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# Material Contribution to Risk in the Canadian Law of Toxic Torts

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# MATERIAL CONTRIBUTION TO RISK IN THE CANADIAN LAW OF TOXIC TORTS

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## I. INTRODUCTION

Common law approaches to causation have historically been based on the premise that if a defendant's negligence has caused a plaintiff's loss, she will probably be able to prove it.[1] This assumption is untenable in our contemporary world of immense chemical complexity.[2] In the toxic torts context,[3] traditional approaches to causation have resulted in under-compensation of injured victims and under-deterrence of chemical wrongdoing.[4] Indeed, writing extra-judicially in the late 1990s, the current Chief Justice of the Supreme Court of Canada noted that "[t]he all-or-nothing outcome of the [traditional] test [for causation] all too often results in a 'nothing,' inconsistent with modern expectations."[5] Jurists and scholars have sought to soften the rigidity of the causation element by importing risk-based innovations into the causation analysis. This Article will introduce and analyze one such innovation: the test of "material contribution to risk" in the Canadian law of toxic torts.[6]

Part II considers the unique challenges that arise in the causation analysis in toxic torts, with a particular focus on the problem of scientific uncertainty. Part III elucidates the stages of the causation inquiry in Canadian

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1. Lynda Collins, *Material Contribution to Risk and Causation in Toxic Torts*, 11 J. ENVTL. L. & PRAC. 106, 106 (2001); David Rosenberg, *The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System*, 97 HARV. L. REV. 851, 858 (1984).

2. CARL F. CRANOR, TOXIC TORTS: SCIENCE, LAW AND THE POSSIBILITY OF JUSTICE 12 (2006).

3. Toxic torts can be defined as torts arising from environmental contamination or a toxic product. LYNDA COLLINS & HEATHER MCLEOD-KILMURRAY, THE CANADIAN LAW OF TOXIC TORTS 1 (2014).

4. See *id.*; *see also* Lynda Collins & Heather McLeod-Kilmurray, *Material Contribution to Justice? Toxic Causation after* Resurfice Corp. v. Hanke, 48 OSGOODE HALL L.J. 411 (2010).

5. The Honorable Beverly M. McLachlin, *Negligence Law - Proving the Connection*, *in* TORTS TOMORROW: A TRIBUTE TO JOHN FLEMING 34 (Nicholas J. Mullany & Allen M. Linden eds., 1998).

6. For a more detailed analysis of the Canadian law of toxic causation, see COLLINS & MCLEOD-KILMURRAY, *supra* note 3, at 123–56.

toxic tort law, including consideration of the standard of proof, the but-for test, and the new test of material contribution to risk. Part IV introduces proposals for risk-based reform in Canadian causation law, and Part V presents a brief conclusion. In order to do justice to toxic tort plaintiffs, and remain relevant in the twenty-first century, Canadian tort law needs to grapple with the new world of chemically-induced harm by adopting a broad test of material contribution to risk, complemented by stronger forms of risk-based liability.

## II. CAUSATION IN THE CHEMICAL WORLD

### *A. Scientific Uncertainty*

In the decades since the 'chemical revolution' of the mid-twentieth century, thousands of synthetic chemicals and millions of chemical mixtures have entered the human environment.[7] While some chemicals are harmless, others have caused untold human suffering. Toxic pollution and products cause tens of thousands of premature deaths each year in North America.[8] In the middle ground between known innocuous and proven toxic substances is a vast grey area of profound and pervasive scientific uncertainty.[9] Surprisingly, for many thousands of chemicals and millions of mixtures, rigorous toxicity data is simply lacking.[10] The generation of chemical safety data has been frustrated by both legal and scientific factors. On the scientific side, the challenges are manifold. Environmental pollu-

7. *See* NAT'L RESEARCH COUNCIL, COMM. ON TOXICITY TESTING & ASSESSMENT OF ENVTL. AGENTS, TOXICITY TESTING IN THE 21ST CENTURY: A VISION AND A STRATEGY 40 (2007); NAT'L RESEARCH COUNCIL, TOXICITY TESTING FOR ASSESSMENT OF ENVIRONMENTAL AGENTS 99 (2006); RACHEL CARSON, SILENT SPRINT 16 (First Mariner Books 2002) (1962) (noting that "[f]or the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals, from the moment of conception until death").

8. *See, e.g.*, DAVID R. BOYD, CLEANER, GREENER, HEALTHIER: A PRESCRIPTION FOR STRONGER CANADIAN ENVIRONMENTAL LAWS AND POLICIES (2015); JOE THORNTON, PANDORA'S POISON: CHLORINE, HEALTH, AND A NEW ENVIRONMENTAL STRATEGY (2000); WORLD HEALTH ORG., COUNTRY PROFILE OF ENVIRONMENTAL BURDEN OF DISEASE: CANADA (2009) (estimating that environmental hazards cause or contribute to 36, 800 premature deaths in Canada each year).

9. *See generally* Steve C. Gold, *When Certainty Dissolves into Probability: A Legal Vision of Toxic Causation for the Post-Genomic Era*, 70 WASH. & LEE L. REV. 237 (2013); Richard Goldberg, *Epidemiological Uncertainty, Causation, and Drug Product Liability*, 59 MCGILL L. J. 777 (2014).

10. *See, e.g.*, Noah M. Sachs, *Rescuing the Strong Precautionary Principle from its Critics*, 2011 U. ILL. L. REV. 1285, 1287 (2011) ("[W]e lack basic toxicity data for the vast majority of chemicals used in cookware, toys, beauty products, food packaging, and other items."); *see* CHRISTIAN HEIDORN, EUROPEAN COMM'N, THE REACH BASELINE STUDY—A TOOL TO MONITOR THE NEW EU POLICY ON CHEMICALS 3 (2009) (noting "our very limited knowledge about the properties of substances and their safe uses"); CRANOR, *supra* note 2, at 12 ("[I]n general, the probability is that for any given substance little is likely to be known about it."); D. ROE ET AL., ENVTL. DEF. FUND, TOXIC IGNORANCE: THE CONTINUING ABSENCE OF BASIC HEALTH TESTING FOR TOP-SELLING CHEMICALS IN THE UNITED STATES (1997).

tants are difficult to trace once released and interact in complex and poorly understood ways with each other, environmental media and human bodies.[11] Non-pharmaceutical chemicals cannot be tested directly on humans, leaving only animal testing, which is costly, time-consuming and ethically controversial.[12] Thousands of new substances are invented every year and yet neither government nor academia has the capacity (in personnel, money or test animals) to subject this number of substances to thorough independent study.[13] To summarize, our ability to invent and disseminate new chemical substances has far outpaced our ability to understand them.

On the legal side, outdated processes in both statutory environmental law and torts have strongly incentivized chemical producers to "choose ignorance" in order to limit liability.[14] Statutory environmental law has presumed chemicals innocent until proven guilty, treating the absence of evidence of harm as evidence of an absence of harm, a fallacy that is soundly rejected by scientists.[15] In a statutory system that requires data in order to justify regulatory limits, the rational manufacturer tends to understudy its products in order to limit the risk of adverse results.[16] Tort law has similarly required the injured plaintiff to present evidence proving on a balance of probabilities that the defendant's substance caused her illness, even where the data to support or refute such a claim are unavailable. Carl Cranor summarizes the legal drivers of chemical uncertainty as follows:

> Because the regulation of suspect substances that enter the market without legally required testing will occur only if a governmental agency [shows] a *risk of harm* and a tort action will proceed only if a plaintiff shows [causation of] *actual harm*, firms have incentives to resist testing their products and monitoring them for adverse effects and often they have not.[17]

Against this backdrop of massive (and sometimes intentional) chemical uncertainty, toxic tort plaintiffs have continued to bear the burden of

11. THORNTON, *supra* note 8, at 414.

12. *See* CRANOR, *supra* note 2, at 105–11.

13. *See generally* Wendy E. Wagner, *Choosing Ignorance in the Manufacture of Toxic Products*, 82 CORNELL L. REV. 773 (1997); Sachs, *supra* note 10.

14. Wagner, *supra* note 13.

15. *Id.*; D.G. Altman & J.M. Bland, *Absence of Evidence is Not Evidence of Absence*, 19 BRIT. MED. J. 311, 485 (1995); David Kreibel et al., *The Precautionary Principle in Environmental Science*, 109 ENVTL. HEALTH PERSP. 871, 873 (2001).

16. CRANOR, *supra* note 2, at 13; Wagner, *supra* note 13, at 774–75.

17. *Id*. (emphasis in original).

proving causation, largely by reference to legal tests that long pre-date our current chemical reality.

Despite compelling scholarly calls for reform,[18] causation remains a touchstone for tort liability in Canada. Indeed, the Supreme Court of Canada has described causation as "an expression of the relationship that must be found to exist between the tortious act of the wrongdoer and the injury to the victim in order to justify compensation of the latter out of the pocket of the former."[19] Causation is an element of the negligence cause of action, without which there can be no recovery.[20] Even with respect to torts that are actionable without proof of injury (e.g., battery), the plaintiff must prove a causal link between the defendant's conduct and her injury in order to recover compensatory damages.[21] A voluminous body of scholarship has attempted to resolve the dilemma of toxic causation,[22] but causation remains the single biggest hurdle to recovery for the toxic tort plaintiff in Canada as elsewhere.[23]

### *B. Legal Uncertainty in Toxic Causation*

In toxic tort cases, the causation element can be broken down into two components: generic causation and specific causation.[24] Generic causation refers to the *capacity* of the substance at issue to cause the kind of injury suffered by the plaintiff. It concerns the general characteristics of the substance, such as whether it has been shown in lab tests to cause a particular illness in test animals, or whether there is epidemiological evidence suggesting a substance-illness connection in human populations.[25] If there is

18. *See, e.g.*, Margaret A. Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Tort*, 97 COLUM. L. REV. 2117 (1997); *see* Ariel Porat & Alex Stein, *Liability for Future Harm*, *in* PERSPECTIVES ON CAUSATION 221, 234 (Richard S. Goldberg ed., 2010).

19. Snell v. Farrell, [1990] 2 S.C.R. 311, 326 (Can.).

20. *Id.*

21. *See* Lynda M. Collins & Heather McLeod-Kilmurray, *Toxic Battery: A Tort of Our Time?*, 16 TORT L. REV. 131, 147 (2008).

22. *See, e.g.*, Collins, *supra* note 1; Collins & McLeod-Kilmurray, *supra* note 4; Gold, *supra* note 9; Brenda Heelan Powell, *Cause for Concern: An Overview of Approaches to the Causation Problem in Toxic Tort Litigation*, 9 J. ENVTL. L. & PRAC. 227 (1999); Per Laleng, *Causal Responsibility for Uncertainty and Risk in Toxic Torts*, 18 TORT L. REV. 102 (2010); Wagner, *supra* note 13; *see generally* Berger, *supra* note 18.

23. *See, e.g.*, JACK B. WEINSTEIN, INDIVIDUAL JUSTICE IN MASS TORT LITIGATION 148 (1995).

24. *See* Lynda M. Collins, *Material Contribution to Risk and Causation in Toxic Torts*, 11 J. ENVTL. L. & PRAC. 106, 109 (2001) [hereinafter Collins, *Material Contribution*] (citing JEAN MACCHIAROLI EGGEN, TOXIC TORTS IN A NUTSHELL 197 (1995); s*ee also* Vern R. Walker, *Restoring the Individual Plaintiff to Tort Law by Rejecting 'Junk Logic' About Specific Causation*, 56 ALA. L. REV. 381, 383 (2004).

25. Collins & McLeod-Kilmurray, *supra* note 4, at 419; CRANOR, *supra* note 2, at 91 (chapter 4: "The science of toxicity and reasoning about causation.").

insufficient evidence that the defendant's substance is capable of causing the plaintiff's illness under any circumstances, then the causation inquiry is at an end. If, however, the plaintiff can prove generic causation, she must nonetheless show that the defendant's toxic substance *actually* caused her illness in the specific circumstances of her case. To assess specific causation, courts will consider factors such as the nature, duration and concentration of the plaintiff's exposure as well as other risk factors that might account for the plaintiff's illness.[26]

Proof of both generic and specific causation frequently founders on the problem of scientific uncertainty discussed above (and thoroughly canvassed in the literature of toxic torts).[27] In addition to the massive uncertainty surrounding the safety (or danger) of chemical substances,[28] the illnesses at issue in many toxic tort actions are both multi-factorial and poorly understood,[29] and the injurious encounter takes place at least partly on a microscopic level invisible to the naked eye.[30] This constellation of factors has produced three discernible kinds of uncertainty in torts cases.

The first scenario involving the indeterminate plaintiff arises when a defendant increases the incidence of an illness that already occurs at background levels in a given population.[31] Through epidemiological evidence, we know that the defendant has harmed some individuals within an exposed group, but there exists no individual plaintiff who can prove causation against the defendant. S.M. Waddams postulates the following hypothetical:

> The defendant pollutes the air and increases the risk to the whole population of Australia of contracting skin cancer, raising the risk, let us say, from 10 per 100,000 to 19 per 100,000. On these figures, no particular plaintiff with cancer can show that the defendant probably caused the disease: more probably than not the plaintiff would have contracted it in

26. *See* Michael R. Hadskis, Finding Our Way Out of the Causation Jungle in Toxic Torts at 117-18 (Sept. 1993) (unpublished thesis, Osgoode Hall Law School) (on file with the National Library of Canada).

27. *See, e.g.*, COLLINS & MCLEOD-KILMURRAY, *supra* note 3, at 9–37.

28. *Id.; See also* Carl F. Cranor & David A. Eastmond, *Scientific Ignorance and Reliable Patterns of Evidence in Toxic Tort Causation: Is There a Need for Liability Reform?*, 64 LAW & CONTEMP. PROBS. 5, 6 (2001) ("In general, little is known about the universe of approximately 100,000 chemical substances or their derivatives registered for commerce (with 800 to 1000 new substances added to the list each year).").

29. *See generally* PHIL BROWN, TOXIC EXPOSURES: CONTESTED ILLNESSES AND THE ENVIRONMENTAL HEALTH MOVEMENT (2007).

30. *See* Hadskis, *supra* note 26, at 3; Gold, *supra* note 9, at 244.

31. *See generally* Shelly Brinker, *Opening the Door to the Indeterminate Plaintiff: An Analysis of the Causation Barriers Facing Environmental Toxic Tort Plaintiffs*, 46 UCLA L. REV. 1289 (1999).

> any case. Should the defendant be liable? If so, should the plaintiff recover full compensation, or only 9/19ths of it?[32]

Population-based evidence is clearly sufficient where it establishes that more than 50% of the plaintiff's total risk factors emanate from the defendant's substance.[33] However, questions arise where risk does not meet this threshold, as in the Waddams example above. In Canada, causation is a qualitative, logical and common sense inquiry rather than a mechanistic, scientific calculation; taking a "robust and pragmatic" common sense approach as instructed by the Supreme Court of Canada,[34] proof of significant risk will often be sufficient to meet the but-for test in the absence of a convincing alternative explanation. Some claims in this category will fail due to scientific uncertainty, but in *Clements v. Clements*, the Supreme Court of Canada explicitly left open the possibility of causation reform in the indeterminate plaintiff scenario in a future case.[35]

The second species of uncertainty identified in the toxic tort literature is that of indeterminate harm, or mere risk exposure.[36] People who are exposed to toxic substances sometimes require medical monitoring, experience anxiety, or feel victimized by the defendant's conduct even if they have not yet contracted a disease (and might never do so).[37] Canadian courts have thus far declined to answer repeated academic calls for the creation of a new tort of negligent creation of risk.[38] There is currently no cause of action in Canada for the negligent infliction of risk alone, but the injury requirement may be met by psychiatric illness or relatively minor physical harm.[39] Although there is no Supreme Court of Canada authority on point, a number of lower courts have also certified class actions for

32. S.M. Waddams, *Causation in Canada and Australia*, 2 TORT L. REV. 75, 77 (1993).

33. Note, however, that proof of a doubling of risk should not be required. *See* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL & EMOTIONAL HARM § 28 (AM. LAW. INST. 2010) ("Any judicial requirement that plaintiffs must show a threshold increase in risk or a doubling in incidence in a group study in order to satisfy the burden of proof of specific causation is usually inappropriate.").

34. *See* Snell v. Farrell, [1990] 2 S.C.R. 311, 323–30 (Can.); Clements v. Clements, [2012] 2 S.C.R. 181, para. 59 (Can.).

35. Clements v. Clements, [2012] 2 S.C.R. 181, para. 44 (Can.).

36. *See* JEAN MACCHIAROLI EGGEN, TOXIC TORTS IN A NUTSHELL 332, 348–56 (4th ed. 2010).

37. *See generally* FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING (2004).

38. *See, e.g.*, David Gerecke, *Risk Exposure as Injury: Alleviating the Injustice of Tort Causation Rules*, 35 MCGILL L. REV. 797 (1990); Porat & Stein, *supra* note 18.

39. *See* Vanek v. Great Atlantic & Pacific Co. of Canada Ltd., [1997] O.J. No. 3304 (Can. Ont. Gen. Div.). Leave to appeal to the Canada Supreme Court was refused in 2000.

medical monitoring.[40] Thus, there is some hope for Canadian plaintiffs in the indeterminate harm scenario.

The final species of uncertainty in toxic torts—and perhaps the most notorious—is that of defendant indeterminacy. In the indeterminate defendant scenario, a plaintiff can show that the particular substance at issue caused her illness, but it is impossible to determine which defendant is responsible for her exposure.[41] Such cases occur where multiple defendants manufacture an identical defective drug[42] or emit a hazardous pollutant that comingles with other identical discharges.[43] In the indeterminate defendant scenario, the plaintiff can prove all elements of negligence except causation; she can demonstrate that each defendant breached a duty owed to her and that she sustained a proximate loss.[44] Moreover, the plaintiff can show that the negligence of one or more in a group of identifiable defendants (e.g., a group of manufacturers of a particular drug) actually caused her illness. However, if she cannot point to the particular defendant or defendants responsible for her illness, then causation is not made out and, on a traditional analysis, she recovers nothing.

Courts in the United States have addressed the indeterminate defendant scenario in a wide variety of ways, from simple dismissal of plaintiffs' claims to the development of new forms of collective liability—most famously the doctrine of market share liability.[45] As elaborated below, the Supreme Court of Canada has gone further, imposing joint and several liability on all defendants in the indeterminate defendant scenario.[46]

These three varieties of uncertainty pose challenges at various stages of the causation inquiry in toxic torts.[47] They complicate the court's assessment of evidence and drive choice-of-instrument decisions in the doctrinal analysis of causation.

40. *See generally* Brandon Stewart, *Just What the Doctor Ordered: A Canadian Approach to Medical Monitoring and Toxic Risk*, 8 CAN. CLASS ACTION REV. 271, 293–95 (2013).

41. *See* Collins, *supra* note 1, at 113–14.

42. *See* Sindell v. Abbott Labs, 607 P.2d 924 (1980); Richard Delgado, *Beyond Sindell: Relaxation of Cause-in-Fact Rules for Indeterminate Plaintiffs*, 70 CAL. L. REV. 881 (1982).

43. *See generally In re* Methyl Tertiary Butyl Ether (MTBE) Products Liab. Litig., 379 F. Supp. 2d 348, 377–78 (S.D.N.Y. 2005); Emily H. Damron, *Reviving the Market for Liability Theories: The "Commingled Product" Theory of Market Share Liability Enters the Judicial Lexicon*, 111 PENN. ST. L. REV. 505 (2006).

44. *See* EGGEN, *supra* note 36, at 216.

45. *See generally* Mark A. Geistfeld, *The Doctrinal Unity of Alternative Liability and Market Share Liability*, 155 U. PA. L. REV. 447 (2006); Christopher J. McGuire, *Market-Share Liability After Hymowitz and Conley: Exploring the Limits of Judicial Power*, 24 U. MICH. J.L. REF. 759 (1991).

46. *See generally* Clements v. Clements, [2012] 2 S.C.R. 181 (Can.).

47. *See generally* ARIEL PORAT & ALEX STEIN, TORT LIABILITY UNDER UNCERTAINTY (Oxford Univ. Press 2002) (2001); LARA KHOURY, UNCERTAIN CAUSATION IN MEDICAL LIABILITY (Hart Publishing 2006) (2003).

## III. CANADIAN APPROACHES TO THE CAUSATION PROBLEM IN TOXIC TORTS

### *A. Standard of Proof*

As in the United States, the standard of proof in Canadian tort actions is the balance of probabilities (also known as the preponderance of the evidence).[48] Although there is no doctrinal controversy on this point, judges in toxic tort actions run the risk of inadvertently adopting the scientific standard of proof as they receive and evaluate voluminous amounts of expert evidence from scientific witnesses. Unlike judges, pure research scientists operate on a limitless timeline and in a culture that places enormous value on causal skepticism.[49] Since scientists do not consider a causal link to be established unless it is proven to a probability of 95% or greater, the importation of scientific standards of proof into torts cases is a serious error.[50] In *Palmer v. Nova Scotia Forest Industries*, for example, the provincial court refused an application for an injunction against the spraying of a pesticide containing dioxin on the basis that there was "no scientifically acceptable proof of risk to health."[51] The appropriate question—whether there was *legally* acceptable proof of risk—was never answered. In contrast, the court in *Ring v. The Queen*[52] noted that while the representative plaintiff's proposed approach to proof of causation might not "'lead to a meaningful scientific answer with respect to a specific dose-response relationship,' it may lead to a meaningful legal answer regarding the creation of unreasonable risks for the general public."[53]

Any amount of uncertainty may prevent a research scientist from concluding that substance X causes illness Y,[54] but a civil court can make a finding of causation even in the presence of substantial doubt. In *Snell v.*

48. *See* Snell v. Farrell, [1990] 2 S.C.R. 311, 323–30 (Can.).

49. *See* CRANOR, *supra* note 2, at 162, 182–85, 215.

50. *See generally* John M. Eisenberg, *What Does Evidence Mean? Can the Law and Medicine Be Reconciled?*, 26 J. HEALTH POL. POL'Y & L. 369 (2001); Susan Haack, *Of Truth, in Science and in Law*, 73 BROOK. L. REV. 985 (2007-2008); Heather McLeod-Kilmurray, *Placing and Displacing Science*, 6 U. OTTAWA L. & TECH. J. 25, 29–32 (2009); Michelle M. Mello & Troyen A. Brennan, *Demystifying the Law/Science Disconnect*, 26 J. HEALTH POL. POL'Y & L. 429 (2001).

51. Palmer v. Nova Scotia Forest Industries, 2 D.L.R. (4th) 397, para. 581 (N.S. T.D.) (1983).

52. Ring v. The Queen, 2007 CanLII 146 (Can. Nfld. & P.E.I.R.).

53. *Id*. at para. 151. Certification was reversed on appeal on the grounds (*inter alia*) that causation was not a common issue among class members, but the trial judge's distinction between scientific and legal causation was not disturbed.

54. *See* Hans-Olov Adami et al., *Toxicology and Epidemiology: Improving the Science with a Framework for Combining Toxicological and Epidemiological Evidence to Establish Causal Inference*, 122 TOXICOLGICAL SCI. 223, 224 (2011) ("Indeed, a principle underlying the philosophy of science is that causality cannot be 'proven'; it can only be inferred with different degrees of certainty.").

*Farrell*, the Supreme Court of Canada suggested that apparent injustices resulting from the but-for test arose from rigidity in its application,[55] and confirmed that causation need not be proved to a level of scientific precision.[56] More recently, Chief Justice McLachlin in *Clements* reiterated that "[t]he 'but for' causation test must be applied in a robust common sense fashion. There is no need for scientific evidence of the precise contribution the defendant's negligence made to the injury."[57] In other words, Canadian torts jurists need not search for the transcendent scientific "truth"; they are merely tasked with deciding whether a causal link is more likely than not.

Having adopted the appropriate standard of proof, courts adjudicating toxic tort actions in Canada are faced with a range of distinct approaches to the test for factual causation. First and foremost among causal tests in the Anglo-Canadian tradition is the but-for (*sine qua non*) approach.

### *B. The But-for Test*

According to the traditional test for factual causation, a plaintiff must demonstrate that "but for" (i.e., in the absence of) the defendant's breach of the standard of care, she would not have sustained her loss. Thus, if a toxic tort plaintiff can prove a probability of 51% or greater that the defendant's negligence caused her illness or injury, then factual causation is treated as a certainty and the plaintiff is presumptively entitled to recover 100% of her past losses from the defendant. If the evidence falls short of a 51% probability of causation, the plaintiff has failed to discharge her burden of proof and recovers nothing.[58] A rigid application of the but-for test produces manifest injustice where the defendant has exposed the plaintiff to an unreasonable risk of developing a particular illness that she does in fact contract, but causation is in doubt because of a lack of data concerning the substance in question.[59] This injustice is particularly pronounced where the uncertainty stems from the defendant's own failure to investigate its substance. In his masterful book, *Toxic Torts: Science, Law and the Possibility of Justice*, Cranor explains:

55. Snell v. Farrell, [1990] 2 S.C.R. 311, 328 (Can.).

56. *Id.*

57. Clements v. Clements, [2012] 2 S.C.R. 181, para. 9 (Can.); *see also* Emir Crowne & Omar Ha-Redeye, *Clements v. Clements: A Material Contribution to the Jurisprudence - The Supreme Court of Canada Clarifies the Law of Causation*, 2 UWO J. LEG. STUD. 1 (2012).

58. In contrast to past losses, once causation of injury is proven on a balance of probabilities future losses flowing from that injury are not subject to the all-or-nothing causation analysis. Instead, future or hypothetical damages arising from a proven injury are recoverable according to the probability that the loss will occur. *See* Athey v. Leonati, [1996] 3 S.C.R. 458, 470–71 (Can.).

59. *See generally* Collins, *Material Contribution*, *supra* note 24.

> [Given the] woeful ignorance that plagues much scientific and agency knowledge of the universe of chemical substances . . . it is both possible and likely that some toxic tort cases are dismissed simply because of ignorance about a particular substance and its properties, leaving wrongfully injured plaintiffs without a remedy, and undermining the deterrence goal of tort law.[60]

In many cases, recovery is possible on a but-for standard where courts adhere to the legal standard of proof, take a common sense perspective on causation, and apply the "robust and pragmatic" approach to evidence mandated by the Supreme Court of Canada. However, even when this flexible, contemporary approach to *sine qua non* is adopted, some meritorious plaintiffs will fail as a result of evidentiary gaps that result from a defendant's intentional choices.

### *C. Reverse Onus*

Given the perverse incentive that exists when manufacturers benefit from a lack of data about their own substances, the idea of reversing the onus of proof would appear to make good sense in the toxic tort context. The House of Lords adopted a reverse onus on causation in the toxic tort case of *McGhee v. National Coal Board.*[61] There, the plaintiff employee cleaned brick kilns for the defendant employer, resulting in the accumulation of dust on his skin. The defendant negligently failed to provide shower facilities for its employees resulting in the plaintiff being forced to bicycle home each day covered in layers of dust. The plaintiff subsequently developed dermatitis and sued the defendant for negligence. At trial, expert testimony established that the defendant's failure to provide showers materially increased the plaintiff's *risk* of developing dermatitis, but it was scientifically impossible to conclude (on a balance of probabilities) that it actually *caused* the dermatitis.

At the House of Lords, Lord Wilberforce developed a new test for causation to address this dilemma; he held that "where a person has, by breach of a duty of care, created a risk, and injury occurs within the area of that risk, the loss should be borne by him unless he shows that it had some other cause."[62] A number of lower courts in Canada initially followed *McGhee*, adopting the reverse onus where there was proof of negligent

60. Cranor & Eastmond, *supra* note 28, at 46.
61. McGhee v. National Coal Board [1972] UKHL 7.
62. *Id.* at 4.

creation of risk and injury within the ambit of that risk.[63] Material contribution to risk survives in Canadian case law, but the reversal in burden of proof on causation was explicitly rejected in *Snell v. Farrell*,[64] a rejection that was later confirmed in *Hanke v. Resurfice*.

### *D. The Material Contribution to Risk Test*

In *Hanke v. Resurfice*, the Supreme Court of Canada returned to the material contribution to risk approach articulated in *McGhee*, but retained the traditional allocation of burden of proof. The plaintiff in *Hanke* was badly burned when he inadvertently placed a water hose into the gas tank of an ice-resurfacing machine, causing an explosion and fire. Hanke sued the manufacturer of the machine, alleging that the two tanks were designed and positioned in such a way that an operator was likely to make such a mistake and suffer injury. On the question of causation, Chief Justice McLachlin held as follows:

> 21 First, the basic test for determining causation remains the "but for" test. This applies to multi-cause injuries. The plaintiff bears the burden of showing that "but for" the negligent act or omission of each defendant, the injury would not have occurred. Having done this, contributory negligence may be apportioned, as permitted by statute.
>
> 22 This fundamental rule has never been displaced and remains the primary test for causation in negligence actions. As stated in *Athey v. Leonati*, at para. 14, *per* Major J., "[t]he general, but not conclusive, test for causation is the 'but for' test, which requires the plaintiff to show that the injury would not have occurred but for the negligence of the defendant." Similarly, as I noted in *Blackwater v. Plint*, at para. 78, "[t]he rules of causation consider generally whether 'but for' the defendant's acts, the plaintiff's damages would have been incurred on a balance of probabilities."
>
> 23 The "but for" test recognizes that compensation for negligent conduct should only be made "where a substantial connection between the injury and defendant's conduct" is present. It ensures that a defendant will not be held liable for the plaintiff's injuries where they "may very well be due to factors unconnected to the defendant and not the fault of anyone": *Snell v. Farrell*, at p. 327, *per* Sopinka J.[65]

63. *See, e.g.*, Wipfli v. Britten (1984), 13 D.L.R. 4th 169 (B.C. C.A.); Powell v. Guttman (No. 2) (1978), 89 D.L.R. 3d 180 (Man. C.A.); Letnik v. Metropolitan Toronto (Municipality) (1988), 49 D.L.R. 4th 707 (F.C.).

64. Snell v. Farrell, [1990] 2 S.C.R. 311, 326–28 (Can.).

65. Resurfice Corp. v. Hanke, [2007] 1 S.C.R. 333, paras. 21–23 (Can.).

She went on to articulate an exception to the but-for test that subsequently generated a vigorous and contentious debate among advocates and legal scholars:[66]

> 24 [I]n special circumstances, the law has recognized exceptions to the basic "but for" test, and applied a "material contribution" test. Broadly speaking, the cases in which the "material contribution" test is properly applied involve two requirements.
>
> 25 First, it must be impossible for the plaintiff to prove that the defendant's negligence caused the plaintiff's injury using the "but for" test. The impossibility must be due to factors that are outside of the plaintiff's control; for example, current limits of scientific knowledge. Second, it must be clear that the defendant breached a duty of care owed to the plaintiff, thereby exposing the plaintiff to an unreasonable risk of injury, and the plaintiff must have suffered that form of injury. In other words, the plaintiff's injury must fall within the ambit of the risk created by the defendant's breach. In those exceptional cases where these two requirements are satisfied, liability may be imposed, even though the "but for" test is not satisfied, because it would offend basic notions of fairness and justice to deny liability by applying a "but for" approach.[67]

Although the phrase "material contribution" is left without object in *Hanke*, in *Clements*, the Supreme Court of Canada explicitly held that the test refers to material contribution to risk rather than injury.[68] Indeed, Chief Justice McLachlin acknowledges that the material contribution test for causation is predicated on risk as the conceptual foundation for liability: "'[M]aterial contribution' as a substitute for the usual requirement of 'but for' causation . . . imposes liability not because the evidence establishes that the defendant's act caused the injury, but because the act contributed to the risk that injury would occur."[69]

66. *See generally* Vaughan Black & David Cheifetz, *Through the Looking Glass, Darkly:* Resurfice Corp. v. Hanke, 45 ALTA. L. REV. 249 (2007); Andrew Botterell & Christopher Essert, *Normativity, Fairness, and the Problem of Factual Uncertainty*, 47 OSGOODE HALL L.J. 663 (2009); Russell Brown, *The Possibility of 'Inference Causation': Inferring Cause-in-fact and the Nature of Legal Fact Finding*, 55 MCGILL L.J. 1 (2010); David Cheifetz & Vaughan Black, *Material Contribution and Quantum Uncertainty:* Hanke v. Resurfice Corp., 43 CAN. BUS. L.J. 155 (2006); Collins & McLeod-Kilmurray, *supra* note 4; Lara Khoury, *Causation and Health in Medical, Environmental and Product Liability*, 25 WINDSOR Y.B. ACCESS JUST. 135 (2007); Jill Lawrie et al., *The Test for Causation in Canada: But for, But. . . Maybe Not*, 75 DEF. COUNSEL J. 378 (2008).

67. Resurfice Corp. v. Hanke, [2007] 1 S.C.R. 333, paras. 24–25 (Can.).

68. *See* Clements v. Clements, [2012] 2 S.C.R. 181, paras. 14-16 (Can.); *see also* Robin Hansen, Fullowka v. Pinkerton's of Canada Ltd. *and the Material-Contribution Test for Factual Causation in Negligence*, 48 ALTA. L. REV. 771 (2011); Khoury, *supra* note 66; *but see* Henry v. British Columbia (Attorney General), [2015] 2 S.C.R. 214, para. 98 (Can.).

69. Clements v. Clements, [2012] 2 S.C.R. 181, para. 15 (Can.).

The plaintiff in *Clements* was severely injured when she was thrown from a motorcycle being driven by her husband, the defendant. The accident occurred when the vehicle ran over a nail that punctured the rear tire, causing it to rapidly deflate; Mr. Clements lost control of the vehicle and it ultimately crashed.[70] The trial court found that the defendant negligently overloaded the vehicle and operated it at an excessive speed, but was not satisfied that the accident would not have occurred but for these factors.[71] The court concluded that the material contribution test set out in *Hanke* could be applied since it was scientifically impossible to determine at which speed and weight the motorcycle could have been brought under control after losing air pressure in the rear wheel.[72]

Applying that test to the facts of the case, the trial judge imposed liability on Mr. Clements.[73] The Court of Appeal reversed, holding that this was not an appropriate case for the application of material contribution.[74] Citing an article by Professor Erik Knutsen,[75] the Court of Appeal held that material contribution may be used only in cases involving either "dependency causation" (the circumstance in which it is impossible to say what a third party would have done had the defendant exercised due care) or "circular causation" (the scenario in which it is clear that one in a group of tortfeasors caused the plaintiff's harm but it is impossible to identify which one).[76] In contrast, the court held that material contribution could not be applied when causal uncertainty results from the fact that the science is "just not there yet."[77]

The Supreme Court of Canada allowed the plaintiff's appeal in *Clements* but adopted a test that appears to be substantially similar to that employed by the Court of Appeal. After clarifying that the "material contribution" test does indeed refer to risk rather than injury, the Court articulated the following summary of causation:

> (1) As a general rule, a plaintiff cannot succeed unless she shows as a matter of fact that she would not have suffered the loss "but for" the negligent act or acts of the defendant. A trial judge is to take a robust and pragmatic approach to determining if a plaintiff has established that the

70. *Id.* at para. 1.
71. *Id.* at paras. 1–3.
72. *Id.*
73. *Id.* at para. 3.
74. Clements v Clements, [2010] 12 B.C.L.R. 5th, para. 64 (Can. B.C. C.A.).
75. Erik S. Knutsen, *Clarifying Causation in Tort*, 33 DALHOUSIE L.J. 153 (2010).
76. Clements v Clements, [2010] 12 B.C.L.R. 5th, paras. 54–56 (Can. B.C. C.A.).
77. *Id.* at para. 59 (quoting Knutsen, *supra* note 75, at 171).

> defendant's negligence caused her loss. Scientific proof of causation is not required.
>
> (2) Exceptionally, a plaintiff may succeed by showing that the defendant's conduct materially contributed to risk of the plaintiff's injury, where (a) the plaintiff has established that her loss would not have occurred "but for" the negligence of two or more tortfeasors, each possibly in fact responsible for the loss; and (b) the plaintiff, through no fault of her own, is unable to show that any one of the possible tortfeasors in fact was the necessary or "but for" cause of her injury, because each can point to one another as the possible "but for" cause of the injury, defeating a finding of causation on a balance of probabilities against anyone.[78]

As it did in *Hanke*, the Court emphasized that but-for remains the default test in cases involving multiple defendants:

> It is important to reaffirm that in the usual case of multiple agents or actors, the traditional "but for" test still applies. The question, as discussed earlier, is whether the plaintiff has shown that one or more of the defendants' negligence was a necessary cause of the injury. Degrees of fault are reflected in calculations made under contributory negligence legislation. By contrast, the material contribution to risk approach applies where "but for" causation cannot be proven against any of multiple defendants, all negligent in a manner that might have in fact caused the plaintiff's injury, because each can use a "point the finger" strategy to preclude a finding of causation on a balance of probabilities.[79]

Thus, although the Court rejects the language of "circular causation" and "dependency causation," it has effectively limited material contribution to risk (for now) to the former scenario. The narrowing of material contribution in *Clements* poses a risk that plaintiffs who are negligently injured by chemical wrongdoing will be denied recovery as a result of uncertainty that is well beyond their control (and indeed, may have been intentional on the part of defendants).[80] The requirement of multiple tortious causes precludes recovery in many cases and will produce absurd results in others.

In the famous case of *Cook v. Lewis*, for example, the Supreme Court of Canada imposed joint and several liability on two defendants who negligently shot in the direction of the plaintiff's face, simultaneously destroying the plaintiff's ability to identify which defendant caused the injury.[81]

78. Clements v. Clements, [2012] 2 S.C.R. 181, para. 46 (Can.).

79. *Id.* at para. 43.

80. *See* Wagner, *supra* note 13.

81. Cook v. Lewis, [1951] S.C.R. 830 (Can.) (*Cook v. Lewis* is the Canadian analogue to *Summers v. Tice*, 33 Cal. 2d 80 (1948)).

The *Clements* approach would inexplicably allow a defendant in the *Cook* scenario to "escape liability if he could show that, while *he* was negligent, the other shooter was not."[82] Despite this anomaly, it does provide a remedy to plaintiffs who are injured by multiple negligent defendants and in this sense provides a meaningful response to the problem of the indeterminate defendant.

Moreover, the Supreme Court in *Clements* specifically left open the question of whether material contribution to risk might also apply in the indeterminate plaintiff scenario:

> [44] This is not to say that new situations will not raise new considerations. I leave for another day, for example, the scenario that might arise in mass toxic tort litigation with multiple plaintiffs, where it is established statistically that the defendant's acts induced an injury on some members of the group, but it is impossible to know which ones.[83]

Thus, although *Clements* undoubtedly represents a retreat from the broader, principled test of material contribution to risk set out in *Hanke*, it is nevertheless an improvement when compared to the traditional but-for approach.

## IV. Proposals For Risk-based Reforms in Toxic Causation

Commentators have suggested a range of risk-based innovations, including the creation of a new tort of negligent creation of risk,[84] the imposition of a reverse onus on proof of inadequate product testing,[85] probabilistic proportional recovery,[86] and the recognition of a cause of action in battery when plaintiffs are exposed to harmful or poorly understood chemicals.[87] The most likely starting point for the expansion of risk-based liability in Canada is through a resuscitation of the broad *Hanke* formulation of material contribution to risk as an alternative to but-for causation.

82. Craig Jones, *Reasoning Through Probabilistic Causation in Individual and Aggregate Claims: The Struggle Continues*, 39 ADVOC. Q. 18, 28 (2011).
83. Clements v. Clements, [2012] 2 S.C.R. 181, para. 44 (Can.).
84. *See generally* Gerecke, *supra* note 38.
85. Wagner, *supra* note 13, at 833–36.
86. PORAT & STEIN, *supra* note 47.
87. *See generally* Collins & McLeod-Kilmurray, *supra* note 21.

### *A. The Case for a Broad Conception of Material Contribution to Risk*

The Supreme Court of Canada's decision in *Clements* is the first explicit articulation of risk-based liability in the Canadian law of causation. From this perspective, it can be seen as a significant step forward for toxic tort plaintiffs and environmental public policy. However, the decision clearly curtailed the broad innovation introduced in *Hanke*, while leaving the door open for future incremental reform in the indeterminate plaintiff scenario. The Supreme Court's back-and-forth dance in *Hanke* and *Clements* suggests some discomfort or even confusion in the court's approach to risk-based liability. From the perspective of tort law's traditional goals of compensation and deterrence, it would seem clear that a broad form of liability for material contribution to risk would improve tort law's ability to meet its objectives. More plaintiffs who are tortiously harmed by toxic wrongdoing would receive compensation, and the manufacturers and emitters of toxic substances would have an increased incentive to exercise care in the investigation and dissemination of chemical products and pollution.

Some critics have expressed a "floodgates" concern, suggesting that a broad test of material contribution to risk would eliminate the gate-keeping function of the causation element.[88] Justice Brown, for example, wrote that on the *Hanke* approach, "if causation is the only obstacle, it is no obstacle at all," suggesting that the demonstration of risk at the causation stage would be redundant (and thus unnecessary) since the plaintiff already has to show unreasonable risk in order to establish a breach of the duty of care.[89] While this proposition may hold true in some contexts, it does not apply to the toxic tort arena. The defendant who does not study its substance at all, for example, will undoubtedly be in breach of the duty of care, but will simultaneously make it impossible for the plaintiff to prove a material contribution to risk since there will be a complete lack of data. The demonstration of material contribution to risk requires a substantial body of reliable data as well as expert opinion by relevant scientists.[90] In some cases, a rigorous data set may in fact demonstrate an *absence* of material risk. In other words, proof of generic causation under a broad conception of

88. *See* Black & Cheifetz, *Through the Looking Glass*, *supra* note 66, at 249; The Honourable Russell Brown, *Material Contribution's Expanding Hegemony: Factual Causation After* Hanke v. Resurfice Corp., 45 CAN. BUS. L.J. 432 (2007); Cheifetz & Black, *Material Contribution and Quantum Uncertainty*, *supra* note 66, at 155; Lawrie et al., *supra* note 66, at 378.

89. BROWN, *supra* note 29, at 445.

90. *See generally* Cranor & Eastmond, *supra* note 28 (describing the massive investment in time, money, and scientific attention necessary to identify the risks posed by any given chemical substance); Collins & McLeod-Kilmurray, *supra* note 4, at 443–44.

material contribution to risk would remain a formidable obstacle to recovery.

In addition to data demonstrating generic causation, plaintiffs seeking to prove a material contribution to risk would also have to adduce evidence concerning the nature of their exposure to the defendant's substance including concentrations, duration, etc. Thus, in many cases the principled risk-based test articulated in *Hanke* would defeat a claim for chemically induced damages; the gate-keeping function of causation remains intact under this approach.

Taking a broader, instrumentalist approach to tort doctrine,[91] it seems clear that the expansion of risk-based liability in Canadian tort law would serve the public interest in environmental health protection. The post-*Clements*, narrow version of risk-based liability privileges defendants who release substances that increase the risk to a population of people but lack sufficient data to ground a finding of but-for causation in any individual case. The *Clements* test only applies in the rare case where the substance-illness connection is clear and the one remaining area of uncertainty is *whose* product or pollution harmed the plaintiff.

As explained above, with respect to many thousands of chemicals, there is inadequate data to prove causation of harm on a but-for test, even when it is clear that the defendant has exposed people to an unreasonable toxic risk. Defendants have the ability to test their substances, and profit from their production and dissemination; plaintiffs bear the risk of exposure and illness. In this context, there is a compelling argument that as between a negligent defendant and an innocent plaintiff, the former should bear the burden of risk.[92]

### *B. Stronger Risk-based Reforms*

Recognizing the profound vulnerability of individuals exposed to toxic substances and the converse informational advantage enjoyed by toxic defendants, it seems just to reverse the burden of proof of causation, once a plaintiff has demonstrated material increase in risk or a negligent failure to investigate. Reversing the burden of proof on causation is perhaps the single biggest contribution tort law could make to the generation of safety data

91. *See generally* Jerry V. DeMarco, *The Supreme Court of Canada's Recognition of Fundamental Environmental Values: What Could Be Next in Canadian Environmental Law?*, 17 J. ENVTL. L. & PRAC. 159 (2007).

92. Nancy Lee Firak, *The Developing Policy Characteristics of Cause-In-Fact: Alternative Forms of Liability, Epidemiological Proof and Trans-Scientific Issues*, 63 TEMP. L. REV. 311, 316 (1990).

on chemical substances.[93] Currently, the rules of causation reward those defendants who produce minimal data, thus precluding a finding of toxicity. Even the broad test of material contribution to risk articulated in *Hanke* cannot be met if there is little or no safety data on the relevant substance.[94] One way to avoid this perverse incentive is to impose liability for a failure to discover and disseminate adequate information concerning a given product or substance, as proposed by Wendy Wagner and Margaret Berger.[95] Such liability may be framed in battery[96] or in negligence. In a negligence action, the plaintiff should be required to prove that the defendant did not conduct adequate investigations and/or disclose relevant information, at which point the burden of proof on causation should be reversed.[97] This formulation reverses the incentive structure inherent in the traditional approach by penalizing the manufacture of ignorance and aligning defendants' commercial interests with the societal interest in constraining the release of hazardous or poorly understood chemical substances.

In the battery formulation, liability is imposed based on the defendant knowingly exposing a particular population or individual plaintiff to "harmful or offensive contact" through a toxic or poorly understood substance.[98] Involuntary touching by a toxic substance clearly meets the definition of "harmful or offensive contact" and touching by a substance that is not well understood may be viewed as involuntary experimentation—a recognized species of battery in Canada.[99] Canadian torts jurisprudence has already recognized small-scale toxic battery actions. In one case the court imposed liability where striking workers introduced a chemical spray into the air system of a truck driven by a replacement worker.[100] In another, the court held a landlord liable in "either negligence or battery" for knowingly supplying drinking water contaminated with arsenic to his tenants.[101] Recognition of larger-scale pollution or provision of toxic products as forms of battery would vindicate the right of Canadian citizens to control their own bodies and would incentivize companies to choose safer products and minimize pollution.

93. Wagner, *supra* note 13, at 833.
94. *Id.*
95. *Id.*; *see also* Berger, *supra* note 18.
96. *See generally* Collins & McLeod-Kilmurray, *supra* note 21.
97. Wagner, *supra* note 13, at 833–34.
98. *See generally* Collins & McLeod-Kilmurray, *supra* note 21.
99. *Id.* at 134 *et seq.*
100. Swanson v. Mallow, [1991] 5 W.W.R. 454 (Can. Sask. Q.B.), *aff'd*, [1992] 2 W.W.R. 718 (Can. Sask. C.A.).
101. MacDonald v Sebastian, [1987] 81 N.S.R. 2d 189 (Can. N.S. T.D.).

Whether framed in negligence or battery, recovery for mere risk exposure (i.e., without present injury) raises questions as to timing and quantification of damages. Ariel Porat and Alex Stein argue that plaintiffs who are exposed to risk should be able to recover an amount proportional to the probability of their incurring the potential injury.[102] They further suggest that plaintiffs should have the option of suing before or after the risk materializes; those who sue for risk alone would be foreclosed from returning to court if the illness ultimately does materialize.[103] Probabilistic proportional recovery for risk alone would appear to be well beyond the conceptual grasp of current Canadian jurisprudence.

However, recovery in battery for involuntary chemical touchings is a recognized cause of action in Canada, and a reversal in burden of proof on causation in negligence actions was at least entertained by the Supreme Court of Canada and lower courts in previous decades.[104] It is possible that given the right set of facts, the Court might be willing to revisit this proposal.

## V. CONCLUSION

There are moments in history when courts are faced with novel harms and must develop novel responses. In the decades following the industrial revolution, for example, society faced an unprecedented form of risk resulting from the new phenomenon of mass production. For the first time, consumers could be exposed to risks created by manufacturers who were far away and socially unaccountable to a person injured by their products. Courts responded with a groundbreaking innovation in the duty of care element of negligence—the articulation of a principled approach that broadened duty beyond the confines of historically recognized categories.[105] Less than a century later, courts in Canada and elsewhere are beginning to recognize yet another unprecedented universe of risks resulting from the burgeoning production and dissemination of chemical products and pollution. Scholars and litigants are asking courts to rise to this challenge just as their predecessors did in response to industrialization.

The introduction of material contribution to risk as an alternative to but-for causation is a baby step in the evolution of Canadian toxic tort law.

102. *See generally* PORAT & STEIN, *supra* note 47.

103. *See, e.g.*, Porat & Stein, *supra* note 18, at 233–34; *see also* John M. Darley et al., *Doing Wrong Without Creating Harm*, 7 J. EMPIRICAL LEGAL STUD. 30 (2010).

104. *See, e.g.*, Snell v. Farrell, [1990] 2 S.C.R. 311, 326–27 (Can.).

105. MacPherson v. Buick Motor Company, 217 N.Y. 382 (1916); Buckley v. Mott, [1919] 50 D.L.R. 408 (N.C. S.C.); Donoghue v. Stevenson, [1932] UKHL 100.

An expansion of risk-based liability through the broadening of material contribution (per *Hanke*), the imposition of a reverse onus on proof of inadequate testing, and the recognition of toxic battery would go further towards protecting the health of Canadian people and ecosystems. Given the dearth of chemical safety data, and the profound vulnerability of exposed populations, calls for these and other risk-based reforms are likely to persist until they are answered.