L L. 133 (1980); Hanley, *Proof of Causation in Environmental Litigation,* in TOXIC TORTS 403 (P. Rheingold, N. Landaue & R. Canavan eds. 1977).

70. *See, e.g.,* Boston Globe, Jan. 8, 1983, at B2 (photograph showing EPA technician working at waste cite clad in full body protective suit and respirator helmet while unprotected residents stood nearby, dressed in civilian clothes, watching the work).

71. *See* NAT'L WILDLIFE FEDERATION, THE TOXIC SUBSTANCES DILEMMA (1980); THE ORIGINS OF HUMAN CANCER 7-8, 751-59 (H. Hiatt, J. Watson & J. Winsten eds. 1978); McGarity, *Substantive and Procedural Discretion in Administrative Resolution of Science Policy Questions: Regulating Carcinogens in EPA and OSHA,* 67 GEO. L. REV. 729 (1979); Large &

does; courts, after all, must decide cases.[72] The next sections explore the conflicting approaches of science and law to hazardous waste injury causation.

III. Methodologies of Causation Proof

A. The Scientific Approach to Causation

To diagnose environmental disease, some scientists use a conventional model of biological causation.[73] At the outset, under the model, acute or potentially substantial injury must be demonstrated. Second, the scientist must identify the hazardous materials in question in the environment. Third, it must be established that the materials actually cause disease or pose significant health risks to man. The toxicity or carcinogenic nature of the waste materials can be suggested from studies evidencing the appropriate long-term adverse health effects in laboratory animals.[74] Lastly, human exposure to the relevant materials can be demonstrated by proving proximity to the hazardous waste site or direct physical contact with the leaked pollutants, including ingestion, inhalation or surface contact with the chemical wastes.[75]

The criteria for proving medical causation are as follow:

1) *Prevalence* of the disease should be significantly higher among those exposed to the putative cause than in case control subjects not exposed. Thus, to prove the substantiality of the injury, the prevalence of the disease should be greater among the persons exposed than the total level of disease among the control subjects not exposed.

2) *Exposure* to the putative cause should be present more often in those persons diagnosed with the disease than in the control cases without the disease.

Michie, *Proving that the Strength of the British Navy Depends on the Number of Old Maids in England: A Comparison of Scientific Proof With Legal Proof,* 11 Envt'l L. 555, 563-68 (1981).

72. Large & Michie, *supra* note 71, at 581-86; Bazelon, *Science and Uncertainty: A Jurist's View,* 5 Harv. Envt'l L. Rev. 209 (1981).

73. While there is no historic precedent for a universally recognized causation model, fundamental criteria for proof of causation have been developed. *See* Evans, *Causation and Disease: Henle-Koch Postulates Revisited,* 49 Yale J. Bio. & Med. 175-95 (1976).

74. The carcinogenic and toxic character of materials in humans can only be detected by long-term, sophisticated biological testing. Interview with Dr. Brown, *supra* note 6.

75. There are very few tests available to measure the degree of contact and absorption of chemicals into the human body. Thus, quantified estimates of exposure to chemicals with adverse effects will satisfy the preconditions of the model. Of course, possibilities of human ex-

3) *Incidence* of the disease should be significantly higher in those persons exposed to the putative cause than in those not exposed.

4) *Temporally,* manifestation of the disease should follow exposure to the causal agent according to a wide distribution of incubation periods along a bell-shaped curve.

5) A *spectrum of responses* from exposure to the causal agent should be distributed among a logical biological spectrum ranging from mild to severe.

6) *Measurable host response*: once exposure occurs, the person who becomes a host of the causal agent must show a measurable response to that agent.[76]

This scientific approach to proving causation fails to recognize the medical reality that there are few, if any, measurable human responses to the exposure to hazardous waste sites.[77] Medical science's inability to measure the effects of human exposure to hazardous waste can be attributed to a number of factors. They include the general lack of medical understanding of hazardous waste injury, the fact that symptoms of exposure to hazardous waste may be masked by the appearance of other illnesses, and the fact that hazardous chemicals affect persons in conjunction with a multitude of other factors.[78] In order to satisfy the rigorous criteria of the causation model, scientists rely on laboratory animal studies of single pollutants under highly controlled conditions.[79] Although a chemical's toxicity or carcinogenic character can be gauged by its effect on a laboratory animal,[80] the validity of inferring human causation from animal responses has been questioned.[81]

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posure must be based at the outset on documentation of the leakage of hazardous wastes into the environment. *Id.*

76. Evans, *supra* note 73, at 175-95.

77. Interview with Dr. Brown, *supra* note 6.

78. *Id.*

79. Davis, *supra* note 48, at 27.

80. B. BROWN, *supra* note 3, at 119.

> [P]roof that a substance, which has been recognized as carcinogenic in animals, actually causes cancer would require, in most cases extremely complex and lengthy epidemiologic studies. . . . Therefore, the only prudent course of action at the present state of our knowledge is to assume that chemicals which are carcinogenic in animals could also be in man, although the direct demonstration in man is lacking. Saffiotti, *supra* note 58, at 60.

81. The studies are questionable due to the fact that there are differences in the actions of chemical residues on animals as distinguished from humans. "The human population is different . . . . The mouse (or rat) doesn't smoke or breathe hydrocarbons or sulfur oxides from fossil fuels, doesn't drink, doesn't take medicine, doesn't eat bacon or smoked salmon." D. Rall, *Threshold?*, in ENVT'L HEALTH PERSPECTIVES 22, 164-165 (1978).

Although it is "practically impossible"to prove that a single case of hazardous waste disease was caused by a single pollutant which migrated from a dumpsite,[82] some medical scientists have been willing to infer causation when an "association" can be demonstrated between exposure to the hazardous chemicals and higher rates of morbidity and mortality.[83] In Woburn, scientists, rather than show a cause-effect relationship, have sought to establish a "possible association" or "statistically significant correlation" between the death and disease patterns and proximity to the waste site or other environmental exposures to the contamination.[84]

Due to the complexities of causation and latent manifestation of injuries associated with hazardous waste epidemiology, medical scientists have also been willing to construe mere human exposure to hazardous waste as a substantial harm by itself, without proof of actual injury.[85] This departure from the conventional notion of injury is an outgrowth of the prevailing logic in the medical community that exposure to a toxic substance or carcinogen increases the risk of developing certain types of illness.[86] The process of evaluating the risk of a particular chemical, known as risk assessment, is based on probability theory which quantifies the likelihood that exposure to a particular hazardous substance will increase the propensity for disease. Probability theory is also applied by some courts to determine the likelihood that a substance caused a particular injury in a given case.[87]

According to medical scientists, before risk assessment can be conducted two critical components must be satisfied. First, the toxicity of the substance must be measured and, second, the extent of human exposure to the substance must be established.[88] The apparent rigor

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82. Interview with Dr. Edward L. Baker, Assistant Professor of Occupational Medicine, Harvard University School of Public Health (Jan. 4, 1982).

83. Interview with Dr. Brown, *supra* note 6.

84. Such a project is being conducted by the Harvard University School of Public Health in conjunction with a Woburn citizens group, For A Cleaner Environment. The community health survey will also attempt to confirm assumptions that the morbidity and mortality rates in Woburn are higher than the rates in other communities. *Id. See supra* text and note at note 20.

85. Interview with Dr. Baker, *supra* note 82.

86. Interview with Dr. Brown, *supra* note 6.

87. *See, e.g.*, Reserve Mining Co. v. EPA, 514 F.2d 492 (8th Cir. 1975); United States v. Reserve Mining Co., 380 F. Supp. 11 (D. Minn. 1974); Reserve Mining Co. v. United States, 498 F.2d 1073 (8th Cir. 1974); Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 426 N.E.2d 824 (1981); Village of Wilsonville v. SCA Services Inc., 77 Ill. App.3d 618, 396 N.E.2d 552 (1979); Carolina Envt'l Study Group v. United States, 510 F.2d 796 (D.C. Cir. 1975).

88. Kennedy, *supra* note 54, at 60.

of these criteria is mollified in application, however, in consideration of the reality that most hazardous waste victims are exposed to a variety of toxic substances and carcinogens, resulting in a variety of effects which are difficult to categorize exclusively.

The methodology for assessing risks of environmental disease due to exposure to hazardous waste is based primarily on chi-square analysis, a standard statistical tool employed by scientists.[89] It is a probability test that determines the likelihood of error in making a statistically significant correlation between health effects and exposure to hazardous chemical waste. The analysis determines what the likelihood is that a cluster of leukemia cases, for example, may have resulted purely by chance. "Statistical significance" is established if there is less than a 3 or 5 percent chance that the exposure-disease association established could be accidental.[90] If, however, the likelihood of error exceeds 3 or 5 percent, the causal connection would be considered a random chance occurrence.

In Woburn, for example, if it can be demonstrated that for every 100 epidemiological surveys conducted, ninety-seven show an abnormally high rate of disease in exposed residents, the statistical likelihood of random chance would be overcome. Thus, although no absolute cause for the high rate of disease and death in Woburn would be identified, a statistically significant association between disease and waste exposure would be made which could satisfy scientific standards of probability.

Despite this apparently flexible methodology, the uncertainty surrounding current scientific data on hazardous wastes makes an understanding of causation exceedingly difficult. The problem of establishing causation between exposure to hazardous waste pollution and injury is illustrated by the Woburn hazardous waste site in-

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89. The chi-square test is in fact a variation of the medical requirement that epidemiological tests must be "valid," that is, that tests measure what they purport to measure, and "reliable," that is, that the same results will be obtained each time. Interview with Dr. Brown, *supra* note 6. For a complete discussion of the chi-square test, see, H. BLALOCK, SOCIAL STATISTICS 212-28 (1960).

90. Variations of the chi-square probability of error test run from probability limits of 1 percent or less and 3 percent to 5 percent.

> Biologists have accepted a convention that if there is no more than a one-in-twenty chance that the result is not due to the experimental variable, then the result is significant. But only when pressed to give full details does a biologist usually bother to point out that a set of confidence limits has been arbitrarily chosen. . . .
>
> After all, there is nothing magic about one in twenty or any other number we use to establish the significance of a result.

Kennedy, *supra* note 54, at 59-60.

cident. Public officials have been unable to determine the exact extent and potential for environmental contamination and human exposure to the known carcinogens and toxins released from the site.[91] No study has identified the precise number and volume of hazardous chemicals existing at the site.[92] Indeed, large portions of the site have never been tested, and it is as yet unknown what hazardous wastes they may contain.[93] Nor has the migratory pathway of exposure that the pollutants have traveled from the site been reconstructed.[94] Medical scientists have been unable to link conclusively the health problems in the community with proximity to the site or use of the contaminated municipal water wells.[95] Despite the apparent cancer microepidemic in East Woburn, no study has definitely identified a causal connection between the death and disease patterns and the hazardous wastes.[96]

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91. "This is not a Love Canal. We have no evidence that what is in the wells is from the hazardous waste site. We do not know that the source of the TCE in the wells is the site." Interview with Rev. Bruce Young, *supra* note 23.

According to Rick Leighton, environmental engineer and Woburn coordinator, EPA: "People should realize, we may never be able to tell what contaminated wells G and H." Schlapowsky, *supra* note 24, at 13.

The EPA has issued a study on the quality of ground water in eastern and northen Woburn to help determine the possible extent of contamination of the water supply. The study indicates the presence of 42 organic and inorganic chemicals included on the EPA list of 129 Priority Pollutants. The presence of the chemical contaminants in the ground water, according to the EPA study, raises the distinct possibility that drinking water from the aquifer may have been contaminated in the past or may become contaminated in the future. The report also sought to identify the potential sources of contamination from leaching of surface deposits at the site. Ecology and Environment, Inc., *Interim Report on the Ground Water Quality of East and North Woburn, Massachusetts,* EPA FIT PROJECT TDD NO. F1-8010-04B (May 6, 1981).

92. Interview with Rev. Bruce Young, *supra* note 23. *See also* HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 11.

93. HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 11.

94. As a recent study noted:

> The site is mostly wetlands and a recharge area, making it especially conducive to spreading the contaminants. Although the threat seems to be primarily one of the future, more testing is needed . . . to determine what the extent of this threat is. . . .
>
> It has been claimed that this site is *not* another Love Canal because most of the chemicals found here are heavy metals that don't easily dissolve, while the substances at Love Canal were more transportable. However, this may be a premature conclusion. The danger posed by the hides is not limited to leaching of the metals which they contain. Additional dangers include organic and microbial contamination of water and prolonged exposure to air pollutants. Also, there may be many other chemicals present which have not yet been tested; some of these may be a more immediate threat.

HAZARDOUS WASTES IN WOBURN, *supra* note 12, at 36-37 (emphasis in original).

95. "The fact that we have not found a connection between the toxins and the elevated ill health patterns and the concentration of childhood cancer does not mean there is no correlation. It is more a reflection of our collective ignorance. No correlation can be proved conclusively." Interview with Dr. Brown, *supra* note 6.

96. A state DPH study has gone so far as to state that the contamination of municipal wells

In view of the causal uncertainty surrounding the death and disease patterns in East Woburn, residents who wish to start private damage actions must establish the grounds for making a valid association between an injury and waste exposure. They must first identify all sources of hazardous waste on the site. Second, the parties must establish the scope of environmental contamination and the migration of the pollutants through identification of baseline ambient air, water, and soil quality, and identification of ground water and other conduits from the site which transport hazardous substances away from the site to outlying areas. Third, potential plaintiffs must attempt to document the extent of human exposure to the released substances and assess the likely effects on human health for the particular types of exposure. Finally, the residents must assess the actual impact of the hazardous wastes on the health and environment of the community. The potential plaintiff is not helped much by risk assessment methodology unless there is reliable baseline data to plug into the analysis.

In summary, the Woburn hazardous waste incident illustrates the critical environmental and health consequences of dumping hazardous wastes near residential communities. In Woburn, some nearby residents and public health scientists believe that injuries have oc-

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G and H did not cause East Woburn's high rate of childhood leukemia. According to DPH Ass't Comm'r of Envt'l Health, Gerald S. Parker, the study's findings, based on death records dating back to 1949, indicate that the rate of childhood leukemia began to climb in the early 1960's before the two wells began pumping in 1964 and 1968. "Our findings did not support an association between the wells and the incidence of childhood leukemia in East Woburn," Parker said. Parker, though, did qualify his conclusions, stating that "the data accumulated on childhood leukemia mortality rates precludes any strong statistical conclusions." MASS. DEP'T OF PUBLIC HEALTH, CANCER MORTALITY IN WOBURN: A THREE DECADE STUDY 1949-1978 (Nov. 17, 1981).

The DPH study has been disputed by various local community leaders and public health scientists, who argue that the seven childhood leukemia deaths occurred in households that were drinking water from the subsequently closed water wells as well as the aquifer running below the site. They claim that the clustering of the childhood leukemia cases around the area that used wells G and H is not mere coincidence.

> We question the accuracy and validity of the study. It is more political than medical. The findings are so inconclusive that the state could not possibly prove or disprove the correlation between the water and the leukemia. The most any study with hard evidence can show is an association, not a cause and effect.

Interview with Rev. Bruce Young, *supra* note 23.

> Scientifically, the DPH study is not valid. There is absolutely no evidence one way or the other to conclude that the quality of the water was the vehicle by which the children were exposed to the carcinogenic or toxic chemicals generally. However, once the wells opened, the concentration of cancer did develop in subsequent years. Both the actual cases and the overall rates were significantly greater.

Interview with Dr. Brown, *supra* note 6.

curred and that the hazardous contaminants are the reason. While high rates of cancer and leukemia do afflict the surrounding area, the causes have yet to be proven. Although there has been some federal, state, and local cleanup response to the pollution, injured parties remain uncompensated. Inevitably, potential claimants have brought and will continue to bring suits for private damages in state court.

It has been shown that in response to the general problem of causal uncertainty, scientists have moved from conventional direct causation theory to probabilities of causation and risk assessment, whereby reasoned inferences are drawn from statistical likelihoods that an association between events (exposure to hazardous waste and disease from exposure) is causal. In the next section, the legal approach to causation will be examined. This article will suggest that the standards of tort law make it virtually impossible for hazardous waste plaintiffs to recover damages. It will also discuss how the interrelation of science and law further obstructs plaintiffs from properly establishing causation so as to prevent compensation for injuries from exposure to hazardous wastes.

B. Proof of Legal Causation

The common law firmly places the burden of proving legal causation on the plaintiff.[97] To prove legal causation, the plaintiff, at the outset, must demonstrate by a preponderance of the evidence[98] that the defendant's conduct was a "substantial factor" in causing the alleged injury.[99] In sum, the plaintiff must establish a cause-in-fact connection between defendant's conduct and plaintiff's injury.[100] To recover damages in a hazardous waste injury suit, the victim also bears the heavy burden of proving that a particular exposure to an identified agent "directly" caused the specific claimed injury.[101]

The required causal connection between the defendant's conduct and the plaintiff's injury cannot be met by a showing of a "mere

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97. SIX CASE STUDIES OF COMPENSATION, *supra* note 7, at 488.

98. W. PROSSER, *supra* note 45, § 38, at 208.

99. *Id.*, § 41, at 240; RESTATEMENT (SECOND) OF TORTS § 431, at 428 (1965). *See also* Hamil v. Bashline, 243 Pa. Super. 227, 364 A.2d 1366 (1976), *overruling* Hamil v. Bashline, 224 Pa. Super. 407, 307 A.2d 57 (1973), *allocatur denied* 224 Pa. Super. xxxvi 407 (1973). Some courts use the "but for" rule of causation, a more extreme rule of exclusion. W. PROSSER, *supra* note 45, § 38 at 208.

100. *Id.*, § 41 at 236-37. *See also* RESTATEMENT (SECOND) OF TORTS, *supra* note 99, §§ 430-453.

101. W. PROSSER, *supra* note 45, § 43, at 263-64.

possibility" of causation, even though such showing is scientifically supportable.[102] Nor is it legally sufficient for the plaintiff to provide evidence that exposure to the environmental contaminant increased the risk of suffering harm.[103] If the plaintiff's argument on the issue of causation is built on speculation or conjecture, the court will direct a verdict for the defendant,[104] a result mandated by established case law and consistent with fundamental tort law principles. Therefore, to establish legal causation, plaintiff may introduce expert testimony based only on "reasonable medical certainty" that the injury in question was caused by defendant's acts or omissions.[105] A medical opinion of a "possibility" of causation or an increased risk of harm is insufficient for a jury to find causation.[106]

To prove a causal link between the agents released from the hazardous waste site and the injury at issue, the plaintiff must fulfill four essential conditions of the traditional approach to legal causation.[107] First, the plaintiff must substantiate the presence of significant amounts of the pollutant which is alleged to have caused the injury. Second, the plaintiff must reconstruct the manner in which the exposure occurred by tracing the path of contaminant migration from the waste site to the victim.[108] Third, the plaintiff must identify the source of the contamination and show a breach of due care by the defendant. Fourth, the plaintiff must demonstrate the effect of the pollutant in question on the injured person.

In the typical hazardous waste pollution incident, where numerous possible contaminants may exist in an uncontrolled environment, it would be an unreasonable burden to require the victims of contamination to prove that one contaminant is the cause of particular symptoms. Indeed, the possible existence of other contaminants necessarily creates doubt that the contaminant in question caused the injury. Similarly, the possible existence of so many contaminants

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102. *Id.*, § 43, at 242. *See* Large & Michie, *supra* note 71, at 591-614.

103. Hamil v. Bashline, 243 Pa. Super. 227, 364 A.2d 1366, 1369-70 (1976).

104. W. PROSSER, *supra* note 45, § 43, at 242-43. *See also* McMahon v. Young, 442 Pa. 484, 276 A.2d 534 (1971).

105. Hamil v. Bashline, 243 Pa. Super. 227, 364 A.2d 1366 (1976).

106. 243 Pa. Super. at 230, 364 A.2d at 1369. *See also* Houston v. Canon Bowl, Inc., 443 Pa. 383, 386, 278 A.2d 908, 910 (1971); Niggel v. Sears-Roebuck & Co., 219 Pa. Super. 353, 281 A.2d 718 (1971); McMahon v. Young, 442 Pa. 484, 276 A.2d 534 (1971).

107. Derived from Soble, *supra* note 63, at 706, 739.

108. The fact that the level of chemical pollutants in the ground water, soil or air decreased directly as the distance from a given waste site increased may be a sufficient demonstration of chemical migration from the dumpsite in question. *See* TOXIC WASTE SYMPOSIUM, *supra* note 62 (address by Ira Monson).

in an uncontrolled setting makes it impossible to determine with exactitude the precise contribution of each contaminant to particular symptoms. Thus, regardless of the common law theory of liability a hazardous waste victim may invoke,[109] proof of legal causation is the paramount obstacle to recovery of compensatory damages.[110] Even

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109. A number of commentators have discussed the difficulties inherent in using traditional common law theories of recovery to remedy hazardous waste-related injuries. *See, e.g.*, Ginsberg & Weiss, *supra* note 65, at 859; Baurer, *Love Canal: Common Law Approaches To A Modern Tragedy*, 11 ENVT'L L. 133 (Fall 1980); Honabach, *Toxic Torts: Is Strict Liability Really the "Fair and Just" Way to Compensate the Victims*, HAZARDOUS WASTE CONFERENCE, ENVIRONMENTAL CENTER, VERMONT LAW SCHOOL (1980); Note, HAZARDOUS WASTES: PRESERVING THE NUISANCE REMEDY, 33 STAN. L. REV. 675 (1981); Comment, *A Private Nuisance Approach to Hazardous Waste Disposal Sites*, 7 OHIO N.U.L. REV. 86 (1980); Note, *Transportation of Hazardous Materials*, 5 HARV. ENVT'L L. REV. 345 (1981); Note, *Strict Liability for Generators, Transporters and Disposers of Hazardous Wastes*, 64 MINN. L. REV. 949 (1980); Note, *Liability for Generators of Hazardous Waste: The Failure of Existing Enforcement Mechanisms*, 69 GEO. L. J. 1047 (1981); Note, *Strict Liability And Hazardus Wastes*, 16 N.E. L. REV. (1981).

110. "The problem of causation — where it involved exposure to a small population and was likely to involve conflicting testimony from expert witnesses — and who to sue, prevented us from pursuing legal action." Interview with Rev. Bruce Young, *supra* note 22.

Indeed, when suit was later brought, *see supra* note 26, named defendant Beatrice Foods Co. and its division, the John J. Riley Co., predictably answered plaintiffs' complaint with the defense, among many, that its acts or omissions "were neither the cause in fact nor the legal cause of any alleged introduction of materials into the environment." Answer of Defendant at 17, Anderson v. Cryovac, Inc., No. 82-1672-S (D. Mass. filed July 6, 1982). Instead, Beatrice Foods Co. asserted that the intervening acts of third parties, over whom it has no control, were the cause of the alleged injuries. *Id.*

As a further deterrent to suit for hazardous waste injury, judges and juries may be unable to reconcile the incongruities between competing health surveys, or the equally technical and complex evidence provided by defendants as rebuttal evidence. Here, the trier of fact is forced to analyze information in fields far removed from lay competence, and must make decisions based on conflicting and ambiguous data. Such highly technical scientific issues may transcend the reach of the courts. David L. Bazelon, Chief Judge, United States Court of Appeals for the District of Columbia, is a leading commentator on this problem. *See* Bazelon, *Risk and Responsibility*, 205 SCIENCE 277, 277-80 (1979). For an example of judicial refusal to evaluate conflicting technical data, see Reserve Mining Co. v. EPA, 514 F.2d 492, 507 n.20 (8th Cir. 1975).

In addition, the problem of certification of class in large plaintiff actions has also deterred pollution victims from bringing so-called environmental class actions. In the private Love Canal litigation, in which residents and former residents of the area together with "transients" who visited the area, attempted to file notices of claim against the City of Niagara Falls, Niagara County, and the Board of Education of the City of Niagara Falls, the court chose to limit the membership of the class according to a nexus of time and injury. The N.Y. Supreme Court sitting in Niagara County held that the issue of notice of claim must be dealt with on a case-by-case basis. According to the court, the injuries to the various plaintiffs did not occur at the same time, so there was no single date from which to measure the accrual of the various causes of action for statute of limitation purposes. Mervak v. City of Niagara Falls, 101 Misc.2d 68, at 75, 420 N.Y.S.2d 692, 697 (Sup. Ct., Niagara County 1979). Thus, it is quite possible that the highly individualized issue of causation will not lend itself to class action suits which requires that "questions of ... fact common to the members of the class

in those cases where there is favorable evidence[111] to indicate that claimants have suffered harm or are in danger of incurring future injury from chemical pollutants released from a hazardous waste site, the standard of legal causation is so extreme in the context of hazardous waste injury as to defeat most actions.[112]

Concomitant with the burden of proving causation is the deterrence effect associated with the enormous costs of developing a hazardous waste private damages case. These costs include the money necessary to retain an attorney, finance extensive discovery, and epidemiological and toxicological studies, and costs to obtain the testimony of expert witnesses. The complex technological issues of hazardous waste litigation necessitate the extensive use of so-called

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predominate over any questions affecting only individual members . . . ." FED. R. CIV. P. 23(b)(3). Certainly, it would be difficult to resolve the cause-in-fact issue on a large class-wide basis.

111. Under current tort law, "favorable evidence" would demonstrate the substantiality of injury and the hazardous nature of the pollution. Plaintiff would provide evidence of the "substantial" or "significant" nature of the injury and contamination by measuring the degree of harm and extent of pollution against the total level for the surrounding community. If the pollution was substantially exceeding the levels elsewhere, and the increased incidence of injury was significant — greater than the community level for ill health — then plaintiff would have provided sufficient evidence to start building the prima facie case.

The scientific mechanism for translating data into legally sufficient harm would require plaintiff to plug the incidence of disease into the numerator of the quotient; the denominator being the total base level of ill health in that particular community. B. BROWN, *supra* note 3, at 58-60.

112. Two writers in the field of compensation of environmental injury have concluded that, "[p]roducing the evidentiary showing required to sustain the substantive proof of legal causation is an undertaking of no small magnitude," Soble, *supra* note 63, at 738; and that "the level of certainty required by the legal system may be impossible to attain." Ginsberg & Weiss, *supra* note 65, at 922.

Even in laboratory experiments, where animals are subjected to comparatively low chronic exposures to chemical toxins and carcinogens — as chronic low-level exposures to humans is the norm — the conclusions gleaned are not sufficient to translate into legal proof of causation. In fact, the levels of exposure the test animals undergo must be extraordinarily high in order to obtain a statistically significant result which can meet legal standards of causation. TOXIC WASTE SYMPOSIUM, *supra* note 62 (address by Ira Monson, Chief Medical Officer, CAL-OSHA).

However, in view of the rarity of forms of cancer associated with exposure to asbestos, courts have found adequate legal proof of causation in asbestosis and mesothelioma cases. In fact, in asbestos litigation it remains undisputed that exposure to asbestos is the cause of asbestosis and mesothelioma. *See* Dombroff v. Armstrong Cork Co., 79-14048 (Cir. Ct. 11th Jud. Cir., August 1981); C.A. Hardy v. Johns-Manville Sales Corp., M-79-145-CA (D.C.E.D. Tex. March 13, 1981); Karjala v. Johns-Manville Prods. Corp., 523 F.2d 155 (8th Cir. 1975); Borel v. Fibreboard Paper Prods. Corp., 493 F.2d 1076 (5th Cir. 1973), *cert. denied,* 419 U.S. 869 (1974). Here, unlike hazardous waste disease, the process of asbestos-related disease is understood, as scientific studies have established a clear link between the inhalation of asbestos dust and respiratory disease and cancer. No such "dose-relationship," or threshold level of exposure has been established by epidemiological studies on the health effects of commonly discharged chemical toxins and carcinogens. *See* 493 F.2d 1076, 1078-79 (5th Cir. 1973).

"exposure," "descriptive," and "causal" expert witnesses at trial.[113] Even if the potential plaintiff has managed to finance the cost of proving causation—or an association—and has ultimately amassed legally sufficient proof to identify the hazardous waste as the source of the injury, the potential defendant may still be unidentifiable, financially insolvent, outside the forum court's jurisdictional reach, or may have ceased operations altogether.

In summary, there are several characteristics of hazardous waste injuries which make it difficult to meet the test of legal causation. The phenomena of long-latency periods, multiple causal agents and effects, and attenuated pollution paths all contribute to the epidemiological uncertainty of hazardous waste injury. In contrast with medical reality, tort law presumes an understanding of these complexities and does not allow for causal uncertainty.

This gap between the medical acceptance of some uncertainty in causation and legally certain causation is itself a major obstacle to recovery in a hazardous waste injury suit. In instances of environmentally-caused disease and cancer, scientists have been willing to infer causation from epidemiological studies evidencing a statistically significant association between exposure and injury. This scientific finding of an exposure-disease association represents a currently valid medical finding of causation. Nonetheless, proof of a scientifically valid association does not necessarily meet the standard of legal causation.

Ultimately, it is the interrelation of science and law that obstructs plaintiffs in establishing causation.[114] Scientific conclusions of a causal association are conditioned upon experimentation, and therefore subject to the conflicting testimony of expert witnesses and the incongruities between competing health surveys. Finally, even if valid scientific data supporting an association between exposure and injury is obtained, tort law may ignore scientific proof if the standards of legal causation are not satisfied.

IV. Obstacles to Compensation

A. Legally Cognizable Injury

Under the common law, proof of injury is a prerequisite to a private right of action for personal damages. Some courts have been

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113. S. Epstein, *supra* note 7, at 472.
114. *See* Large & Michie, *supra* note 71, at 581-607.

reluctant to find legally cognizable injury based on transitory or legally insufficient medical conditions.[115] Courts insist that the right to maintain a cause of action does not "accrue" until the claimant can show a legally provable injury, i.e., when the injury manifests itself with sufficient certainty to be subject to proof in court.[116] Thus, a mere "potentiality or threat" of harm is not sufficient to sustain a cause of action for personal injury.[117] Instead, the plaintiff must allege and prove a present injury based on medically detectable symptoms. Reasoned the Fourth Circuit in *Sides v. Richard Machine Works, Inc.*:[118] "If harm had not ensued, there would have been no tort and nothing to sue on."[119]

The effect of this approach to legal injury is to preclude "at-risk" injury claims.[120] Such claims, which rest entirely on alleged harmful exposure with no manifestation of effect, and a prediction of future harm, would be unsuccessful under tort law since the plaintiff has suffered no present injury sufficient to maintain a cause of action. As the Virginia Supreme Court of Appeals explained in *Louisville & Nashville Railroad Co. v. Saltzer,*[121] "[t]he reason and justice of this is perfectly apparent, for a plaintiff who merely feared ultimate damages . . . under such circumstances would invite defeat if he only relied upon his fears and was unable to prove any actual injury."[122]

To the potential hazardous waste plaintiff who has been exposed to known chemical toxins or carcinogens without incurring immediate injury, the common law principle that legal injury does not result until harm actually manifests itself is a nearly insurmountable obstacle to recovery. In reality, according to scientists, in incidents of hazardous waste-related disease and cancer, "injury" does not occur upon exposure. Rather, such injuries result after a period of chronic ex-

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115. *See* Schenebeck v. Sterling Drug, Inc., 423 F.2d 919 (8th Cir. 1970); Sterling Drug, Inc. v. Cornish, 370 F.2d 83 (8th Cir. 1966); Young v. Clinchfield R.R. Co., 288 F.2d 499 (4th Cir. 1961).

116. Louisville & Nashville R.R. Co. v. Saltzer, 151 Va. 165, 144 S.E. 456, 457-58 (1928).

117. W. PROSSER, *supra* note 45, § 30, at 146-47.

118. 406 F.2d 445 (4th Cir. 1969).

119. *Id.* at 446.

120. This reluctance to award compensatory damages for "at-risk" injuries is particularly evident in negligence cases, as "[n]ominal damages, to vindicate a technical right, cannot be recovered in a negligence action, where no actual loss has occurred. The threat of future harm, not yet realized, is not enough." Bridgford v. United States, 550 F.2d 978, 982 (4th Cir. 1977) (quoting W. PROSSER, *supra* note 45, § 30, at 146-47).

121. 151 Va. 165, 144 S.E. 456 (1928).

122. 151 Va. at 167, 144 S.E. at 457-58.

posure, and typically have extended latency periods before symptoms of harm become apparent.

B. Statutes of Limitations

The running of the statute of limitations in certain jurisdictions can leave the victim of hazardous waste pollution without legal remedy by preventing the filing of suit at the outset. To those persons exposed to chemical waste with resultant injuries unknown or inherently unknowable at the time of exposure, a restrictive statute of limitations can bar a claim for damages well before the injury becomes apparent to the victim.

The traditional purpose of a statute of limitations is to protect defendants from having to defend stale, frivolous suits.[123] A statute of limitations runs at the time of the first legal injury, or at the point a cause of action accrues, even if the full extent of damages may not be known.[124] Ideally, the starting point for the limitation period should not be clearly arbitrary or unreasonable in precluding claimants from litigating an accrued cause of action.[125] Some courts recognize that the power to extend statutes of limitations is vested exclusively with each state legislature.[126] Many other state courts, however, have been willing to determine when suits accrue for statute of limitations' purposes.[127] At trial, the defendant bears the burden of proving the defense of the statute of limitations[128] by showing the extent of plaintiff's overall injury that is barred by the relevant statute.

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123. R.R. Telegraphers v. Ry. Express Agency, 321 U.S. 43 (1944). *See* Street v. Consumers Mining Corp., 185 Va. 561, 39 S.E.2d 271 (1946); Belton v. Traynor, 381 F.2d 82, 87 (4th Cir. 1967).

124. *See* Claudill v. Wise Rambler, Inc., 210 Va. 11, 168 S.E.2d 257, 259 (1969); Garrett v. Raytheon Co., Inc., 368 So.2d 516, 519 (1979).

125. Wilson v. Iseminger, 185 U.S. 55 (1901); Annotation, *Limitation of Actions*, 51 AM. JUR. 2d §§ 31-36 (1970).

126. Hawkins v. Barney's Lessee, 30 U.S. (5 Pet.) 457 (1831). *See* Thornton v. Roosevelt Hospital, 47 N.Y.2d 780, 781-82, 391 N.E.2d 1002, 1003, 417 N.Y.S.2d 920 (1979); Sellers v. Edwards, 289 Ala. 2, 265 So.2d 438 (1972).

127. Locke v. Johns-Manville Corp., 790171 (Cir. Ct. City of Richmond, March 6, 1981). Free v. Ass'd Indem. Corp., 78 Ga. App. 839, 52 S.E.2d 325 (1945); Ross v. Beach Aircraft Corp., 214 Kan. 888, 522 P.2d 369 (1977); Frisby v. International Paper. 76 So.2d 621 (La. App. 1954); Tillotson v. Penn-Dixie Cement Corp., 47 Mich. App. 427, 209 N.W.2d 427 (1973); Struther-Wells Gulfport Inc. v. Bradford, 304 So.2d 645 (Miss. 1981); Borowski v. Armco Steel, 188 Neb. 654, 198 N.W.2d 460 (1972); Duncan v. Carpenter, 233 N.C. 422, 64 S.E.2d 410 (1951); Sierzega v. U.S. Steel Corp., 204 Pa. Super. 531, 205 A.2d 696 (1965); Drake v. Raybestos Mfgrs., 241 S.C. 116, 127 S.E.2d 188 (1962); Consolidation Coal Co. v. Price, 224 Tenn. 188, 452 S.E.2d 349 (1970).

128. In Massachusetts, for example, the statute of limitations is an affirmative defense

The long latency periods of many hazardous waste injuries present critical statute of limitations difficulties in many state courts where the limitation period runs from the date of exposure to the hazard, rather than from the time the injury is discovered or the cause ascertained. In these jurisdictions, a personal injury claim is deemed to accrue at the time of the plaintiff's initial contact with the causative agent.[129] Thus, the statute of limitations runs immediately upon the plaintiff's exposure to the potentially harmful materials. Under this date-of-exposure limitation period, ignorance of injury or of the existence of a cause of action will not toll the running of the statute.[130] The underlying problem with this approach is that it presumes that "injury" cannot occur without "symptoms."[131] This assumption conflicts with the current scientific understanding of the delayed biological effects of hazardous waste disease and the cumulative nature of exposure to chemical pollutants.

In the situation where exposure to hazardous waste and injury are not simultaneous, any cause of action emanating from the incident would be dismissed under the exposure standard. As the United States Supreme Court stated in *Urie v. Thompson,*[132] a plaintiff's "failure to diagnose within the applicable statute of limitations a disease whose symptoms had not yet obtruded on his consciousness would constitute waiver of his right to compensation at the ultimate day of discovery and disability."[133] Thus, in jurisdictions employing the exposure rule, a plaintiff's claim would be barred even though he has no way of determining that he has been damaged by a harmful chemical substance, as the symptoms may not be evident until the statute of limitations has already run.

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which must be pleaded by the defendant if it is to be effective. MASS. R. CIV. P. 8(c). For tort actions (actions for negligence, nuisance, trespass, and strict liability) a complaint must be filed by the plaintiff within three years from the date the claim arises. MASS. GEN. LAWS ANN. ch. 260, § 2A (West 1981).

129. *See* Roybal v. White, 72 N.M. 285, 383 P.2d 250 (1963); Thornton v. Roosevelt Hosp., 47 N.Y.2d 780, 781-82, 391 N.E.2d 1002, 1003, 417 N.Y.S.2d 920 (1979). *See also* Hutton, *Statute of Limitations and Radiation Injury,* 23 TENN. L. REV. 278 (1954).

130. Kelley v. Shropshire, 199 Ala. 602, 75 So. 291 (1917); Hudson v. Moore, 239 Ala. 130, 194 So. 147 (1940).

131. In Strickland v. Johns-Manville Corp., 461 F. Supp. 215 (S.D. Tex. 1978) the court attempted to draw the distinction between ignorance of a legally-cognizable injury and the absence of a legal injury as follows: "It would be unreasonable to dismiss the plaintiff's suit because there was no injury and then not allow him to bring the suit years later when asbestosis developed on the ground that the claim is barred by the statute of limitations." 461 F. Supp. at 217 (S.D. Tex. 1978).

132. 337 U.S. 163, 69 S.Ct. 1018, 93 L.Ed. 1282 (1949).

133. 337 U.S. at 169, 69 S.Ct. at 1024, 93 L.Ed. at 1287.

A second starting point for the limitation period, known as the "discovery rule," triggers the running of the statute when the injury is discovered or should have been discovered by the plaintiff in the exercise of reasonable diligence.[134] There is considerable dispute among the courts as to when "discovery" occurs. Under a restrictive interpretation, the limitation period runs from the time the plaintiff discovers the fact of injury.[135] As the court in *Karjala v. Johns-Manville Products Corp.*,[136] explained,

> "[t]he plaintiff's claim arises when the harm to his person becomes evident .... The statute doesn't commence to run against [the plaintiff] until he has contracted the disease ... and the process of contracting the disease does not cease until physical impairment manifests itself."[137]

Some state courts have extended the discovery rule to the period when the plaintiff discovers the facts giving rise to the cause of action, not just the fact of injury.[138] The plaintiff need not know the legal cause of the injury or even that he has a cause of action.[139] Rather, the facts giving rise to a cause of action need be only those sufficient to put the plaintiff on notice that someone is responsible for the injury.[140]

The third basis for a statute of limitations is the "ascertainment of injury causality" rule. While not widely adopted, it is the most ad-

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134. Virginia Military Inst. v. King, 217 Va. 760, 232 S.E.2d 895 (1977).

135. *See also* Borel v. Fibreboard Paper Products Corp., 493 F.2d 1076, 1102 (1973), *cert. denied,* 419 U.S. 869 (1974) ("the cause of action does not accrue until the effects of such exposure manifest themselves"); Assoc. Indemnity Corp. v. Indus. Accident Comm'n, 124 Cal. App. 378, 381, 12 P.2d 1075, 1076 (1932) (the party "can be held to be [legally] injured only when the accumulated effects of the deleterious substances manifest themselves"); Roman v. A.H. Robins Co., 518 F.2d 970 (5th Cir. 1975) (applying Texas law) (discovery occurred when plaintiff learned of illness due to drug); Schenebeck v. Sterling Drug, Inc., 423 F.2d 919 (8th Cir. 1970) (applying Arkansas law) (discovery occurred when disease fully manifested, not at discovery of earliest symptom). In Florida, the discovery rule allowed a plaintiff to recover for injuries resulting from exposure to X-rays five years prior to the suit. Miami v. Brooks, 70 So.2d 306 (Fla. 1954). Most recently, the Court of Appeals in Maryland applied the discovery rule to an action for cancer allegedly resulting from exposure to harmful asbestos over a period of fifteen years ending in 1955. Harig v. Johns-Manville Products Corp., Misc. No. 1 (Ct. App. Md., Nov. 21, 1978).

136. 523 F.2d 155 (8th Cir. 1975).

137. *Id.* at 159 n.7.

138. Cadieux v. Int'l Tel. & Tel. Corp., 593 F.2d 142 (1st Cir. 1979); Frank Cooke, Inc. v. Hurwitz, 1980 Mass. App. Ct. Adv. Sh. 1197, 406 N.E.2d 678 (1980); Hendrickson v. Sears, 365 Mass. 83, 88-91, 310 N.E.2d 131 (1974); Friedman v. Jablonski, 371 Mass. 482, 484-87, 358 N.E.2d 994 (1976); Nantucket v. Beincke, 1979 Mass. Adv. Sh. 2623, 2627-28, 398 N.E.2d 458, 462-63 (1979).

139. *See supra* note 138 (cases cited).

140. Cadieux v. Intl. Tel. & Tel. Corp., 593 F.2d 142, 144 (1st Cir. 1979). *See also supra* note 138 (cases cited).

vantageous starting point for hazardous waste plaintiffs. Under this standard, the statute of limitations does not run until the injured party is able or should reasonably be able to ascertain a causal connection between the injury and exposure to the environmental hazard.[141] Thus, the running of the statute of limitations is tolled until the causal connection for the injury can be recognized.

Modern case law reflects a pattern of gradual judicial movement away from the more rigorous exposure rule to increasing acceptance of the liberal standards of discovery, and, to a lesser extent, the causality rule. Nonetheless, in the typical case where the symptoms of hazardous waste injury are not easily recognized and where causation is difficult to prove scientifically, even the discovery and causality rules may be of little avail to the plaintiff.

The judicial approach to the problem of statutes of limitations most receptive to the person exposed to hazardous waste is that which tolls the statutory period until the discovery of actual physical or mental harm to the plaintiff. In short, the running of the statute would not be keyed to the date of exposure, but tied to the plaintiff's knowledge of the existence of a potentially legally compensable injury. This approach would ensure that the recognizable symptoms of the disease are evident to the potential claimant prior to triggering the running of the statute. Knowledge of injury may thereby compel a resident living in proximity to a known hazardous waste site to inquire whether the injury is related to a pollution occurrence, and to determine whether a causal association with the nearby waste site can be drawn.

Hazardous waste industry critics may argue that the proposed standard acts to preserve the open-ended liability of potential defendants. Such a fear may prove misplaced, however, since the discovery rule would ensure that industry only defend against legitimate suits. A premature or speculative claim made by the plaintiff based on the unsubstantiated fear of future disability would not meet the threshold standard of the discovery approach—there would be no recognized injury in such cases. Under the discovery rule, the defendant would be free of frivolous suits, while a valid cause of action of an aggrieved party would not be precluded by the expiration of the limitations period. Further, once an injury is discovered, the plaintiff is encouraged to determine the cause of the injury as soon as

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141. *See* Caron v. United States, 548 F.2d 366 (1st Cir. 1976) (applying Michigan law) (discovery occurred when cause of convulsions learned); Gilbert v. Jones, 523 S.W.2d 211 (Tenn. Ct. App. 1974) (discovery occurred when causal connection learned).

possible. Thus, the discovery rule ultimately is capable of protecting defendants from stale or frivolous claims while protecting the cause of action which, because of its peculiar time-delayed aspects, would otherwise be time-barred.

C. Judicial Assessment of Probability of Causation

A showing of a probability that a statistically significant correlation exists between exposure to a hazard and injury ordinarily will not support a cause of action for compensatory damages under the standard of legal causation.[142] In response to this, as an alternative to traditional legal causation, some courts have adopted probability theory to establish causation.[143] This judicial probability of causation theory requires a high degree of certainty and is applied by the trier of fact to determine the likelihood of a causal connection between defendant's conduct and a present injury.[144] In theory, the probability approach to causation differs significantly from the usual standard of legal causation. In effect, however, the two theories are indistinguishable. Most hazardous waste plaintiffs seeking compensatory damages will continue to suffer directed verdicts for failure to establish causation under the current judicial approach to probability theory.

To prove causation under probability theory, the plaintiff must establish that an injury was "more probably than not" caused by a particular act or material.[145] In contrast, conventional causation theory only accepts a definitive showing of cause and effect. Commonly known as the "reasonably probable" test (some courts apply the term "reasonably certain") this approach measures whether statistical evidence of a possibility of medical causation is adequate to support a reasonable probability of legal causation.[146] The test examines whether there is a reasonable likelihood that the defendant's conduct was *a substantial factor* in producing the injury.[147] As the

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142. Soble, *supra* note 63, at 740-41.

143. For a discussion of the mathematical probabilities of legal proof, see Tribe, *Trial By Mathematics,* 84 HARV. L. REV. 1329 (1971). *See also* Large & Michie, *supra* note 71, at 569-80.

144. Estep, *Radiation Injuries and Statistics: The Need for a New Approach to Injury Litigation,* 59 MICH. L. REV. 259, 274-75 (1960).

145. *Id.* at 274; W. PROSSER, *supra* note 45, at 241.

146. Estep, *supra* note 144, at 274; W. PROSSER, *supra* note 45, at 241.

147. Owen, *The Highly Blameworthy Manufacturer: Implications on Rules of Liability and Defense in Products Liability Actions,* 10 IND. L. REV. 769, 778-80 (1977).

This is a different test from "but for" causation. *See* Malone, *Ruminations on Cause-In-Fact,* 9 STAN. L. REV. 60 (1958).

court in *Parker v. Employers Mutual Liability Insurance Company of Wisconsin*[148] said: "a possible cause only becomes 'probable' when in the absence of other reasonable causal explanations it becomes more likely than not that the injury was a result of its action. This is the outer limit of inference upon which an issue can be submitted to the jury."[149]

Rigid application of a "more likely than not" rule would require plaintiff to show a greater than 50 percent chance that defendant's conduct—ownership, control, transport, disposal, or release of the contaminants—was a substantial factor in causing the injury.[150] Under this standard, it is not enough to show that the probabilities of causation were evenly divided.[151] Instead, the evidence must balance in plaintiff's favor.[152] Accordingly, the more-probable-than-not test requires that the trier of fact be at least slightly greater than 50 percent certain that the defendant's acts or omissions caused the plaintiff's injury. In those cases where the injury is apparent to both the plaintiff and the trier of fact at trial, and where the only proof of a causal connection is a statistically significant correlation or association drawn between exposure and injury, the chances that all other causes together could have caused the injury cannot exceed 49 percent in order for the plaintiff to establish legal causation.

Evidence of the reasonable probability of causation can be adduced by expert testimony.[153] Medical opinion suggesting a "possibility" of causation, however, will be insufficient under the common law standards.[154] Instead, the medical expert must testify with certainty that there is a "reasonable medical probability" that the alleged injury was caused by the exposure.[155] If an expert witness fails to testify to a reasonable medical probability of causation, the plaintiff will suffer a directed verdict or fail to convince a jury that legal causation exists.

Medical science has not reached the level of sophistication demanded by the common law standard of more-probably-than-not.

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148. 440 S.W.2d 43, 47 (Tex. 1969).

149. *Id.* at 48.

150. W. PROSSER, *supra* note 45, at 242.

151. RESTATEMENT (SECOND) OF TORTS, *supra* note 99, at 428; W. PROSSER, *supra* note 45, at 242.

152. RESTATEMENT (SECOND) OF TORTS, *supra* note 99, at 428; W. PROSSER, *supra* note 45, at 242.

153. Parker v. Employers Mut. Liab. Ins. Co., 440 S.W.2d at 51 (1969).

154. 440 S.W.2d at 46; W. PROSSER, *supra* note 45, at 242.

155. 440 S.W.2d at 47.

Scientists are unable to establish a likelihood greater than 50 percent that exposure to a given substance causes injury. Rather, medical causation is accepted when there is less than a 3 or 5 percent chance that the association established could be accidental. Ultimately, of course, as a matter of law, any showing of causation that is not supported by a 50 percent probability rating is insufficient to support a cause of action for money damages.

V. "AT-RISK" INJURY: COMPENSATION FOR ENDANGERMENT OF INJURY

The traditional common law system provides little hope of recovery to the plaintiff without ascertainable injury who seeks compensation for exposure to hazardous waste and the attendant risk of harm.[156] This can be attributed to the high level of certainty, required by most courts, by which a plaintiff must show the probability of future harm in order to sustain a cause of action for at-risk injury.[157] To recover damages for exposure to an acknowledged harmful substance where there is no proof of actual harm, the plaintiff must provide "certain" proof that it is "highly probable" that injury will occur. A showing by the plaintiff of a "possibility" of harm is not sufficient to obtain relief.[158] Courts have traditionally required a showing of a substantial risk that injury will "necessarily result"[159] from exposure and that the future harm will be "substantial."[160] Since the court must determine that the "danger" of harm is "real and immediate,"[161] an at-risk injury claim for hazardous waste exposure, due to the injury's inherent latent and uncertain nature, would be too remote to form the basis for relief.

In recognition of the unfairness inherent in this approach, some courts have not strictly adhered to the "highly probable" test of determining the substantiality of at-risk injury claims. In *Union Carbide Corp. v. Industrial Commission,*[162] the Supreme Court of Colorado displayed a willingness to award compensatory damages for

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156. Estep, *supra* note 144, at 275.

157. Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 26-27, 426 N.E.2d 824, 836-37 (1981).

158. 86 Ill.2d at 25-26, 426 N.E.2d 824, 836 (1981); W. PROSSER, *supra* note 45, § 90, at 603.

159. Fink v. Bd. of Trustees, 71 Ill. App.2d 276, 281-82, 218 N.E.2d 240, 245 (1966); Difanis v. Futia, 56 Ill. App.3d 920, 926, 373 N.E.2d 530, 535 (1978).

160. Springer v. Walters, 139 Ill. 419, 422, 28 N.E. 761, 762 (1891). *See also* Union Drainage Dist. No. 6 v. Manteno Limestone Co., 341 Ill. App. 353, 93 N.E.2d 500 (1950).

161. Fink v. Bd. of Trustees, 71 Ill. App.2d 276, 218 N.E.2d 240 (1966).

162. 196 Colo. 56, 581 P.2d 734 (1978).

"injurious exposure" to "a concentration of toxic material which would be sufficient to cause . . . disease in the event of prolonged exposure to such concentration."[163] In a footnote, the court explained the "sufficient to cause" wording of the injurious exposure test in light of the tension between the medical and legal definitions of causation.

> The problem is that the legal definition is at variance with the medical definition. The medical experts do not speak of concentrations which are 'sufficient to cause' occupational diseases, but rather refer to concentrations which 'increase the risk' of contracting a disease. Insignificant concentrations of radiation do not 'increase the risk'; in this case, the epidemiologist testified that, in his opinion, only concentrations in excess of 4 WLMs were sufficient to increase the risk of contracting lung cancer. We do not find these differences in wording to be meaningful in this area of the law. We perceive no reason to get involved in 'futile searches for unattainable factual certainties.'[164]

In *Union Carbide Corp.*, the court reviewed the "last injurious exposure" claim of an employee of Union Carbide who had undergone an eight-day exposure to radioactive materials at the company mine. Previously, the employee had worked as a uranium miner over a sixteen-year period for various employers. He later died of lung cancer resulting from exposure to radioactive materials.[165] The court construed the Colorado Occupational Disease Disability Act[166] to authorize the employer in whose employment the employee was "last injuriously exposed"—Union Carbide—to pay the occupational disease benefits.[167] It rejected the Colorado Court of Appeals' opinion which held that proof of a concentration of toxic material sufficient to "increase the probability" of lung cancer was necessary to establish the liability of the employer.[168] Instead, the Colorado Supreme Court found injurious exposure from evidence that the employee's exposure to concentrations of radiation simply increased the risk of contracting lung cancer.[169]

In a private suit for compensation of the future risk of a child developing epilepsy as a result of an accident, a Virginia federal

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163. 196 Colo. at 58, 581 P.2d at 736.

164. 196 Colo. at 59, 581 P.2d at 737 n.4 (quoting Mathis v. State Accident Ins. Fund, 10 Or. App. 139, 499 P.2d 1331 (1972)).

165. 196 Colo. at 57, 58, 581 P.2d at 735, 736.

166. COLO. REV. STAT. § 8-51-112(1) (1976 & Supp. 1980).

167. Union Carbide Corp. v. Indus. Comm'n, 196 Colo. at 58, 581 P.2d at 736.

168. 196 at Colo. at 58 n.4, 581 P.2d at 736 n.4.

169. 196 Colo. at 60, 581 P.2d at 738.

district court, in *McHall v. United States,* [170] acknowledged the "many intangibles" and "uncertain future developments" which make it "more than usually difficult" to conduct a "probability estimate" of future disease.[171] Several doctors who testified at the trial rated the chances that the plaintiff would later develop epilepsy as a result of the accident from a low of 3 percent to a high of 25 percent. Despite the uncertain nature of the at-risk injury, the court found the "possibility" of "future difficulties" to be sufficient to award damages to the plaintiff.[172]

In *Gomes v. Taylor,*[173] a state prison inmate was permitted to recover for the increased likelihood of contracting cancer due to blood tests performed by law authorities in the course of an investigation. Similarly, in *Payton v. Abbott Laboratories,*[174] a DES (diethylstilbestrol) case, conditional certification of an "at-risk" class was permitted by the court, absent a determination that there was no cause of action on behalf of the questioned class under controlling law. There has been no such determination in the case. In *Payton,* the class of plaintiffs was composed of women in Massachusetts exposed to DES in utero, who had not developed uterine or vaginal cancer. The plaintiff class was conditionally certified to enable the court to determine, among other issues, whether a cause of action for the increased risk of developing cancer due to exposure to DES is, under Massachusetts law, a compensable claim.[175]

The most significant move toward judicial recognition of the legal sufficiency of at-risk injury claims has been displayed by a minority of courts in prospective public nuisance litigation.[176] Although these cases largely involve judicial review of agency decisions, they are still pertinent to the common law treatment of the private cause of action for exposure to hazardous waste. Despite the acknowledged scientific uncertainty surrounding risk assessment, these courts have recognized the validity of at-risk injury claims. In employing

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170. 206 F. Supp. 421, 426 (E.D. Va. 1962).

171. *Id.* at 426.

172. *Id.*

173. No. 77-0228 (D.R.I. March 21, 1979).

174. 83 F.R.D. 382 (D. Mass. 1979), *later proceedings,* Payton v. Abbott Labs, 512 F. Supp. 1031 (D. Mass. 1981).

175. 83 F.R.D. at 386.

176. *See* Reserve Mining Co. v. EPA, 514 F.2d 492 (8th Cir. 1975); United States v. Reserve Mining Co., 380 F. Supp. 11 (D. Minn. 1974); Reserve Mining Co. v. United States, 498 F.2d 1073 (8th Cir. 1974); Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 426 N.E.2d 824 (1981); Village of Wilsonville v. SCA Services, 77 Ill. App.3d 618, 396 N.E.2d 552 (1979).

risk assessment, the courts adopted the rationale for the so-called "threatened tort" enunciated in the Second Restatement of Torts, that "[t]he more serious the impending harm, the less justification there is for taking the chances that are involved in pronouncing the harm too remote."[177] Thus, in situations where a claimant individually or the environment as a whole has been exposed to an extremely hazardous activity with potentially adverse health consequences, some courts have been willing to grant injunctive relief on a showing of a possibility of harm substantially less than a "dangerous probability."[178] In such cases the public agency has not been required to show actual harm or harm certain to occur; rather, the agency has been required only to establish a scientifically supportable potential for harm. As Judge J. Skelley Wright in his majority opinion in the seminal case *Ethyl Corp. v. Environmental Protection Agency,*[179] explained, health "may properly be found endangered by both a lesser risk of a greater harm and by a greater risk of a lesser harm."[180]

Although the *Ethyl Corp.* case dealt with section 211(c)(1)(a) of the Clean Air Act,[181] which authorizes the Administrator of the EPA to regulate gasoline additives, emission products of which "will endanger the public health or welfare,"[182] its importance to the common law lies in the demonstration of judicial tolerance of the at-risk injury claim. Here, the D.C. Circuit, in the face of a challenge by manufacturers and refiners of gasoline to regulations promulgated by the EPA in accordance with the Act, which mandated annual reductions in the lead content of gasoline in part because of lead's possible danger to public health, upheld the regulations based on uncertain scientific evidence. The court reasoned that less rigor is required in the establishment of cause and effect where evidence of causation is difficult to obtain or involves conflicting expert opinions because such decisions are often on the "frontiers of scientific knowledge."[183]

In rejecting the traditional high probability requirement for establishing the likelihood of future injury where there is clear evidence of exposure to a health hazard, courts have also recognized that the complexities of environmental medicine make certainty in

177. RESTATEMENT (SECOND) OF TORTS, *supra* note 99, § 933, at 561 comment b (1979).
178. Reserve Mining Co. v. EPA, 514 F.2d 492, 538 (8th Cir. 1975).
179. 541 F.2d 1 (D.C. Cir.), *cert. denied,* 426 U.S. 941 (1976).
180. *Id.*
181. 42 U.S.C. § 1857f-6c(c)(1)(A) (1976 & Supp. IV 1980).
182. *Id.*
183. Ethyl Corp. v. EPA, 541 F.2d at 28 (D.C. Cir.), *cert. denied,* 426 U.S. 941 (1976).

predicting injury for each incident of hazardous waste exposure "achievable only after the fact."[184] Thus, in a case where certain proof of harm was impossible, the Court of Appeals for the Eighth Circuit, in *Reserve Mining Co. v. EPA,*[185] concluded that assessments of danger are dependent upon the relationship between the risk and harm presented by each case, and therefore cannot legitimately be pegged to "probable harm" without regard to the degree of potential harm.

In *Reserve Mining,* the EPA, along with the states of Michigan, Wisconsin, and Minnesota, and several environmental groups, sought an injunction ordering the Reserve Mining Company to cease discharging iron ore refuse into the waters of Lake Superior and into the ambient air of Silver Bay, Minnesota. The plaintiffs had argued that the discharges into the air and water contained asbestos fibers which had been associated by scientists with an increased incidence of cancer in humans. The district court granted injunctive relief,[186] ordering an immediate end to the discharges, thereby closing the plant.

On appeal the Eighth Circuit affirmed in part and reversed in part, holding that the evidence to establish a legally cognizable health risk to the public was sufficient only to justify a less stringent form of injunction which would not result in closing the plant. The Eighth Circuit found that the company had been releasing a substance considered carcinogenic by medical scientists, and ruled that a proper assessment of a public health hazard would depend upon an analysis of the probability of harm posed by the chemical releases. First, the court held that the *probability* of harm linked to the discharges into the water was too low to be legally cognizable, because there was no actual proof of past health injury in the area attributable to ingestion of the waters of Lake Superior containing the asbestos fibers from the plant's discharges. The court found that the only existing proof was the medical conclusion that ingestion of asbestos fibers was generally a causative factor in increasing the cancer rate among asbestos workers. The court ruled, however, that this *risk* of harm associated with the ingestion of asbestos fibers released into the ambient air of Silver Bay was supported by the more substantial proof of a correlation between the inhalation of asbestos dust and subsequent illness in the area. Thus, although the health hazard could only

184. 541 F.2d at 25.
185. 514 F.2d 492, 520 (8th Cir. 1975).
186. United States v. Reserve Mining Co., 380 F. Supp. 11 (D. Minn. 1974).

be measured in terms of a concern for the public health based on a reasonable medical probability rather than based on certain proof of actual harm, the court found the *degree of risk* sufficient to justify an injunction to abate the health hazard "as a precautionary and preventive measure to protect the public health."[187]

As these cases illustrate, some courts have adopted a "probability of risk—consequences of harm" risk assessment analysis[188] to provide relief for an unreasonable risk of environmental injury. Such a balancing analysis is essentially a substitute for the traditional equity weighing of the social utility of the prospective tortious conduct of the defendant against the potential damage that can result from that conduct. Under this innovative approach to determining whether a potential threat to health is of sufficient gravity to be legally compensable, the greater the gravity of the potential harm the less potential risk the plaintiff need show to obtain relief. Thus, the D.C. Circuit concluded in *Ethyl Corp. v. EPA* that the "magnitude of the risk sufficient" to justify relief is "inversely proportional to the harm to be avoided."[189]

This judicial approach to the analysis of a legally cognizable at-risk injury can be appropriately applied to the area of hazardous waste injuries. Specifically, to the extent that there is proof that potentially

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187. Reserve Mining v. EPA, 514 F.2d at 520.

In both *Ethyl Corp.* and *Reserve Mining,* no claim of ascertainable injury was made by the public agency. Instead, the federal appeals court in each case inferred an endangerment to public health from evidence suggesting an association between ill health and exposure to hazardous waste. In *Ethyl Corp.*, the EPA introduced medical studies evidencing associations between increased lead levels in the blood of persons exposed to lead and a variety of diseases. 541 F.2d at 39 n.85. Supported by this statistical evidence, the EPA constructed a causal model demonstrating the link between leaded gasoline automotive emissions and morbidity. *See* LARGE & MICHIE, *supra* note 71, at 604. The EPA concluded, first, that elevated blood lead levels exist to a small but significant extent in the general adult population, and to a greater extent among children; second, that airborne lead absorbed directly into the body through respiration constitutes a significant risk to the public; and third, that airborne lead falls to the ground where it mixes with dust and poses a significant threat to the health of urban children. *Id.* The appeals court supported the EPA contention that airborne lead, which accumulates on the surface, is an endangerment to children, by employing inferences similar to the causal paradigm used in *Reserve Mining*: First, high concentrations of lead in dust and dirt are found in urban areas; second, lead from exhaust is the primary source of lead in urban dust and dirt; third, children prone to pica, about fifty percent of those between one year and three years, eat nonfood items including dust and dirt; therefore, children in urban areas can be expected to absorb lead in this fashion. *Id.* at 605.

188. *See, e.g.,* Carolina Envt'l Study Group v. United States, 510 F.2d 796, 799 (D.C. Cir. 1975).

189. Ethyl Corp. v. EPA, 541 F.2d 1, 19 (D.C. Cir. 1975).

Wrote Judge J. Skelley Wright in his dissent in the D.C. Circuit's initial consideration of *Ethyl Corp.*: "The significance of the risk . . . can only be ascertained through knowledge of the threatened harm, and it is the total risk of harm that must be sufficient to endanger the

severe consequences do result from chemical emissions from a hazardous waste site, rather than prove the common law standard that the probability of harm occurring must be "more likely than not" (greater than 50 percent), the plaintiff need only prove a "potential" of harm[190] (greater than a remote probability) or provide evidence of a "reasonable medical concern" that injury will occur.[191] Indeed, as Justice Ryan of the Illinois Supreme Court wrote in his concurring opinion in *Village of Wilsonville v. SCA Services, Inc.*,[192] the reason a relatively slight showing of probability of risk of future harm is justified is that the consequences of the probable harm from hazardous waste releases are particularly great.

> [T]here are situations where the harm that is potential is so devastating that equity should afford relief even though the possibility of the harmful result occurring is uncertain or contingent . . . . If the harm that may result is severe, a lesser probability of it occurring should be required . . . . Conversely, if the potential harm is less severe, a greater probability that it will happen should be required.[193]

In *Village of Wilsonville,* the Illinois Supreme Court upheld a lower court injunction requiring the closure of a hazardous waste disposal site and the removal of its contents, based on prospective public nuisance theory. Cognizant of the extremely hazardous nature of the chemicals being dumped, including PCB substances, and fearful of the potentially catastrophic results of migration of the chemicals into the nearby water supply and ambient air, the court balanced the relative hardship to the plaintiffs and benefits to the defendant of permitting the site to operate and concluded that the site's dangers outweighed its utility.[194] Despite a lower court holding

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public health." Ethyl Corp. v. EPA, Civil No. 73-2205 (D.C. Cir. 1975) at 14 n.14 (dissenting opinion).

190. Ethyl Corp. v. EPA, 541 F.2d at 20.

191. *Id. See also* Smith v. Smith, No. 80-2197 (Fla. Dist. Ct. App.2d Dist., Nov. 18, 1981). Here, the expert witness testified with reasonable medical certainty that while the plaintiff did not at the time of trial have cancer, there was a significant risk that the disease would recur at a later date. The court awarded damages.

192. 86 Ill.2d 1, 37-38, 426 N.E.2d 824, 842 (1981). *See also* Reserve Mining v. EPA, 514 F.2d 1 (8th Cir. 1975).

193. Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 37-38, 426 N.E.2d 824, 842 (1981). Justice Ryan concluded:

> This balancing test allows the court to consider a wider range of factors and avoids the anomalous result possible under a more restrictive alternative where a person engaged in an ultrahazardous activity with potentially catastrophic results would be allowed to continue until he has driven an entire community to the brink of disaster. A court of equity need not wait so long to provide relief.

Id., at 38, 426 N.E.2d 824, 842 (1981).

194. Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 35, 426 N.E.2d 824, 841 (1981).

that evidence that the hazardous substances would actually migrate out of the landfill and contaminate outside areas was uncertain, because contingent upon the existence of conditions in the subsurface which were not known,[195] the Illinois Supreme Court had "no doubt" of the high probability that the chemical disposal site would bring about a substantial injury.

> [W]e think it is sufficiently clear that it is highly probable that the instant site will constitute a public nuisance if, through either an explosive interaction, migration, subsidence, or the 'bathtub effect,' the highly toxic chemical wastes deposited at the site escape and contaminate the air, water, or ground around the site . . . . A court does not have to wait for it to happen before it can enjoin such a result.[196]

In Woburn, it has been predicted that the consequences of chemical contamination will be severe.[197] Conceivably, by analogy to the probability-of-risk-consequences-of-harm analysis, a potential Woburn claimant seeking compensatory damages should be required only to prove a reasonable likelihood of risk to recover damages for at-risk injury. There are, however, problems in applying this balancing approach to the Woburn incident. Public health officials have been unable to establish that the waste discharges into the air, water, and soil from the hazardous waste site give rise to a potential threat to human health. In fact, medical scientists have yet to discover a significant probability that drinking the contaminated water or breathing the polluted air will increase the propensity for disease among residents. At most, scientists can forecast that the existence of chemical contamination and environmental exposures to the population create a reasonable medical concern of health risk. This appraisal may be sufficiently translated into a "reasonable likelihood of harm" to enable the trier of fact to award damages for at-risk injury. But as has been seen above, only a minority of courts have displayed a judicial willingness to accept such argument.

To obtain at least theoretical judicial support for the at-risk injury claim, the hazardous waste plaintiff may turn to the prospective public nuisance balancing approach incorporated in *Village of Wilsonville.* The circumstances surrounding *Village of Wilsonville,* however, can be distinguished from the Woburn incident. In *Village of Wilsonville,* plaintiffs seeking the injunction alleged no present

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195. Village of Wilsonville v. SCA Services, Inc., 77 Ill. App.3d 618, 634-35, 396 N.E.2d 552, 563 (1979).

196. Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 27, 426 N.E.2d 824, 837 (1981).

197. *See supra* text and notes at notes 10, 13, 15, 18, 94, 96.

harm to any person. In addition, plaintiffs did not cite an example of direct human exposure to the chemical waste at the site. The permanent injunction was upheld due to the high probability that a public nuisance would result if a release from the waste site occurred. Since only an injunction was sought the probability that a disease generating pollution incident would indeed occur was not the only factor in the risk weighing analysis conducted by the court.[198] The waste site did not have to cause diseases to be enjoined as a public nuisance. In contrast, potential plaintiffs in Woburn must go considerably further to obtain compensatory relief. To start a suit a plaintiff must document incidents of exposure to waste materials originally buried at the site, establish the migratory pathway from the waste site to the person, and at a minimum, demonstrate a causal association between the death and disease pattern in the community and proximity to the site. A finding by the court that substantial injury would result from a release of pollutants contained at the site would not by itself support recovery of compensatory damages by a Woburn plaintiff. The enjoining of such a "nuisance" does little to compensate the victims.

VI. Introduction to Proposal for Reform

It is accepted that the dumping of hazardous wastes in landfills and open pits near residential communities poses a significant environmental and public health problem. The unique complexities of hazardous waste injuries, where causes are varied, effects diverse, latency periods long, and exposures difficult to reconstruct, make epidemiological diagnosis uncertain. The problem of causal uncertainty is further complicated by the fact that cancer now accounts for nearly 20 percent of deaths each year; about 55 million people now alive have contracted or will eventually contract cancer.[199]

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198. *See* Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 26-27, 426 N.E.2d 824, 836-37 (1981).

199. Experts have agreed that 60 to 90% of cancers are caused by environmental factors rather than by genetic factors. Environmental factors include substances in the food one eats, cigarettes, or substances in the water and air. Toxic Substances Strategy Committee, Report to the President at VII-4 to VII-6 (Aug., 1979) (Draft), *summary printed in* 44 Fed. Reg. 48,134 - 48,140 (1979); Council on Envt'l Quality, Sixth Annual Report 17 (1975); S. Epstein, *supra* note 7, at 326. *See supra* note 7. Industry representatives cite estimates that only 1 to 5% of cancer cases have been shown to be attributable directly to man-made chemicals. *See* 3 Chem. Reg. Rep. (BNA) (Curr. Rep.) 1, 109 (1979). Such arguments and estimates both ignore the accepted knowledge that cancers are caused by multiple factors in the environment. Toxic Substances Strategy Comm., *supra* this note, at VII-9.

Thus, it becomes even more difficult to isolate the causes of a single case of cancer in an area near a hazardous waste site, since some residents will incur cancer regardless of their exposure to hazardous waste pollution.

In addition, the public regulatory system is inadequate to provide relief to the victims of hazardous waste pollution.[200] Federal statutes and most state public remedies do not recognize a private cause of action for victim compensation. Nor is it likely that the scope of public law will be expanded during the tenure of the Reagan Administration to include compensation of hazardous waste victims. Further, a gap exists between medical acceptance of causation and legal acceptance in case law which makes proof of legal causation nearly impossible, through no fault of the injured party.

Since public law cannot handle the problem of compensating persons injured by exposure to hazardous waste, the common law must respond to this conundrum. The gap in federal and state legislation is in the domain of the state courts, where persons exposed to hazardous waste can obtain compensation. In light of the evidentiary and substantive obstacles to bringing a private damages action in state court, the courts must reform relevant case law to ensure greater availability of courts to hazardous waste plaintiffs.

In view of the broad societal and economic weighing of equities implicit in tort law, the Woburn hazardous waste pollution incident presents a fundamental question: are the innocent victims of an inactive hazardous waste disposal site to be compensated at the expense of industries that produced and/or disposed those wastes or operated the site? In *Cities Service Co. v. Florida,*[201] a case involving a mining operation which polluted state waterways, the Florida Supreme Court concluded that the obligation to pay money damages should be imposed on the profit-oriented mining company, despite the community importance of their mining activities. As the court stated:

> Though there are still many hazardous activities which are socially desirable, it now seems reasonable that they pay their own way. It is too much to ask an innocent neighbor to bear the burden thrust upon him as a consequence of an abnormal use of the land next door.[202]

Some state courts and legal theorists[203] have balanced the equities associated with indispensable, yet hazardous industry activities, by

200. *See supra* text and notes at notes 31-36.

201. 312 So.2d 779 (Fla. 1975).

202. *Id.* at 801.

203. Calabresi & Hirschoff, *Toward a Test for Strict Liability in Torts,* 81 YALE L.J. 1055,

awarding liability to the party best able to absorb and distribute the costs of the injury-producing enterprise. In his concurring opinion in *Escola v. Coca Cola Bottling Co.*,[204] Justice Traynor of the California Supreme Court sought to spread the costs of injury—costs that might overwhelm an individual—to the manufacturers who can insure against the risk or pass the higher costs on to their customers. "[T]he cost of an injury and the loss of time or health may be an overwhelming misfortune to the person injured, and a needless one, for the risk of injury can be insured by the manufacturer and distributed among the public as a cost of doing business."[205] In this manner, the generator or waste site operator can either insure against this liability, or recover the costs of preventing such injuries by passing those costs on to consumers in the form of higher prices for its products, either the sources or products of hazardous wastes. Since consumers benefit from having chemical products available, it is more equitable, the Traynor view would argue, that the consumers in the marketplace, rather than hazardous waste victims ultimately bear the full costs associated with the products—including the costs of disposing hazardous wastes.

Justice Traynor's approach can also be supported on purely economic grounds consonant with tort law. If the full societal cost of manufacture is not incorporated in the price of the waste generating products, these products will enjoy an unwarranted financial advantage in the marketplace. Either their cost will exceed safer alternative products or, perhaps, prevent the introduction of those products into the marketplace. In effect, the artificially low cost of these waste producing products will be unwittingly subsidized by the innocent victims of hazardous waste exposure.

The court system faces a choice in hazardous waste injury litigation. First, it can impose risks of injury upon persons residing near hazardous waste sites. Under this alternative, hazardous waste injury may be regarded as an unavoidable cost of modern technology, and courts will only provide sporadic compensation, if at all, under traditional tort law. Second, in order to ensure that serious injuries suffered by large numbers of people without a satisfactory source of public relief are compensated, the courts can recast traditional tort standards of legal proof.

1060-74 (1972); Calabresi, *Some Thoughts on Risk Distribution and the Law of Torts*, 70 YALE L.J. 499, 517 (1961); Morris, *Hazardous Enterprises and Risk Bearing Capacity*, 61 YALE L.J. 1172, 1175-79 (1952).

204. 24 Cal.2d 453, 150 P.2d 436 (1944).

205. 24 Cal.2d at 462, 150 P.2d at 441.

This article proposes a change in the legal standards of proof on the threshold issues of legal causation, legal injury, the burden of production, and the burden of proof, to facilitate the maintenance of a prima facie cause of action for personal damages by persons injured from exposure to hazardous waste. This article also proposes a change in which party carries the burden of persuasion—the risk of non-persuasion—from plaintiff to defendant. By adjusting the balance between plaintiff and defendant in hazardous waste injury litigation, aggrieved parties will be able to overcome the chief obstacle to recovery: the non-suit, either upon the motion to dismiss or at the directed verdict stage of the trial.

First, the proposed approach modifies the concept of legal causation to respond to the medical realities of hazardous waste injuries. Under this proposal, a valid scientific demonstration of causation can be translated into sufficient proof of legal causation to enable the plaintiff to survive a directed verdict. Accordingly, the plaintiff need only show an association—a statistically significant correlation— between the defendant's conduct and the alleged injury. Documentation of a significant correlation which withstands the statistical probability of error test[206] constitutes competent proof of legal cause and establishes the prima facie showing of causation. Thus, a plaintiff is not required to meet the traditional test of legal causation—that a particular exposure directly caused the injury more probably than not (greater than 50 percent chance).

Second, the traditional concept of legal injury will be broadened to enable a plaintiff without ascertainable injury to bring a private damages action for at-risk injury due to exposure to hazardous wastes. To withstand the defense motion for non-suit or a directed verdict, plaintiff must allege and prove that exposure to hazardous contaminants has occurred, and that a reasonable likelihood has arisen that exposure to the contaminants may potentially lead to future injury as established by medical research.

Third, the conventional tort standard to guide the trier of fact in determining the burden of production, the burden of coming forward with evidence, will be changed from a preponderance of the evidence to a reasonable likelihood. Under the traditional common law system, in order to avoid a directed verdict, judges require the plaintiff to carry the burden of production sufficiently to convince a jury by a preponderance of the evidence that there were legally

206. For a discussion of the statistical test *see supra* text and notes at notes 89-90.

cognizable exposure and injury.[207] In fact, in most hazardous waste incidents, aggrieved parties will be unable to meet the burden of coming forward with a preponderance of the evidence sufficient to establish legal causation and injury, and thereby will suffer directed verdicts.

Fourth, the standard for determining whether a litigant has met the ultimate burden of proof by which the jury would be persuaded in favor of the party carrying the burden will be changed from a preponderance of the evidence to a reasonable likelihood. Under traditional tort law, in order to find for the plaintiff, the jury must determine by a preponderance of the evidence that plaintiff has established the elements of the cause of action.[208] Again, in light of the uncertainty of hazardous waste injuries, a claimant would likely fail to prove to the jury that a preponderance of the evidence supports the truth of the claim asserted and thus, the claimant would suffer a directed verdict.

Fifth, if the plaintiff satisfies the threshold requirements of the proposal, thereby setting forth a prima facie case, the burden of persuasion—the risk of nonpersuasion—shifts to the named defendant to come forward with sufficient evidence—a preponderance of the evidence—to rebut the plaintiff's case. In the absence of any contrary showing by the defendant, plaintiff can obtain a directed verdict. If, however, the defendant does offer evidence in rebuttal, yet fails to convince the trier of fact by a preponderance of the evidence as to the truth of his defense in evidence, a verdict may still be directed against the defendant.

This proposal creates a precise analytical framework by which the victim of hazardous waste pollution can sustain a cause of action for private damages relief. The proposal itself is a hybrid, combining the fundamental elements of the 1980 Senate proposal (S. 1480) for a private compensatory fund under Superfund,[209] the State of California Hazardous Substance Account Act of 1981,[210] and the prob-

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207. W. PROSSER, *supra* note 45, § 38, at 208.

208. *Id.*

209. *See* Environmental Emergency Response Act. S. 1480, 96th Cong., 2d Sess. §§ 2-12 CONG. REC. 14,930, 14,932 (1980). S. 1480 established a $4 billion compensation fund and contained broad liability provisions, calling for strict, joint and several liability among a range of potentially responsible parties. In addition, it covered private injuries and included provisions for the payment of medical expenses. The measure providing for private recovery of damages was dropped from the legislation after a compromise measure was agreed upon with the House of Representatives at the end of the lame duck session in early December, 1980.

210. State of California Hazardous Substance Account Act of 1981, ch. 756, 1981 Cal. Legis. Serv. 2619 (West) (to be codified at CAL. HEALTH & SAFETY CODE § 25300).

ability-of-risk-consequences-of-harm balancing theory adopted by some courts in prospective public nuisance cases.[211]

VII. A Proposal for the Determination of Legal Causation

A. Injury-In-Fact[212]

If a claimant with ascertainable injury introduces evidence sufficient to enable the trier of fact to find first, that the claimant was or is exposed to a hazardous substance or hazardous substances found in a discharge, release, or disposal; second, that there exists a reasonable likelihood that exposure to such substance or substances causes or significantly contributes to injury or disease of the class or type which that claimant alleges to have suffered; and third, that the exposure was or is of a sufficient amount and duration that there exists a reasonable likelihood that it caused or contributed to the type or class of injury or disease which that claimant alleges to have suffered; then the trier of fact shall determine that the hazardous substance caused or significantly contributed to the injuries or disease which the claimant alleges to have suffered. Further, if a claimant introduces evidence sufficient to enable the trier of fact to find that there exists a reasonable likelihood that a party or group of parties caused or significantly contributed to the pertinent exposure or injury, then it shall be determined that such party caused or significantly contributed to the injuries or disease suffered by that claimant.

In considering those circumstances under which the defendant is liable to the plaintiff, the trier of fact may examine the following catalogue of evidence tending to establish that the hazardous substances in question causes or contributes to the injury or disease alleged by the claimant: 1) evidence indicating an increase in incidence of the alleged injury or disease in the exposed population

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211. *See supra* text and notes at notes 176, 188.

Further, so as not to obscure the pivotal role of the causation determination in the proposed compensation framework, the related problem of tort liability will not be discussed. For an analysis of the issue of liability as it concerns the generators and disposers of hazardous waste, see, *e.g.*, Ewell v. Petro Processors Of Louisiana, 364 So.2d 604 (Ct. of App. La. 1978); Curry Coal Co. v. M.C. Arnoni Co., 439 Pa. Commw. Ct. 114, 266 A.2d 678 (1970); Boroughs v. Joiner, 337 So.2d 340 (Ala. 1976); W. Prosser, *supra* note 45, § 78, at 509; Note, *The* Rylands v. Fletcher *Doctrine in America: Abnormally Dangerous, Ultrahazardous, or Absolute Nuisance?*, Ariz. St. L. J. 99, 100 (1978).

212. This section mirrors in pertinent part the presumption of cause element in S. 1480, 96th Cong., 2d Sess. §§ 4(c)(3)(A)-4(c)(3)(B)(4), 126 Cong. Rec. 14932, 14941 (1980).

above the measured level of morbidity and mortality in the otherwise unexposed population; 2) results of pertinent epidemiological (without regard to the sample) and toxicological studies; 3) results of relevant animal studies; 4) results of pertinent tissue culture and microorganism culture studies; 5) information on the correlations between chemicals and their potential to cause harm; and 6) studies of the effects of environmental exposures on chemical materials, the potential effects of disease by those materials and the metabolic transformation of those materials.

In addition, the trier of fact, in deciding whether the defendant is liable to the plaintiff, should also examine the following threshold questions: 1) to what substances was the plaintiff exposed and under what conditions; 2) did other people exposed to the same substance contract similar diseases or harm; 3) was the plaintiff exposed to other substances that are capable of causing this disease which cannot be traced to the discharge, release, or disposal at issue; 4) what is the expected occurrence of the disease-injury-harm for people without such exposure; and 5) did plaintiff's own conduct or existing environmental conditions increase the risk of contracting the disease or injury?

A showing of legal cause by the plaintiff shifts the burden of production and proof to the defendant to persuade the trier of fact by a preponderance of the evidence that there is not a reasonable likelihood that exposure to the pertinent hazardous substance caused or significantly contributed to the injuries alleged by the claimant. Likewise, the identification of a causal relationship shifts the burdens of production and proof to the defendant to persuade the trier of fact by a preponderance of the evidence that there is not a reasonable likelihood that the defendant caused or significantly contributed to the injuries alleged by the claimant.

To fulfill the burden of persuasion, defendant's arguments of rebuttal may take the following form: first, the defendant may allege and prove that it did not generate or release the environmental contaminants at issue; second, that the hazardous waste materials generated by the defendant could not have migrated along an environmental pathway from the landfill to the injured person; third, that the hazardous wastes in defendant's control could not have produced the etiology attributed to the pollution by plaintiff's showing; fourth, that the defendant was not solely responsible for the hazardous waste pollution at issue; and fifth, due to chemical synergism, the hazardous wastes within defendant's control by itself could not have comprised the injury or disease causing substance.

Under the contribution provision of the California Superfund law,[213] any defendant to an action for recovery of the cost of response to a release or threatened release of hazardous substances may make a motion to the court to join any other party who may be liable for costs or expenditures under the state act.[214] If a party can show by a preponderance of the evidence that it is only responsible for a portion of the costs of response, the court must duly apportion the damages.[215] Similarly, Senate Bill 1480 recognized a defendant action to limit or apportion liability according to the degree of contribution.[216]

B. At-Risk Injury

If a claimant without ascertainable injury introduces evidence to enable the trier of fact to find: first, that the claimant was or is exposed to a hazardous waste substance or substances found in a discharge, release, or disposal; second, that there exists a reasonable likelihood that the chemical wastes released are dangerous to humans due to the amount and the type of hazardous waste substances involved; and third, that there exists a reasonable likelihood that exposure to such waste substances will cause or contribute to a potential risk that the claimant will contract disease-injury-harm; exposure to the dangerous waste substances has increased the potential for injury occurring and should therefore be compensable. Further, if a claimant without ascertainable injury introduces evidence sufficient to enable the trier of fact to find that there exists a reasonable likelihood that a party or group of parties caused or contributed to the pertinent hazardous exposure, then the trier of fact shall determine that such party or parties caused or contributed to the potential risk that the claimant will contract disease or injury in the future.

Assessment of the potential risk of harm can be based upon one's proximity to the location where the hazardous waste has been emitted and upon the duration, intensity, and frequency of exposure. The calculation of compensable risk is also based upon the prediction

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213. Cal. Superfund, ch. 756 § 2, 1981 Cal. Legis. Serv. at 2618-19 (West) (to be codified at CAL. HEALTH & SAFETY CODE §§ 25362-25363).

214. *Id.* at § 2, 1981 Cal. Legis. Serv., at 2618 (to be codified at CAL. HEALTH & SAFETY CODE § 25362).

215. *Id.* at § 2, 1981 Cal. Legis, Serv. at 2618-19 (to be codified at CAL. HEALTH & SAFETY CODE § 25363).

216. S. 1480, 96th Cong., 2d Sess. § 5(c)(3)(B)(f)(2), 126 CONG. REC. 14932, 14941 (1980).

of the consequences of human exposure to the substances at issue. For a plaintiff to establish that the exposure to the pollutants released from the hazardous waste site increased the risk of future disease-injury-harm, plaintiff should not be required to prove that injury will probably result from exposure. Instead, the claimant need only provide expert witnesses testifying to a reasonable medical concern that exposure increased the risk of potential injury.

Once plaintiff meets this burden, the burdens of production and proof are shifted to the defendant to persuade the trier of fact by a preponderance of the evidence that there is not a reasonable likelihood that defendant placed the claimant at risk of incurring future injury. Such arguments of rebuttal can take the following form: first, that the likely effect of exposure to the hazardous waste substances within the defendant's control could not cause future injury; second, that the hazardous waste substances were not generated or released by defendant at the time the plaintiff claims to have been exposed to hazardous waste; and third, that the hazardous waste substances within the defendant's control could not have migrated into the claimant's environment.

VIII. Discussion of the Proposal in the Context of the Woburn Dumpsite

The unique characteristics of hazardous waste injuries, ranging from the long latency periods to the cumulative nature of exposure, make precise legal proof of causation nearly impossible. Cognizant of this scientific reality, this proposal has sought to bring existing legal standards of proof into conformity with modern medical reality. Such a proposed "leap of faith" from traditional tort doctrine to judicial acceptance of the medical approach to causation confronts our common law courts with two distinct options. To quote the California Court in *Sindell v. Abbott Laboratories*,[217] "[t]he response of the courts can be either to adhere rigidly to prior doctrine, denying recovery to those injured by . . . products, or to fashion remedies to meet . . . changing needs."[218]

In Woburn, Massachusetts, dangerous chemical carcinogens and toxins from a nearby hazardous waste site have been released into the air and groundwater of a small residential community, thereby threatening its inhabitants with the risk of contracting various

217. 26 Cal.3d 588, 607 P.2d 924 (1980), *cert. denied*, 449 U.S. 912 (1980).
218. 26 Cal.3d at 610, 607 P.2d at 936.

diseases and cancers. Already, a microepidemic of childhood leukemia and renal cancer has been identified. Independent evidence also suggests that disease and mortality rates are unusually high in the area. Nonetheless, potential plaintiffs are confounded by the nearly insurmountable obstacles posed by the formal requirements of legal proof of causation.

Under this article's proposal, where a casual association can be established, a potential Woburn plaintiff exposed to hazardous materials may be able to sustain a cause of action for private damages. The plaintiff need not isolate the precise exposure nor identify the landfill owner's specific waste contaminants which actually caused the injury; nor must the plaintiff ultimately prove with absolute certainty that the particular exposure directly caused the injury. Documentation of a reasonable likelihood of a disease causing relationship with the exposure should constitute sufficient proof to make the prima facie case of legal causation.

As an alternative to the public regulatory solution, the private tort suit can be seen as the market's answer to the problem of hazardous waste pollution injury in much the same way as products liability doctrine functions. Due to the potential costs of defendant accountability that may be incurred by the generator or disposer of hazardous waste, or by the waste site operator, a common law framework for compensation may provide financial incentives for regulatory compliance. At the same time, it would spread the tort loss among the manufacturers of chemical products and, ultimately, the consumers of the end products of hazardous waste. This way the costs of liability will move up the industry ladder from the generator to the transporter, disposer, and manufacturer.

If persons exposed to hazardous waste are barred from recovery for injury due to the considerable barriers of legal proof, the generators of the waste or the operators of the waste sites will have profited from their activities without liability for the harm produced. Such informal immunity is unlikely to deter the waste producer or landfill owner from continuing to contaminate the surrounding environment. Indeed, any waste generating party which spent funds to bring its activities into regulatory compliance would be put at a competitive disadvantage against those parties that save money by exposing the public to dangerous waste materials. That unequal treatment cuts against elemental principles of tort law.

Under this proposal, however, the common law courts may still be an unsatisfactory source of relief when the party responsible for the release of the hazardous substances and the resulting damages can-

not be identified. Moreover, even if a responsible defendant can be found, it is still difficult to prove a reasonable likelihood of a disease association, especially where an unseen substance unknowingly ingested at an indeterminant time is involved. Assuredly, the defendant will provide a series of expert witnesses who will challenge the determination of a reasonable likelihood of causation, which may result in extensive witness examinations, creating delays and a battle of experts in the progression of the suit. Further, the expensive nature of developing a plaintiff's hazardous waste injury case may still deter victims with damages smaller than the potential costs of litigation from bringing suit at all.

Compensating plaintiffs for at-risk injury claims at the time of exposure based on the reasonable chance that they will incur future disease is also problematic. Since it is impossible to distinguish in advance the exposed persons who will contract disease from those who will not, courts may compensate some plaintiffs for the risk of injuries that they never will suffer. Further, courts may award money damages, upon proof of exposure, which will inadequately compensate those plaintiffs who later suffer extraordinary injuries, including death.

Critics may also justifiably argue that the effect of shifting the burden of persuasion from plaintiff to defendant may be to guarantee that plaintiffs who establish the prima facie case will automatically prevail, as defendants are no more capable of disproving factual causation than plaintiffs are of proving it.[219] The result of such an alleged bias in the proposal may be to encourage massive personal injury litigation due to hazardous waste exposure, with devastating financial consequences for defendant parties. Indeed, there may not be enough money to compensate claimants for the variety of injuries which may attach from exposure to hazardous wastes. Thus, in view of the magnitude of money damages potentially involved in a judgment order for plaintiff, it is possible that the culpable defendant may not have the sufficient financial assets or insurance coverage to pay the damages awarded by a court.

The potential enormity of judgment orders may also lead to economic dislocation in the hazardous waste industry. Substantial adverse judgments may drive defendants out of business who cannot afford to pay the costs of litigation or liability, as well as deterring others from entering the industry altogether. Indeed, it is con-

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219. 26 Cal.3d at 613, 607 P.2d at 947 (1980) (Richardson, J., dissenting).

ceivable that those waste site operators, generators, and disposers who bring their injury producing activities into regulatory compliance may still be liable under common law tort for personal injury damages, due to the lack of a private cause of action for compensatory relief in public law. In view of the undeniable need for facilities to dispose of industrial hazardous wastes,[220] and the already considerable financial investment made by existing site operators in providing the needed service,[221] society may not be able to afford the proposed changes in the litigation of hazardous waste suits. Indeed, it may be preferable to have hazardous waste sites than to have illegal dumping in rivers, streams, and deserted areas.[222]

IX. Conclusion

It is precisely in the residential communities that ring hazardous waste sites where the public health must be carefully safeguarded. There will rarely, if ever, be scientific agreement on "safe" levels of exposure in those situations where on the one hand, large industries are at stake and on the other, there is substantial evidence of material adverse health effects in the exposed population. Predictably, in these situations exposed and possibly injured residents will turn to their state and federal government for relief. Yet, the public regulatory system cannot provide compensation to persons harmed or endangered by hazardous waste releases.

To the person exposed to hazardous waste seeking compensation for injury or the endangerment of health outside public law, state courts remain a largely inaccessible forum for relief. The problem of multiply-caused, time-delayed injuries is an anomaly to a legal system that does not recognize the medical phenomenon of the uncertain human health effects of hazardous waste pollution. Without flexibility or alterations in the common law, it is likely that most victims of hazardous waste pollution will continue to unsuccessfully litigate personal injury claims, and, thus, will remain uncompensated.

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220. *See* Village of Wilsonville v. SCA Services, Inc. 77 Ill. App.3d 618, 636, 396 N.E.2d 552, 564 (1979).

221. Village of Wilsonville v. SCA Services, Inc., 86 Ill.2d 1, 23-24, 426 N.E.2d 824, 835 (1981).

222. *Id.* at 30-31, 426 N.E.2d 824, 838 (1981).