McGill Law Journal
Revue de droit de McGill

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Volume 55, Number 1, March 2010

URI: https://id.erudit.org/iderudit/039835ar
DOI: https://doi.org/10.7202/039835ar

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Publisher(s)

McGill Law Journal / Revue de droit de McGill

ISSN

0024-9041 (print)
1920-6356 (digital)

Explore this journal

Cite this article

Brown, R. (2010). The Possibility of “Inference Causation”: Inferring Cause-in-Fact and the Nature of Legal Fact-Finding. *McGill Law Journal / Revue de droit de McGill*, *55*(1), 1–45. https://doi.org/10.7202/039835ar

Article abstract

This article defends what it refers to as “inference causation”: a fact-finder’s drawing of a causal link between a defendant’s actions and a plaintiff’s suffering in tort claims in the absence of expert scientific evidence.

This type of reasoning, affirmed in 1990 by Justice Sopinka in the Supreme Court of Canada decision, *Snell v. Farrell*, has encountered significant academic criticism. The author defends inference causation by considering evidence theory. First, he shows that inference causation forms a part of law’s veritism—its commitment to the truth—since legal fact-finding’s aim is always to seek out the best obtainable truth, rather than the absolute truth. Second, he critiques the primacy of scientific evidence by showing that both its reasoning process and the nature of its conclusions are different from those of legal fact-finding. Last, the author shows that all fact-finding—particularly all legal fact-finding—is already inferential. Scientific evidence forms but one of many different elements that are analyzed by fact-finders in their inference about which factual account of the disputed events is the best account. Accordingly, where none is available, the same inference of fact is nonetheless possible.

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THE POSSIBILITY OF "INFERENCE CAUSATION": INFERRING CAUSE-IN-FACT AND THE NATURE OF LEGAL FACT-FINDING

*Russell Brown**

This article defends what it refers to as "inference causation": a fact-finder's drawing of a causal link between a defendant's actions and a plaintiff's suffering in tort claims in the absence of expert scientific evidence.

This type of reasoning, affirmed in 1990 by Justice Sopinka in the Supreme Court of Canada decision, *Snell v. Farrell*, has encountered significant academic criticism. The author defends inference causation by considering evidence theory. First, he shows that inference causation forms a part of law's veritism—its commitment to the truth—since legal fact-finding's aim is always to seek out the best obtainable truth, rather than the absolute truth. Second, he critiques the primacy of scientific evidence by showing that both its reasoning process and the nature of its conclusions are different from those of legal fact-finding. Last, the author shows that all fact-finding—particularly all legal fact-finding—is already inferential. Scientific evidence forms but one of many different elements that are analyzed by fact-finders in their inference about which factual account of the disputed events is the best account. Accordingly, where none is available, the same inference of fact is nonetheless possible.

Cet article défend l'« inférence de causalité », le fait d'établir un lien de causalité entre les actes du défendeur et le préjudice subi par le demandeur en l'absence de preuve scientifique d'expert dans le cadre d'une poursuite en responsabilité extracontractuelle.

Ce type de raisonnement, approuvé en 1990 par le juge Sopinka dans l'arrêt *Snell c. Farrell* de la Cour suprême du Canada, a depuis été vivement critiqué par la doctrine. L'auteur le défend par une étude de la théorie de la preuve. D'abord, il démontre que l'inférence de causalité s'inscrit dans la mission de recherche de la vérité du droit, puisque le but de la recherche juridique des faits est de parvenir aussi près de la vérité que possible et non d'atteindre la vérité absolue. Ensuite, il critique la primauté de la preuve scientifique puisque sa méthode et la nature de ses conclusions diffèrent de celles de la recherche juridique des faits. Finalement, l'auteur démontre que la constatation des faits, en particulier la constatation juridique des faits, inclut déjà l'inférence. La preuve scientifique n'est qu'un élément parmi plusieurs que le juge des faits analyse pour déduire le meilleur compte rendu possible des faits en litige. Ainsi, quand aucune preuve scientifique ne peut être établie, il est néanmoins légitime de recourir à l'inférence.

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* Associate Professor, Faculty of Law, University of Alberta. I am indebted to Duane Szafron, Professor of Science at University of Alberta, for an illuminating discussion of scientific fact-finding. I also thank two anonymous peer reviewers, Allan Beever, Vaughan Black, David Cheifetz, Ted DeCoste, Lindsey Ehrman, Lewis Klar, Moin Yahya, and Bruce Ziff for their helpful comments. I am also grateful for the comments of participants at the "Perspectives on Causation" conference, University of Aberdeen, June 2009.

Citation: (2010) 55 McGill L.J. 1 ~ Référence: (2010) 55 R.D. McGill 1

Introduction

My aim in this paper is to justify what I shall refer to as "inference causation" in the tort of negligence. At stake is the proposition that, where scientific expert evidence is unable to verify a causal link between a defendant's creation of risk and a plaintiff's suffering, a legal fact-finder may infer such a link.

My account of inference causation will avoid the well-worn paths of causation theory, drawing instead from theoretical considerations of evidence and of its role in the fact-finding process. Canadian legal tradition has not embraced (or given much consideration to) a theory of evidence as it pertains to legal fact-finding.[1] Moreover, tort lawyers have shown no interest in exploring how evidence theory might relate to inference causation, perhaps because evidence merely provides the basis for finding or not finding cause-in-fact. Such indifference is, however, misplaced. Such a convention does not, for example, explain trial phenomena.[2] More to the point, it does not account for the uncertain threshold of civil proof that equates mere probability with certainty, nor the processes of logical reasoning that legal fact-finders bring to a trial. In short, it fails to account for the distinction between the *nature* of cause-in-fact, and what is required to *prove* cause-in-fact. My rationale, then, for introducing theoretical *evidence* scholarship to the debate within tort law about inference causation is that evidence theory takes this distinction seriously by explicitly accounting for the standard of proof and the epistemology of legal fact-finding. It therefore injects an air of adjudicative reality into the discourse on inference causation.

The express genesis of inference causation[3] within Canadian law constitutes only one element within Canadian torts jurisprudence out of an emerging array of non-exclusive tests[4] for assessing whether a plaintiff has discharged the requirement of proving cause-in-fact. I should there-

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1 For a notable exception, see Marilyn MacCrimmon, "Developments in the Law of Evidence: The 1988-89 Term: The Process of Proof: Schematic Constraints" (1990) 1 Sup. Ct. L. Rev. (2d) 345 [MacCrimmon, "Law of Evidence"]; Marilyn MacCrimmon, "What is 'Common' about Common Sense?: Cautionary Tales for Travelers Crossing Disciplinary Boundaries" (2001) 22 Cardozo L. Rev. 1433 [MacCrimmon, "Common Sense"].

2 For a discussion of some of these trial phenomena, see text accompanying note 92.

3 I say "express", as I will be arguing that inference causation has always been an immanent element of legal fact-finding.

4 Vaughan Black, "Decision Causation: Pandora's Tool-Box" in Jason W. Neyers, Erika Chamberlain & Stephen G.A. Pitel, eds., *Emerging Issues in Tort Law* (Oxford: Hart, 2007) 309 ("this new attitude is what we might call the array approach" at 309). See also *Kuwait Airways v. Iraqi Airways (Nos. 4 and 5)*, [2002] UKHL 19, [2002] 2 A.C. 883 at 1106, [2002] 2 W.L.R. 1353, Lord Hoffman.

fore take care at the outset to distinguish what I am setting out to elucidate from what I am not. I will therefore begin by situating inference causation within recent Canadian jurisprudence on cause-in-fact. Having distinguished inference causation (or at least its current doctrinal expression) within that body of law, I will recount various criticisms that have been levelled in respect of inference causation. A substantial portion of what follows will be devoted to responding to each of those criticisms in turn. Ultimately, however, my aim is justificatory, and to that end I will conclude by offering an account for inference causation, grounded in the characteristics of evidence, and in the demonstrated cognitive processing that legal fact-finders apply to that evidence.

I. The Jurisprudence and the Objections

A. Inference Causation's Place in Canadian Jurisprudence

The array of tests available in Canada to plaintiffs for proving cause-in-fact comprise the material contribution to risk test, the material contribution to harm test, and the but-for test.[5] The first test, which appears *obiter dicta* in the Supreme Court of Canada's recent pronouncement in *Hanke*, is said to be available to a fact-finder where "factors that are outside of the plaintiff's control" such as "current limits of scientific knowledge" make it, in part, impossible for the plaintiff to prevail using the but-for test.[6] The second test, the material contribution to harm test, was described in *Athey* as being available where the but-for test is "unworkable".[7] In contrast to *Hanke*'s exclusive focus on augmentation of mere risk, *Athey*'s test allows a plaintiff to succeed only where the defendant's negligence "materially contributed" to the occurrence of the actual injury.[8]

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5 For my conceptualization of these tests, see Russell Brown, "Material Contribution's Expanding Hegemony: Factual Causation after *Hanke v. Resurfice Corp.*" (2007) 45 Can. Bus. L.J. 432 [Brown, "Expanding Hegemony"]. For the material contribution to harm test, see *ibid.* at 434-38. See also *Athey v. Leonati*, [1996] 3 S.C.R. 458, 140 D.L.R. (4th) 235 [*Athey* cited to S.C.R.]; *Walker Estate v. York-Finch General Hospital*, 2001 SCC 23, [2001] 1 S.C.R. 647, 198 D.L.R. (4th) 193. For the material contribution to risk test, see *Resurfice Corp. v. Hanke*, 2007 SCC 7, [2007] 1 S.C.R. 333, 278 D.L.R. (4th) 643 [*Hanke*].

6 "It must be clear that the defendant breached a duty of care ... exposing the plaintiff to an unreasonable risk of injury, and the plaintiff must have suffered that form of injury": *ibid.* at para. 25.

7 *Athey, supra* note 5 at 466.

8 *Ibid.* This conception of "material contribution" is distinct from a nearly forgotten, more orthodox conception that was expressed as recently as *Myers v. Peel County Board of Education* ([1981] 2 S.C.R. 21, 123 D.L.R. (3d) 1). See David Cheifetz, "The Snell Inference and Material Contribution: Defining the Indefinable and Hunting the Causative

In Canadian tort jurisprudence, however, the third test—the orthodox, counterfactual, *sine qua non* but-for test requiring proof on a balance of probabilities[9]—retains primacy. Even within *Athey* and *Hanke*, the but-for test was not only affirmed as the presumptive test for proving cause-in-fact,[10] but was also applied. To the extent that any post-*Hanke* trend is discernible, it is characterized by a marked judicial reluctance to conclude that the but-for test is "unworkable" (per *Athey*)[11] or "impossible" (per *Hanke*),[12] thereby dooming the claims of plaintiffs unable to meet its more stringent requirement of showing a probable and necessary causal link between their suffering and a defendant's negligence.[13]

The ongoing primacy of the but-for test is largely due to the subsisting influence of the 1990 pronouncement of Justice Sopinka for the Supreme Court of Canada in *Snell v. Farrell*,[14] and his explicit recognition of inference causation as the means by which the but-for test is to be applied in cases of factual uncertainty. In *Snell*, the plaintiff, in her seventies by the time of trial, underwent surgery to remove a cataract. A retrobulbar hemorrhage that was visible to the defendant surgeon occurred during the surgery. Although the hemorrhage itself was not a result of negligence, the trial judge found that the defendant's failure to abort the surgery upon discovering the hemorrhage was unreasonable. By the time the

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Snark" (2005) 30 Advocates' Q. 1 at 83 [Cheifetz, "Causative Snark"]; Jane Stapleton, "Lords a'Leaping Evidentiary Gaps" (2002) 10 Torts L.J. 276 at 282-83 [Stapleton, "Lords a'Leaping"]; Brown, "Expanding Hegemony", *supra* note 5 at 309. This older conception recognized that factors additional to the defendant's negligence that also contributed to the plaintiff's injury would not, in and of themselves, preclude the defendant's liability.

9 *Re B. (Children)*, [2008] UKHL 35, [2009] 1 A.C. 11, [2008] 4 All E.R. 1; *F.H. v. McDougall*, 2008 SCC 53, [2008] 3 S.C.R. 41, 297 D.L.R. (4th) 193.

10 *Athey*, *supra* note 5 at 466 (the "general" test); *Hanke*, *supra* note 5 at para. 21 (the "basic" test).

11 *Athey*, *supra* note 5 at 466.

12 *Hanke*, *supra* note 5 at para. 25.

13 Indeed, by giving no serious consideration to the meaning of these threshold terms, Canadian courts skirt the thorny normative questions of whether and when the but-for test ought to be abandoned in certain cases. Even in the relatively few instances where plaintiffs have been able to overcome evidentiary "gaps" due to scientific uncertainty, they have done so in most cases *not* on the basis of the alternative tests for proving cause-in-fact, but rather because they were viewed as having discharged the but-for test. See Russell Brown, "Material Contribution's Expanding Hegemony (Or, Where Are We and How Did We Get Here?)" in Continuing Legal Education Society of British Columbia, ed., *Causation in Tort After Resurfice* (Vancouver, June 2008) 2.1.1 at 2.1.11-14.

14 [1990] 2 S.C.R. 311, 72 D.L.R. (4th) 289 [*Snell* cited to S.C.R.].

plaintiff's vitreous chamber cleared (nine months later), the plaintiff's optic nerve had atrophied to the point of blindness.

The cause-in-fact issue in *Snell* lay in the uncertain etiology of the optic nerve atrophy. While it can result from retrobulbar hemorrhage, other possible causes of optic nerve atrophy include three conditions from which the plaintiff suffered: high blood pressure, diabetes, and severe glaucoma. Neither party's expert was able to express an opinion on the cause of the atrophy. The trial judge applied Lord Wilberforce's judgment in *McGhee v. National Coal Board*[15] (where the defendant employer's negligent failure to provide washing facilities for their workmen was one of several possible causes of the plaintiff's dermatitis) to reverse the onus of proof and impose liability upon the defendant.[16] Both the result and the reasoning were approved at the New Brunswick Court of Appeal.[17]

While affirming the judgment of the lower court, Justice Sopinka, for the Supreme Court of Canada, reviewed the five speeches in *McGhee* as well as the following speech of Lord Bridge of the House of Lords in *Wilsher v. Essex Area Health Authority*:

> The conclusion I draw ... is that *McGhee v. National Coal Board* laid down no new principle of law whatever. On the contrary, it affirmed the principle that the onus of proving causation lies on the pursuer or plaintiff. Adopting a *robust and pragmatic* approach to the undisputed primary facts of the case, the majority concluded that it was a legitimate *inference of fact* that the defenders' negligence had materially contributed to the pursuer's injury.[18]

Elaborating on the desired "robust and pragmatic"[19] approach to making common sense inferences, Justice Sopinka added that "the dissatisfaction with the traditional approach to causation stems to a large extent from its too rigid application by the courts in many cases. Causation need not be determined by scientific precision."[20] Justice Sopinka quoted Lord Salmon from *Alphacell Ltd. v. Woodward*: it is "essentially a practical question of fact which can best be answered by *ordinary common sense* rather than abstract metaphysical theory."[21] Justice Sopinka continued:

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15 (1972), [1973] 1 W.L.R. 1, [1972] 3 All E.R. 1008 (H.L.) [*McGhee*].

16 *Snell v. Farrell* (1986), 77 N.B.R. (2d) 222, 195 A.P.R. 222 (Q.B.T.D.).

17 *Snell v. Farrell* (1988), 84 N.B.R. (2d) 401, 214 A.P.R. 401 (C.A.).

18 [1988] 2 W.L.R. 557 at 569, [1988] 1 All E.R. 871 (H.L.) [emphasis added, references omitted, *Wilsher*].

19 *Ibid.*

20 *Ibid.*

21 *Alphacell Ltd. v. Woodward*, [1972] A.C. 824 at 847, [1972] 2 All E.R. 475 [emphasis added], cited in *Snell*, *supra* note 14 at 328.

> The legal or ultimate burden remains with the plaintiff, but in the absence of evidence to the contrary adduced by the defendant, an inference of causation may be drawn although positive or scientific proof of causation has not been adduced.[22]

For Justice Sopinka and the Court, our limited scientific understanding of what must have happened in a given occasion does not pose an insurmountable hurdle to the plaintiff. The absence of affirmative scientific evidence can be legitimately overcome by an *inference* of cause-in-fact from the "undisputed primary facts" of a case.[23] More specifically, a causal link may be inferred where such an inference is supported by the available evidence, assessed in a "robust" and "pragmatic" fashion. We are told that this correction of our understanding of how to treat evidence should furnish a salutary amelioration of the "too rigid application" of the "traditional approach" to the but-for test.[24] Therefore, instead of perpetuating a historical insistence upon a (curiously ambiguous) blend of "scientific precision" and "metaphysical theory", *Snell* tells us that we should view the question of whether or not the evidence reveals a causal link between risk and suffering as "essentially a practical question of fact."[25]

In sum, and irrespective of the ambiguity in his account of how cause-in-fact *used* to be determined, Justice Sopinka's statement made it clear that cause-in-fact would henceforth be determined by a process of inferential reasoning. Such reasoning would, in turn, draw from evidentiary treatment that would be both "pragmatic" and "robust". Justice Sopinka then concluded in *Snell* that the evidence supported an inference that the defendant surgeon's negligent failure to abort the surgery after discovering the hemorrhage was the cause-in-fact of the optic nerve's atrophy.

In this paper, I shall treat Justice Sopinka's holding in *Snell* as the substance of inference causation,[26] with the caveat that I will neither defend nor rely upon *Snell*'s empty references to an approach that is "robust and pragmatic", questions of fact that are "practical", or "common sense"[27]

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22 *Snell*, *supra* note 14 at 330.

23 *Ibid.* at 324.

24 *Ibid.* at 328.

25 *Ibid.*

26 The reasoning in *Snell* has since twice been affirmed by the Supreme Court of Canada. See *Laferrière v. Lawson*, [1991] 1 S.C.R. 541, 78 D.L.R. (4th) 609; *St-Jean v. Mercier*, 2002 SCC 15, [2002] 1 S.C.R. 491, 209 D.L.R. (4th) 513.

27 Lara Khoury has attempted to rehabilitate a role for "common sense" in legal fact-finding as reflecting the desired "[judicial] attitude ... towards the evidence," but in doing so affirms that it is no rationale for actual causal determination: Lara Khoury, *Uncertain Causation in Medical Liability* (Oxford: Hart, 2006) at 202-203.

that is "ordinary".[28] That is, I have deprived myself of the rhetorical fudging that afflicts judicial discourse on cause-in-fact generally and on inference causation specifically,[29] leaving me with only two reference points: the evidence, and whether it might (or might not) permit an inference of causal linkage to be drawn where "the doctors cannot identify the process of causation scientifically."[30]

B. Anticipating Objections and Looking to Evidence Theory

At present, and even within Canada where *Snell* still governs, legal scholars have expressed little support for inference causation generally[31] and *Snell* specifically.[32] Although there has been substantial debate about the merits of the alternative tests of material contribution to harm and material contribution to risk,[33] academic commentary has been almost

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28 Here I am agreeing with Cheifetz: "Causative Snark", *supra* note 8 at 49-51.

29 See Vaughan Black, Book Review of *Uncertain Causation in Medical Liability* by Lara Khoury, (2008) 47 Can. Bus. L.J. 145 [Black, Book Review of *Uncertain Causation*] ("'Robust and pragmatic' are fudge words of the first degree" at 151). See also MacCrimmon, "Common Sense", *supra* note 1 ("Although frequently relied upon, common sense is seldom defined, nor is reliance on common sense justified" at 1435); Jane Stapleton, "Cause-in-Fact and the Scope of Liability for Consequences" (2003) 119 Law Q. Rev. 388 at 388, citing *Fairchild v. Glenhaven Funeral Services Ltd.*, [2002] UKHL 22, [2003] 1 A.C. 32 at para. 45, [2002] 3 W.L.R. 89, Lord Nicholls [*Fairchild*]; Jane Stapleton, "Occam's Razor Reveals an Orthodox Basis for *Chester v. Afshar*" (2006) 122 Law Q. Rev. 426 at 426.

30 *Snell*, *supra* note 14 at para. 22, citing *Wilsher*, *supra* note 18 at 567.

31 For exceptions, see H.L.A. Hart & Tony Honoré, *Causation in the Law*, 2d ed. (Oxford: Clarendon Press, 1985) at 1, 23-61; Richard W. Wright, "Causation, Responsibility, Risk, Probability, Naked Statistics, and Proof: Pruning the Bramble Bush by Clarifying the Concepts" (1988) 73 Iowa L. Rev. 1001 at 1003, 1009, 1018 [Wright, "Bramble Bush"].

32 There are some prominent exceptions: Khoury, *supra* note 27 at 202-203; Allan Beever, *Rediscovering the Law of Negligence* (Oxford: Hart, 2007) at 489-92 [Beever, *Rediscovering*].

33 For support of these alternative tests, see Allen M. Linden & Bruce Feldthusen, *Canadian Tort Law*, 8th ed. (Toronto: LexisNexis Butterworths, 2006) at 120-23; Mitchell McInnes, "Causation in Tort Law: Back to Basics at the Supreme Court of Canada" (1997) 35 Alta. L. Rev. 1013; Craig Jones, "Riffing on Mass Torts, Risk & Uncertainty: *Resurfice Corp. v. Hanke* and Proof of Causation in Populations" in Continuing Legal Education Society of British Columbia, *Causation in Tort After Resurfice* (Vancouver, June 2008) 4.1.1. In opposition to these alternative tests, see Brown, "Expanding Hegemony", *supra* note 5; Cheifetz, "Causative Snark", *supra* note 8; Gillian Demeyere, "The 'Material Contribution' Test: An Immaterial Contribution to Tort Law: A Comment on *Briglio v. Faulkner*" (2000) 34 U.B.C. L. Rev. 317; Lewis Klar, "Downsizing Torts" in Nicholas J. Mullany & Hon. Allen M. Linden, eds., *Torts Tomorrow: A Tribute to John Fleming* (Sydney: LBC Information Services, 1998) 305 at 311; Stapleton, "Lords a'Leaping", *supra* note 8.

universally critical of inference causation.[34] And, while *Snell*'s references to "common sense" and "robust[ness]" are seen as supplying the vocabulary for baseless rationalization,[35] the objections go beyond inference causation's semantics. Put generally, the criticism is that either by design or in effect, inference causation excuses legal fact-finders from offering clear reasoning for a plaintiff's recovery in the absence of evidence proving cause-in-fact to a probable standard. Intuitive fact-finding thus smacks of the same problem that Peter Birks discerned in "intuitive *law*-finding"—specifically that "[i]t frees the judge from the shackles of traditional legal rationality."[36] The criticism levelled by Lewis Klar is generally representative of the scope of the various arguments, although more severe than most.[37] Describing inference causation as a "more liberal and relaxed approach,"[38] he explains:

> The effect of *Snell v. Farrell* on proving causation in cases where the scientific and expert evidence cannot establish a probable connection between a defendant's negligence and a plaintiff's injury has been significant. To allow an inference of cause to be drawn even where there is no scientific evidence of a probable connection between negligence and injury is in effect to accept the essential principle of *McGhee* via a different route.[39]

The most recent edition of Klar's critique omits the following passage, which appeared in an earlier edition:

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[34] Vaughan Black, "The Transformation of Causation in the Supreme Court: Dilution and 'Policyization'" in Todd Archibald & Michael Cochrane, eds., *Annual Review of Civil Litigation 2002* (Toronto: Carswell, 2003) 187 at 195 [Black, "Policyization"]; Cheifetz, "Causative Snark", *supra* note 8 at 49-54; John G. Fleming, "Probabilistic Causation in Tort Law" (1989) 68 Can. Bar Rev. 661 at 670; Lewis N. Klar, *Tort Law*, 4th ed. (Toronto: Thomson Carswell, 2008) at 447 [Klar, *Tort Law*]; Stephen N. Pincus, "Progress on the Causal Chain Gang: Some Approaches to Causation in Tort Law and Steps Toward a Linguistic Analysis" (1986) 24 Osgoode Hall L.J. 961 at 983; Jane Stapleton, "The Gist of Negligence, Part II: The Relationship Between 'Damage' and Causation" (1988) 104 Law Q. Rev. 389 at 404 [Stapleton, "The Gist of Negligence"]. A notable exception is Khoury (*supra* note 27).

[35] Black, Book Review of *Uncertain Causation*, *supra* note 29 at 151.

[36] Peter Birks, "Three Kinds of Objection to Discretionary Remedialism" (2000) 29 U.W.A.L. Rev. 1 at 17 [emphasis added]. I will, however, suggest in concluding this paper that inference causation is an instance of judgment, as distinguished from intuition. See text accompanying notes 213-15.

[37] Khoury describes Klar's criticism (see text accompanying note 39) as "more assertive" (Khoury, *supra* note 27 at 166).

[38] Klar, *Tort Law*, *supra* note 34 at 447, n. 91.

[39] *Ibid.* at 446-47 [footnote omitted]. By "the essential principle of *McGhee*" (*ibid.* at 447), Klar is referring to Lord Wilberforce's imposition in *McGhee* of a reverse onus, requiring the defendant to prove that his or her negligence did not cause the plaintiff's injury (*ibid.* at 441-42). See also Khoury, *supra* note 27 at 166.

> While [inference causation] may produce a pragmatic solution to a plaintiff's dilemma in difficult causation cases, it does depart from the traditional "but for" test, and the balance of probability standard.[40]

This criticism of inference causation essentially advances three general objections. First, it implicitly claims that inference causation is indifferent to the law's concern for veritism in fact-finding.[41] Cause-in-fact is being established even in the absence of a probable connection between negligence and suffering.[42] The point here is that, inasmuch as the law accepts as true only what is shown to be probable, any reasoning process that is indifferent to probability is necessarily indifferent to the law's veritistic aims. Second, it is argued that "scientific evidence" is privileged as being inherently reliable, or at least *more* reliable than an inference made without the benefit of scientific evidence.[43] And third, critics argue that no legal fact-finder can legitimately infer cause-in-fact in the absence of such scientific evidence. Any defence of inference causation must take these ob-

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There has been substantial debate about the meaning to be ascribed to *McGhee*, and particularly to Lord Reid's speech; two mutually opposing views exist. See Stapleton, "Lords a'Leaping", *supra* note 8 at 286-87; Beever, *Rediscovering*, *supra* note 32 at 466-67. It is unnecessary for me to resolve this here, as I take Sopinka J.'s reasons in the later decision of *Snell* as my reference point. Nor do I propose to engage Stapleton's additional criticism in "The Gist of Negligence" (*supra* note 34) in reference to the facts of *McGhee*, that "it is not clear why ... the common sense inference is in favour of a cumulative cause mechanism rather than an alternative cause mechanism" (*ibid.* at 404). My justification of inference causation is indifferent to whether liability is cumulative or apportioned with other material sources of harm.

40 Lewis Klar, *Tort Law*, 3d ed. (Toronto: Thomson Carswell, 2003) at 403. As a matter of positive law, this is an incorrect statement. Inference causation is no derogation from the but-for test but is rather an epistemological instantiation of it. See text accompanying note 22 (passage from *Snell*); David Cheifetz, "Materially Increasing the Risk of Injury as Factual Cause of Injury: *Fairchild v. Glenhaven Funeral Services Ltd.* in Canada" (2004) 29 Advocates' Q. 253 ("*Snell* is a but-for case" at 263). However, given the text that precedes it, I take this as stating that inference causation has, in effect, relaxed the plaintiff's evidentiary burden. Indeed, without explanation, Linden and Feldthusen describe this supposedly "relaxed" quality as lending it a "more balanced" and "humane" quality (*supra* note 33 at 119).

41 Veritism is the law's concern for evaluating a factual proposition by reference to its conformance to absolute truth. This term is devised from the work of Alvin Goldman, who specified that our drive to know presupposes a desire for truth (or at least for the closest approximation of truth)—a desire he labelled "veritistic". "Veritistic epistemology is such a special field, where the selected good is knowledge and the selected bad are error and ignorance": Alvin I. Goldman, *Knowledge in a Social World* (New York: Oxford University Press, 1999) at 6.

42 See MacCrimmon, "Common Sense", *supra* note 1 ("Justice ... totally dependent on unexamined common sense is, to my mind, a fertile breeding ground for miscarriages of justice" at 1434-35).

43 This is also the argument of Lord Rodger in *Fairchild* (*supra* note 29 at para. 150).

jections seriously, and in this paper, I will argue that such defences reflect a misunderstanding of the epistemic processes that are integral to scientific fact-finding and legal fact-finding.

More specifically, in response to the first criticism that inference causation is indifferent to veritism in fact-finding, I will argue that this criticism is simply wrong, inasmuch as it is grounded in a misapprehension of what it means for legal fact-finding to be veritistic. In addressing the second criticism—that "scientific evidence" is a necessary precondition to reliable legal fact-finding—I will argue that scientific fact-finding, though potentially helpful to legal fact-finders, cannot be determinative of legal outcomes because it fails to account for the cognitive processes that are necessarily brought to bear upon evidence. Inference causation, I will show, is an unavoidable process in *any* causal inquiry because we never know with certainty whether the mechanism by which a risk could materialize into suffering was instantiated in a given case: legal fact-finders infer (or do not infer) that it was. Inference causation's immanence within legal fact-finding also helps answer the final criticism—that in the absence of scientific evidence, no legitimate inference of cause-in-fact can be made. I will, however, also attempt to bolster my response with reference to various criteria that have been emphasized by, *inter alia*, evidence theorists, psychologists, and epidemiologists for making reliable inferences of causal association.

To some extent, this paper will merely affirm the legitimacy of current judicial practice: despite criticism, resort to inference causation has persisted in Canadian jurisprudence. And, as Richard Wright reminds us, "judges and juries ... consistently have demonstrated an ability to make intuitively plausible factual causal determinations," resulting in causal judgments that have *inter se* enjoyed "remarkable agreement".[44] I will be guided, however, by Wright's caution that intuitions not conjoined with theory when searching for underlying principles "are often inadequate for the hard cases and sometimes may mislead even in the easy cases";[45] my task in addressing the final criticism will be not merely to reiterate judicial practice, but also to theorize (albeit generally) the application of this shared but undefined causal conception.

In answering these criticisms of inference causation, I will take a slightly different path from that of Wright, whose theory explains how inference causation is applied but does not seek to justify the reliance upon

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44 Wright, "Bramble Bush", *supra* note 31 at 1018.

45 *Ibid.* at 1018-19.

it per se (except to show how it might be justly and rationally applied).[46] For Wright, to accept inference causation is to accept an epistemological standpoint that reasonable conclusions (or at least not obviously false, arbitrary, or irrational conclusions) can be drawn from reliable evidence and rational processes of reasoning. This theory makes sense when one considers that such processes occur within an adjudicative context that imposes a less-than-certain and merely probable threshold for proof. This is not to suggest that "context" should displace a serious analysis, but rather that its bar-setting function influences the epistemological project of explaining how inference qualifies as knowledge.

I therefore do not dispute Wright's defence of inference causation. My argument instead delves a little more deeply into, *inter alia*, its presupposition of an uncertain threshold of civil proof within adjudication in general, and legal fact-finding in particular. My account of how evidence is cognitively processed and juristically assessed will lead me to consider that a justification for the application of inference causation in legal fact-finding might be found not in a theory of causation, but rather in a theory of evidence and its role in the fact-finding process. The inference of cause-in-fact from evidence of possible correlation has been, after all, a substantial epistemic concern among twentieth-century legal scholars of evidence.[47] It began with what William Twining called the "rationalist tradition", which emphasized the role of generalizations in inferential fact-finding,[48] through to the "new" or "mathematicist" evidence scholarship, which emerged in the 1960s and 1970s and maintained that inferential reasoning in the face of uncertainty is a species of probabilistic reasoning.[49] Therefore, the advantage of drawing from theoretical evidence scholarship to inform tort lawyers' debates about inference causation is that such a theory might account for the cognitive processing and juristic assessment of evidence in an adjudicative context. Here, I am taking as a

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46 Wright comes closest to justifying intuitional causal judgment, as I describe it, in his response to Mark Kelman's pragmatic objections to his NESS test (*ibid.* at 1037). While he concedes that our imperfect knowledge means that legal fact-finders are sometimes unable to determine whether a condition is more than a mere condition such that it contributed to the result, Wright argues that this point is irrelevant to the "appropriate theory of actual causation" (*ibid.*). Instead, "[a]s lawyers, judges, jurors, or lay persons, we do the best that we can" (*ibid.*).

47 Peter Tillers, "Mapping Inferential Domains" (1986) 66 B.U.L. Rev. 883 at 883.

48 William Twining, "The Rationalist Tradition of Evidence Scholarship" in Enid Campbell & Louis Waller, eds., *Well and Truly Tried: Essays on Evidence in Honour of Sir Richard Eggleston* (Sydney: Law Book Company, 1982) 211.

49 See especially John Kaplan, "Decision Theory and the Factfinding Process" (1968) 20 Stan. L. Rev. 1065; Michael O. Finkelstein & William B. Fairley, "A Bayesian Approach to Identification Evidence" (1970) 83 Harv. L. Rev. 489; Richard O. Lempert, "Modeling Relevance" (1977) 75 Mich. L. Rev. 1021 [Lempert, "Modeling Relevance"].

given that such context, while plainly relevant to empirical theorizing about legal proof, is also relevant to normative theorizing about how the evidence can be said to permit the inference of a fact, including cause-in-fact.

This is not to suggest that evidence theory per se supplies the answer; these weaknesses are also shared by the theory of evidence presupposed by Klar's criticisms, which offer a probabilistic account privileging statistical information for assessing the reliability of evidence.[50] As I will show in my primary inquiry in this paper, probabilistic theory denies subtle characteristics of both evidence and legal fact-finding, and its statistical expression is of dubious reliability on its own terms. This will lead me to conclude by considering an emerging body of work within evidence theory (drawing particularly but not exclusively from the work of Ronald J. Allen) that emphasizes the legal fact-finding process as entailing the assessment and continuing reassessment of competing versions of events. That process, put succinctly, is seen as resting upon the fact-finder's "inference to the best explanation." My claim will be that, allowing for certain important corrections, such an understanding offers tort lawyers a generally promising normative justification for inference causation by accounting for both the epistemology of legal fact-finding and the adjudicative context in which it takes place.

II. Veritism

I turn, then, to the first criticism of inference causation—that it does not conform to the law's veritistic objectives. Inference causation, the argument goes, is a rhetorical proxy for lowering the standard of proof in cases where there are gaps in the evidence marshalled by the plaintiff.[51] As such, it is an instance of a more general "policyization"[52] of cause-in-fact, affording by way of the vacuous incantations of "robustness" and "common sense" a crutch for fact-finders who cannot point to affirmative evidence explaining why a plaintiff ought to recover.[53] In short, it has little to do with truth and more to do with the fact-finder's own preferences. This concern draws strength from the language that Justice Sopinka used in *Snell*, which demonstrated tepid commitment to veritism at best, insofar as he speculated that the causal "inference" could be drawn with "very

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50 Klar, *Tort Law*, *supra* note 34 at 447, n. 91. See *infra* note 152 and accompanying text.

51 See text accompanying note 38.

52 Black, "Policyization", *supra* note 34 at 195. See also Salvatore Mirandola, "Lost Chances, Cause-in-Fact, and Rationality in Medical Negligence" (1992) 50 U.T. Fac. L. Rev. 258 at 260; Ernest J. Weinrib, "A Step Forward in Factual Causation" (1975) 38 Mod. L. Rev. 518 at 532 [Weinrib, "A Step Forward"].

53 *Snell*, *supra* note 14 at 328.

little affirmative evidence on the part of the plaintiff."[54] As I have already noted, his references to "robust[ness]" and "common sense"[55] amplify the sense that the truth of the matter, relative to the particular outcome that a fact-finder might desire, is unimportant.

Such minimization of veritism is troubling, as truth-seeking is an elemental aspiration of our legal order. Accurate fact-finding is essential, particularly if we understand the rule of law as a substantive limitation on the state's ability to manipulate facts to its own ends, even where that manipulation is for the ostensibly benevolent purpose of compensating injured plaintiffs.[56] Within the framework of a tort action, then, the law insists on linking a finding of actual wrongdoing by the defendant to the plaintiff's suffering. This linkage "supplies the particular feature about the defendant that singles him out from the generality of those available for the shifting of the plaintiff's loss."[57] A serious account of inference causation must therefore distinguish its underlying epistemic processes from emotivism or any similarly non-cognitive, meta-ethical point of view such as the popular concept of "truthiness",[58] or the "benevolent principle" that Lord Nourse discerned in *Fitzgerald v. Lane*—a concept that "smiles on ... factual uncertainties and melts them all away."[59] In such a mindset, where "all evaluative judgments ... are *nothing but* expressions of prefer-

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54 *Ibid.* at 328.

55 *Ibid.*

56 Birks, *supra* note 36 at 15:

> The suggestion that judges should be free to apply whatever remedy they think best for the trouble in hand emanates from our taking the rule of law for granted. Benevolent power is in one sense more dangerous than malevolent power. It undermines vigilance. We easily drop our guard.

57 Ernest J. Weinrib, "Causation and Wrongdoing" (1987) 63 Chicago-Kent L. Rev. 407 at 412.

58 "Truthiness" is a term coined in 2005 by political satirist Stephen Colbert that refers to "the quality of stating concepts or facts one wishes or believes to be true, rather than concepts or facts known to be true": Stephen Colbert, "The Word-Truthiness", *The Colbert Report* (17 October 2005), online: Colbert Nation <http://colbertnation.com/the-colbert-report-videos>. See also Stephen Colbert, "Colbert Roasts Bush" (Talk presented at the White House Correspondents' Dinner, Washington, D.C., 29 April 2006), online: YouTube <http://www.youtube.com>. As Colbert put it:

> We're not some brainiacs on the nerd patrol. We're not members of the fact-inista. We go straight from the gut. ... That's where the truth lies, right down here in the gut. Do you know you have more nerve endings in your gut than you have in your head? You can look it up. Now I know some of you are going to say, "I did look it up, and that's not true." That's because you looked it up in a book. Next time look it up in your gut. ... I call it the "no-fact-zone" [transcribed by author].

59 [1987] 3 W.L.R. 249 at 262, [1987] 2 All E.R. 455 (C.A.).

ence, expressions of attitude or feeling,"[60] there is no difference between stating that the defendant acted wrongly by causing the plaintiff's injury and claiming that I like the plaintiff more than I like the defendant.

The question of *how* we link together two persons and two moments in time—the defendant and the moment of his or her negligence, and the plaintiff and the moment of his or her suffering—must therefore be answered in a manner that reconciles the inferential leap with the law's veritistic aims. Inference causation cannot be a matter of merely cobbling together narratives taken out of thin air with a view to expressing what a fact-finder *feels*; rather, it must presuppose an adjudicative procedure that is veritistic. I will later seek to do so with reference to what Alvin Goldman conceived of as the epistemological principle of "total evidence", being that a fact-finder must "fix his beliefs or subjective probabilities in accordance with the total evidence in his possession at the time."[61] I shall assume that Goldman's direction is uncontroversial because its reference point of "evidence" affirms a veritistic imperative. There is a difference between being involuntarily disposed to feel that the defendant's negligence has caused the plaintiff's suffering, and voluntarily accepting based upon the evidence that it has.[62] By being tied to an evidentiary reference point, inference causation can be distinguished from the fudging that is said to permit legal fact-finders to find in favour of sympathy-inducing plaintiffs because it *feels* right.[63]

While Goldman's "total evidence" presupposes veritism, it also presupposes that a fact-finder's belief will be decided by reference only to such evidence "in his possession at the time."[64] The fact-finder's truth-seeking obligation, then, is unavoidably conditioned upon and discharged in a state of incomplete evidence. What evidence *is* before the fact-finder may and often will lead not to some absolute truth, but rather to an approximation of events. Lord Wilberforce remarked in *Air Canada v. Secretary of State for Trade*[65] that adjudication often entails imperfect or even withheld evidence, and legal fact-finding therefore occurs without knowledge of the whole truth. "[Y]et," he continued, "if the decision has been in

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60 Alasdair MacIntyre, *After Virtue: A Study in Moral Theory*, 3d ed. (Notre Dame, Ind.: University of Notre Dame Press, 2007) at 11-12 [emphasis in original].

61 Alvin I. Goldman, "Epistemic Paternalism: Communication Control in Law and Society" (1991) 88 Journal of Philosophy 113 at 113 [Goldman, "Epistemic Paternalism"].

62 L. Jonathan Cohen, "Should a Jury Say What It Believes or What It Accepts?" (1991) 13 Cardozo L. Rev. 465 at 468 [Cohen, "Should a Jury"].

63 *Cf.* Cheifetz, "Causative Snark", *supra* note 8 ("The common sense method does not mean that the fact finder may consider [propositions] that are not in evidence" at 35).

64 Goldman, "Epistemic Paternalism", *supra* note 61 at 113.

65 [1983] 2 A.C. 394, [1983] 2 W.L.R. 494 (H.L.) [*Air Canada* cited to A.C.].

accordance with *the available evidence* and with the law, justice will have been fairly done."[66]

The underlying presupposition here is that veritism is not the exclusive goal of adjudication, nor would it be even if it were theoretically possible to achieve absolute truth after painstaking inquiry. What we strive for is justice achieved through "a process reasonably designed to ascertain the truth, [and] in ways consistent with ... *other ends of the legal system*."[67] Indeed, *Air Canada* goes so far as to suggest that "[t]he principal, if not the only, purpose of civil litigation" is not truth-seeking, but rather "the resolution of disputes."[68] One can think of even more non-veritistic objectives such as public confidence,[69] acceptance of the rule of law, pacification of parties or simply removing a sense of injustice.[70] Concerns for procedural efficiency and thrift, or for fostering relationships such as those between solicitors and clients, between spouses, or between parties generally,[71] also operate as competitors to veritism. So does the exclusion of evidence going to character, to subsequent remedial measures, or to attempts to compromise a claim. The new emphasis in civil justice reform on mandatory alternative dispute resolution mechanisms and the enshrinement of formal settlement procedures in most rules of court (complete with cost incentives) is similarly indifferent to truth-seeking. Moreover, this systemic anti-veritism is perpetuated in turn by the *functus* rule, which precludes further reflection upon the evidence.[72]

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66 *Ibid.* at 438 [emphasis added].

67 John Rawls, *A Theory of Justice*, rev. ed. (Cambridge, Mass.: Harvard University Press, 1999) at 210 [emphasis added].

68 J.A. Jolowicz, "Civil Litigation: What's It For?" (2008) 67 Cambridge L.J. 508 at 514. This was echoed by Blackmun J.'s observation in *Daubert v. Merrell Dow Pharm.* that the legal system aspires to "quick, final, and binding ... judgment" (509 U.S. 579 at 597 (1993) [*Daubert*]).

69 Laurence H. Tribe, "Trial by Mathematics: Precision and Ritual in the Legal Process" (1971) 84 Harv. L. Rev. 1329 at 1376.

70 Patrick Devlin, *The Judge* (Oxford: Oxford University Press, 1979) at 3. More pluralist understandings of the aims of civil process have also embraced "economizing of resources, inspiring confidence, supporting independent social policies, permitting ease in prediction and application, adding to the efficiency of the entire legal system, and tranquilizing disputants": Jack B. Weinstein, "Some Difficulties in Devising Rules for Determining Truth in Judicial Trials" (1966) 66 Colum. L. Rev. 223 at 241.

71 Kronman views the imperative of understanding relations between parties and "those who identify with or support them" as being so fundamental to adjudication that it speaks to the ethics of judging: Anthony T. Kronman, "Living in the Law" (1987) 54 U. Chicago L. Rev. 835 at 864.

72 "The general [*functus* rule is] that a final decision of a court cannot be reopened": *Chandler v. Alberta Association of Architects*, [1989] 2 S.C.R. 848 at 860, 101 A.R. 321,

I do not mean to suggest that some of these rules are without problems; indeed, objectives other than truth are replete with interesting philosophical implications. My point here, however, is that all of these rules, which remove from the fact-finder's consideration the information relevant to drawing pertinent inferences, augment the likelihood of inaccurate fact-finding. They demonstrate that rectitude of factual determination in civil process inevitably clashes with other objectives.[73] Veritism *simpliciter*, taken as the evaluation of a factual proposition by *exclusive* reference to its conformance to absolute truth, is simply never in the cards in a system where truth-seeking may be constrained or outright sacrificed by legal desiderata, which have little, if anything, to do with truth.

At the same time, indifference to truth seems less troubling when it is employed to achieve settlement, for example, than when it governs legal fact-finding. The former does not implicate a norm that privileges judgments that are understood by the fact-finder as being at least as correct as possible (allowing for the impossibility of absolute correctness given imperfect information). It is surely wrong, however, to associate legal fact-finding with extreme relativism. We want not mere finality, but *just* finality, and substantial justice requires a premium on truth. On the rare occasion when veritism is expressly abandoned in adjudicating cause-in-fact,[74] one might ask: Why bother having a trial? Why hear witnesses? Why insist upon testimony in the language of perception and not of interpretation? To conclude that none of these things matter would be to view the institution of the trial as an elaborate charade. While veritism *simpliciter* is not the goal and not empirically achievable, the law nonetheless aspires to connect causally a defendant's liability with a defendant's negligent act or omission. Fact-finding thus requires truth in at least "a sufficient amount".[75]

While veritistic aims subsist in legal fact-finding, any theory of legal fact-finding generally, and of finding cause-in-fact in particular, must also account for the uncertainty contemplated by the structure of proof within which evidence is processed; that is, how one determines that data repre-

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Sopinka J., majority. "It is based ... on the policy ground which favours finality of proceedings" (*ibid*. at 862).

73 Lisa Dufraimont, "Evidence Law and the Jury: A Reassessment" (2008) 53 McGill L.J. 199 at 203-204.

74 *Hymowitz v. Eli Lilly & Co.*, 539 N.E.2d 1069 (N.Y. 1989) ("there should be no exculpation of a defendant who, although a member of the market producing DES for pregnancy use, *appears not to have caused a particular plaintiff's injury*" at 1078 [emphasis added]).

75 James R. Olchowy, "Battling for the Judge's or Jury's Imagination: Evidence, Storytelling, and Effective Trial Advocacy" (2003) 16 Windsor Rev. Legal Soc. Issues 1 at 2.

sents proof of a factual proposition.[76] To return to my earlier point, the objectives of evidence law are epistemic and concern the rational reasoning methods by which conclusions are reached. Both reference points of "total evidence"[77] and of the civil standard of proof influence the epistemological project of explaining how the cognitive inferences drawn by fact-finders qualify as knowledge: though legal fact-finders may seek truth from the evidence, the most they will find is a *likelihood* of truth. For juristic purposes, something short of absolute knowledge—including inferential knowledge—must therefore still carry veritistic value. The first criticism is thus unconvincing: by adopting an evidentiary reference point, inference causation proves to be no less veritistic than adjudication itself.

III. Scientific Fact-Finding

I now progress to the second inquiry by examining the criticism that inference causation disregards a supposed need for scientific evidence linking the defendant's negligence with the plaintiff's suffering. Specifically, I advance two reasons for which scientific uncertainty cannot justly halt the fact-finder's inquiry in its tracks. First, scientific fact-finding is, simply put, not the same thing as legal fact-finding. They are not mutual substitutes. Second, scientific fact-finding, which operates at a general statistical level, tells us only about the causal link that *might* or *might not* exist in general, and not whether such a link is instantiated in the particular instance of the defendant's negligence and the plaintiff's suffering.[78]

A. Differentiating Scientific Fact-Finding from Legal Fact-Finding

The first reason why the absence of scientific evidence should not defeat a legal finding of causation implicates the contrasting standards of proof and underlying epistemic processes entailed by science and law respectively. While both courts[79] and academics[80] rightly aver the diver-

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76 Ronald J. Allen, "Factual Ambiguity and a Theory of Evidence" (1993) 88 Nw. U.L. Rev. 604 at 606 [Allen, "Factual Ambiguity"]; James Q. Whitman, *The Origins of Reasonable Doubt: Theological Roots of the Criminal Trial* (New Haven: Yale University Press, 2008) at 20-21.

77 Goldman, "Epistemic Paternalism", *supra* note 61 at 113.

78 See Hart & Honoré, *supra* note 31 ("In the sciences causes are often sought to explain not *particular* occurrences but *types* of occurrence" at 33 [emphasis in original]).

79 *Snell*, *supra* note 14 ("Causation need not be determined by scientific precision" at 328; "Medical experts ordinarily determine causation in terms of certainties whereas a lesser standard is demanded by the law" at 330). See also *Daubert*, *supra* note 68 ("there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory" at 596-97).

gence in standards of proof, its significance lies not in the existence of two thresholds but in the intervening gap.

The point becomes more plain when expressed mathematically.[81] The legal burden of juridical proof is conventionally understood to be a probability measure of {>0.50}, meaning that the fact, while less than certain to represent absolute truth, is more likely true than not.[82] The scientific threshold for proof, however, is substantially higher. Statistically significant conclusions normally fall within an interval of confidence, which is the range within which a study parameter lies 95% of the time.[83] Thus, a scientific expert would deny causal association between potential causes and effects unless the connection would not occur due to chance (or some other potential cause) more than 5% of the time.[84] This leaves a range of {<0.449} between the two thresholds—the probability measure of propositions that satisfy legal fact-finders but not scientific fact-finders—within which the plaintiff's case ought to succeed. To side with the defendant whenever a scientific fact-finder will not opine on cause-in-fact therefore creates a one-sided inquiry in the defendant's favour.[85] It is simply unjust for a legal fact-finder to maintain that a scientific fact-finder's refusal or inability to discern the necessary causal linkage between risk creation

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80 Beever, *Rediscovering*, *supra* note 32 at 491-92; Glanville Williams, "Causation in the Law" [1961] Cambridge L.J. 62 at 66-69 [Williams, "Causation in the Law"].

81 The reducibility of burdens of proof to numerical terms appears to be widely accepted, although it remains controversial in some circles. See e.g. Robert J. Rhee, "Probability, Policy and the Problem of Reference Class" (2007) 11 Int'l J. of Evidence & Proof 286 at 287-88; Craig R. Callen, "Kicking Rocks with Dr. Johnson: A Comment on Professor Allen's Theory" (1991) 13 Cardozo L. Rev. 423 at 428 [Callen, "Kicking Rocks"]; Ronald J. Allen & Craig R. Callen, "The Juridical Management of Factual Uncertainty" (2003) 7 Int'l J. of Evidence & Proof 1 at 7 [Allen & Callen, "Juridical Management"]. My purpose here, however, is simply to use statistical reference points to demonstrate the gap between legal and scientific fact-finding thresholds.

82 Allen, "Factual Ambiguity", *supra* note 76 at 604; Ronald J. Allen & Michael S. Pardo, "The Problematic Value of Mathematical Models of Evidence" (2007) 36 J. Legal Stud. 107 at 111 [Allen & Pardo, "Mathematical Models"]. See also *Fennell v. Southern Maryland Hosp. Ctr.*, 580 A.2d 206 at 206 (Md. 1990); *Russell v. Subbiah*, 500 N.E.2d 138 at 141 (Ill. App. 3 Dist. 1986).

83 Richard Goldberg, *Causation and Risk in the Law of Torts: Scientific Evidence and Medicinal Product Liability* (Oxford: Hart, 1999) at 105; Margaret A. Berger & Lawrence M. Solan, "The Uneasy Relationship between Science and Law: An Essay and Introduction" (Symposium, *A Cross-Disciplinary Look at Scientific Truth: What's the Law to Do?*, Brooklyn Law School, 2 March 2007) (2008) 73 Brook. L. Rev. 847 at 852.

84 Troyen A. Brennan, "Helping Courts with Toxic Torts: Some Proposals Regarding Alternative Methods for Presenting and Assessing Scientific Evidence in Common Law Courts" (1989) 51 U. Pitt. L. Rev. 1 at 23-24 [Brennan, "Helping Courts"]; Berger & Solan, *supra* note 83 at 852.

85 Beever, *Rediscovering*, *supra* note 32 at 471.

and suffering is determinative of the outcome of a tort action.[86] All that this failure tells us is that the factual proposition is not provable to a probability measure of {0.95}. The juristic inquiry must continue. The question is how.

The divergence in thresholds is less revealing than the divergence in underlying methodologies. Since the intellectual tasks of the scientist and jurist are distinct *inter se*, they call for distinct intellectual processes. In science, where we know what has happened but are left with indeterminate data that fail to explain why it happened, experiments are repeated until the event can be satisfactorily replicated. The underlying process of fact-finding, then, involves further refinement of the deductive structure of extant knowledge by eliminating anomalies whether empirical or theoretical, thereby modifying or even replacing the overall conceptual structure of that kind of event. In this way, the scientific process seeks to simplify phenomena, usually by controlling as many variables as possible. Until that occurs, determinations of a causal link between risk augmentation and suffering must always remain provisional:[87] counterexamples, or the possibility of confounding factors, can never be ruled out.[88]

Legal fact-finders, by contrast, do not replicate events to determine why something happened. Instead, parties offer up various, and typically inconsistent versions of events, all of which are assessed in drawing a conclusion about the event.[89] In part, this difference in process exists because of the practical imperatives in the law that preclude waiting for certainty;[90] whereas science is ongoing, law needs finality, and so the fact-finding inquiry *must* stop at some point.[91] More fundamentally, there are

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86 "[T]he law prefers a 50 per cent[] chance of doing justice to the certainty of doing injustice": Weinrib, "A Step Forward", *supra* note 52 at 524, citing Glanville L. Williams, Case Comment on *Cook v. Lewis*, (1953) 31 Can. Bar Rev. 315 at 317. This is also the law on criminal causation. See *R. v. Smithers*, [1978] 1 S.C.R. 506, 75 D.L.R. (3d) 321 ("The weight to be given to the evidence of the experts was entirely for the jury. In the search for truth, the jury was entitled to consider all of the evidence, expert and lay, and accept or reject any part of it" S.C.R. at 518).

87 Chris Miller, "Causation in Personal Injury: Legal or Epidemiological Common Sense?" (2006) 26 L.S. 544 at 547.

88 See Berger & Solan, *supra* note 83 at 851-52.

89 See generally Allen, "Factual Ambiguity", *supra* note 76.

90 Miller, *supra* note 87 at 547.

91 Alex Stein, "The Refoundation of Evidence Law" (1996) 9 Can. J.L. & Jur. 279 at 286 [Stein, "Refoundation"]. Indeed, further investigation may be futile; the notion that there may be "[c]ompleteness of evidence" is only a "scientific ideal" (Dufraimont, *supra* note 73 at 206). Because factual uncertainty derives from gaps in evidence instead of known-but-unavailable evidence, nobody can predict the fact that would be proven by the "missing" evidence, were it available. Causal determinations, then, entail underly-

simply too many variables in legal fact-finding to be accounted for, including factors for which scientific deduction cannot account. Trial phenomena, such as lawyers' and witnesses' conduct, demeanour, emotive qualities, and personal idiosyncrasies fit uneasily into scientific fact-finding because homing in on their meaning involves complex mental activities that have their own peculiar logic and pattern.[92] These phenomena instantiate "soft variables", which are resistant to ready quantification. Nearly forty years ago, Laurence Tribe saw them as undermining scientific claims to normatively superior fact-finding properties.[93] Confronted with the necessity of reaching just verdicts with such uncertain evidence, legal fact-finders reason inductively.

For scientific fact-finding to be substitutional for legal fact-finding, it would have to be able to make deductive sense of soft variables, with the necessary and sufficient conditions for drawing a conclusion set out in advance. For example, if the expert witness smiles at her interrogator more at one end of the mouth than the other, twitches her eyebrows, and averts her gaze, she lacks confidence in her answer. This deduction is of course impossible, because the cognitive rules by which soft variables are processed defy definitive articulation.[94] What I am suggesting here is that legal fact-finding's inductive structure is a necessary instantiation of the more general observation of Martha Nussbaum and Hilary Putman:

> [*M*]*ental states are not only compositionally plastic but also computationally plastic*, that is, [there are] reasons to believe that physically possible creatures ... have an indefinite number of different 'programs', and that *the hypothesis that there are necessary and sufficient conditions for the presence of such a belief in computational, or computational-cum-physical, terms is unrealistic* in just the way [that] the theory that there is a necessary and sufficient condition for the presence of a table stateable in phenomenalist terms is unrealistic: such a condition would be infinitely long, and not constructed according to any effective rule.[95]

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ing reasoning that would have to account for unrealized and unknowable forensic possibilities. See Alex Stein, "An Essay on Uncertainty and Fact-Finding in Civil Litigation, with Special Reference to Contract Cases" (1998) 48 U.T.L.J. 299 at 300 [Stein, "Uncertainty"].

92 Tillers, *supra* note 47 at 921; MacCrimmon, "Common Sense", *supra* note 1 at 1436. See also *Faryna v. Chorny* (1951), [1952] 2 D.L.R. 354, 4 W.W.R. (N.S.) 171 (B.C.C.A.).

93 Tribe, *supra* note 69 at 1361, 1393.

94 Allen, "Factual Ambiguity", *supra* note 76 at 626-27.

95 Martha C. Nussbaum & Hilary Putnam, "Changing Aristotle's Mind" in Martha C. Nussbaum & Amelie Oksenberg Rorty, eds., *Essays on Aristotle's* De Anima (Oxford: Oxford University Press, 1995) 27 at 48 [emphasis added].

Therefore, the most that we can say is that such information, when put before a fact-finder, may or may not influence the outcome drawn. It depends on "the sum total of [the fact-finder's] experiences at the moment of decision,"[96] which would, by that time, include counsel's submissions on the meaning of such information and all other observations generated during the trial.

In an illuminating psychological study of the cognitive processes of legal fact-finding where jurors are employed, experimental psychologists Nancy Pennington and Reid Hastie empirically demonstrated these cognitive processes at work.[97] The juror, they conclude, is a "sense-making information processor" who, confronted with evidentiary uncertainty including soft variables, "strives to create a meaningful summary of the evidence available that explains what happened."[98] This meaningful summary is achieved by imposing a "narrative story form" upon the evidence, informed by the evidence itself,[99] knowledge about events "similar in content" to the case under consideration, and "generic expectations about what makes a complete story."[100] In short, explanations of events take the form of stories constructed from "deductive and inductive reasoning procedures applied to the evidence and world knowledge," including inferences about "events, and causal relations between them."[101] Where there is factual uncertainty, individuals attempt to make sense of the available evidence by composing the most compelling plausible explanation possible.

The understanding of legal fact-finding as entailing the composition of a narrative is hardly new.[102] In fact, it is consistent with the advice that

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96 Allen, "Factual Ambiguity", *supra* note 76 at 627.

97 Nancy Pennington & Reid Hastie, "A Cognitive Theory of Juror Decision Making: The Story Model" (1991) 13 Cardozo L. Rev. 519 [Pennington & Hastie, "Cognitive Theory"]. See also Reid Hastie, Steven D. Penrod & Nancy Pennington, *Inside the Jury* (Cambridge, Mass.: Harvard University Press, 1983); Reid Hastie & Nancy Pennington, "The O.J. Simpson Stories: Behavioral Scientists' Reflections on *The People of the State of California v. Orenthal James Simpson*" (1996) 67 U. Colo. L. Rev. 957. Causal cognition is in fact a substantial topic in psychological research, although Pennington and Hastie's work represents a rare instance of empirical insight. Even neuroscience has not shed insights. See David Danks, "The Psychology of Causal Perception and Reasoning" in Helen Beebee, Christopher Hitchcock & Peter Menzies, eds., *Oxford Handbook of Causation* (Oxford: Oxford University Press, 2007).

98 Pennington & Hastie, "Cognitive Theory", *supra* note 97 at 519.

99 *Ibid.* at 522 ("case-specific information acquired during the trial").

100 *Ibid.*

101 *Ibid.* at 524.

102 See Hart & Honoré, *supra* note 31 at 28-30; Robert P. Burns, *A Theory of the Trial* (Princeton: Princeton University Press, 1999) [Burns, *Theory*]; Richard Lempert, "Tell-

senior trial counsel impart to junior counsel as to the most effective way of presenting a case,[103] and has led to theoretical reconceptualizations of the trial.[104] Nonetheless, these findings—which, after twenty-five years, have yet to be challenged—are fundamentally disconcerting to some. If "stories" are dependent, even partly, on a fact-finder's life experience, then different fact-finders may presumably derive different (and inconsistent) accounts from identical facts. Further, while it might be tempting to consign this problem to the specific case of civil juries, which are still commonly employed in Canada,[105] the implications of such cognitive processes in "judge-alone" cases are actually *more* troubling. Jurors must persuade and be persuaded by one another, while a judge need only persuade him- or herself. Disconcerting as this may be, however, the point remains from Pennington and Hastie's work that this process is an empirically demonstrated phenomenon.

B. The Generality of Scientific Fact-Finding and the Specificity of Legal Fact-Finding

The danger of completely subsuming legal fact-finding into scientific fact-finding is also obvious when one considers that scientific method emphasizes the indispensability of statistical explanations.[106] That is, it attempts to derive statistically significant correlations or associations between outcomes and exposures to variables, such as risk augmentation. This ostensibly formal methodology may be intuitively appealing to legal fact-finders, who must otherwise rely on indeterminate and therefore fallible human intuition and intelligence to reconstruct a past that may or may not have occurred as they have determined.[107] It has, as Tribe observed, the "lure of objectivity and precision."[108] This allure, however, is

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ing Tales in Court: Trial Procedure and the Story Model" (1991) 13 Cardozo L. Rev. 559; Linda R. Hirshman, "It Will Be Pleasanter to Tell You a Story" (1991) 13 Cardozo L. Rev. 445.

[103] MacCrimmon, "Law of Evidence", *supra* note 1 at 345.

[104] Burns, *Theory*, *supra* note 102; Olchowy, *supra* note 75.

[105] Civil juries are particularly common in British Columbia, perhaps due to the frequent resort to juries by British Columbia's public motor vehicle insurer. See The Honourable John C. Bouck, "Civil Jury Trials—Assessing Non-Pecuniary Damages—Civil Jury Reform" (2002) 81 Can. Bar Rev. 493 at 513.

[106] Troyen A. Brennan & Robert F. Carter, "Legal and Scientific Probability of Causation of Cancer and Other Environmental Disease in Individuals" (1985) 10 J. Health Pol. 33 at 38-39.

[107] However, legal fact-finders typically do not accept statistical analysis as determinative of anything. See Wright, "Bramble Bush", *supra* note 31 at 1050-51.

[108] Tribe, *supra* note 69 at 1331.

false because mathematical probability is rarely absolutely certain.[109] Consider Jonathan Cohen's celebrated "gatecrasher paradox": where 501 out of 1000 spectators gatecrashed their way into a rodeo, a purely statistical analysis would lead to the absurd injustice of the impresario being able to recover admission fees from all 1000 spectators, based solely on the probability {>0.50} that every one of them was a gatecrasher.[110] Even if we were to increase the number of gatecrashers to within the scientific fact-finding threshold—say, 951 out of 1000—the impresario's claim would still seem absurd.

False mathematical certainty aside, the imposition of a purely statistical methodology upon legal fact-finding also carries both normative and practical difficulties.[111] The normative problem lies in the detraction from individualized justice represented by a statistical approach. As Glanville Williams observed, "the scientist is concerned with causal generalisations. But in historical and legal statements this notion of generalisation and reproducibility hardly figures at all."[112] This is because statistics tell us only about the frequency of increased risk translating into suffering, while the attribution of individual suffering to the risk creator is always indeterminate.[113] The law's veritistic aims, however, presuppose a normative ideal that adjudication involves attempting to find what happened during specific, unique events.[114] Given this ideal, legal fact-finders seek to pronounce individualized judgments about whether the risk creator actually caused the suffering.[115] And so, they investigate particular phenomena "[a]rmed with ... knowledge of general physical laws and other data such as eyewitness testimony of behaviour,"[116] and then "apply [their] data (including [their] knowledge of general physical laws) to an investigation of a

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109 Randolph N. Jonakait, "Stories, Forensic Science, and Improved Verdicts" (1991) 13 Cardozo L. Rev. 343 at 350.

110 L. Jonathan Cohen, *The Probable and the Provable* (Oxford: Clarendon Press, 1977) at 74-75.

111 Wright, "Bramble Bush", *supra* note 31 ("'Probabilistic causation' is philosophically and pragmatically insupportable" at 1003).

112 Williams, "Causation in the Law", *supra* note 80 at 66.

113 Brennan, "Helping Courts", *supra* note 84 at 24; Khoury, *supra* note 27 at 49-50.

114 See Richard W. Wright, "Causation in Tort Law" (1985) 73 Cal. L. Rev. 1735 at 1822-23 [Wright, "Causation"].

115 Rabbi Paul Bergman & Reverand Al Moore, "Mistrial by Likelihood Ratio: Bayesian Analysis Meets the F-Word" (1991) 13 Cardozo L. Rev. 589 at 591.

116 Jane Stapleton, "Choosing What We Mean by 'Causation' in the Law" (2008) 73 Mo. L. Rev. 433 at 435.

particular completely specified phenomenon occurring on a specific occasion."[117]

The problem is even more fundamental for juristic purposes. Statistical evidence suffers from an inherent flaw that demands caution even when it is employed solely as a basis for estimating general frequencies.[118] Consider that the event in question can be modelled in an infinite number of ways, and that each privileges certain characteristics that will generate a particular probability. The dependency of the resulting probability on the class from which it is drawn generates an epistemological problem: different classes will yield different probabilities. Furthermore, there is no a priori method for determining whether any particular class is relatively closer or further from the objective truth.[119] Considering Cohen's gatecrasher paradox, we can create subsets of rodeo attendees by, for example, distinguishing church-goers from atheists (on the assumption that the former are more likely to be honest about paying admission); or wealthy from poor (on the assumption that the former have no incentive to gatecrash); or old from young (on the assumption that the former have more respect for the law). In short, it is not enough to know how many attendees there are in order to formulate generalized causal probabilities. We need to know the circumstances that are relevant to the statistical probability of someone bilking the impresario.

This problem, which is typically conceptualized as one of "reference classes",[120] is implicated in factual causation. In a case like *Snell*, science could generate some conditional probabilities, such as the chance of going blind without the defendant's negligence, contrasted with the chance of going blind *with* the defendant's negligence. From that, science could ultimately generate an equation showing the probability that the blindness was caused by the defendant's negligence. I have already observed that, being a mere probability, this evidence is unhelpful in determining indi-

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[117] *Ibid*. at 438.

[118] Vern R. Walker, "Theories of Uncertainty: Explaining the Possible Sources of Error in Inferences" in Marilyn MacCrimmon & Peter Tillers, eds., *The Dynamics of Judicial Proof: Computation, Logic, and Common Sense* (Heidelberg: Physica-Verlag, 2002) 197 ("Statistical associations among sampling data may warrant a conclusion or finding about generic causation, but that conclusion has an inherent risk of causal error" at 223).

[119] See Michael S. Pardo, "Reference Classes and Legal Evidence" (2007) 11 Int'l J. of Evidence & Proof 255 at 256; Wright, "Bramble Bush", *supra* note 31 at 1047.

[120] John Maynard Keynes, *A Treatise on Probability* (London, U.K.: Macmillan, 1921) at 94; David Papineau, *For Science in the Social Sciences* (London, U.K.: Macmillan, 1978) c. 3 at 50ff.; Wright, "Bramble Bush", *supra* note 31 at 1046-47; Paul Roberts, "From Theory into Practice: Introducing the Reference Class Problem" (2007) 11 Int'l J. of Evidence & Proof 243.

vidualized causation.[121] My point here, however, is that the probability, *as a probability*, is of questionable value unless we know much more about the reference class from which it is derived. The reference class can be gerrymandered in an infinite number of ways. It could be as narrow as someone of the gender, age, and identical medical history as the plaintiff in *Snell*, as broad as all patients whose case histories are canvassed in the scientific literature, or somewhere in between—perhaps the expert's own patients, or subsets comprising female patients or female patients with particular pre-existing conditions.

The relevance, or probative value, of statistical evidence thus depends upon the selected group of persons, or reference class, as the overall population from which probabilities are extracted, and in respect of which factual generalizations are made. The problem is not just that some reference classes will lead to the probabilistic conclusion that negligence caused suffering while other reference classes will not permit that conclusion in statistical terms. It is also that the value of probability assessments varies with the chosen reference class: the less specific the reference class is to the question at hand, the less reliable the derived probability assessments are.[122] The ostensibly objective and methodically rigorous quality of probability assessments is therefore illusory.

Moreover, the reference class problem is not merely a question of obstructing attempts to find a "true" cause of an event. Because the reference class is the basis on which correlation is attributed to causality, an overly broad reference class will lead to false causality.[123] This is particularly germane to epidemiology, which is based not upon experimentation, but upon "statistical causation", denoting correlations between risk exposures and outcomes.[124] To consider a simple example, suppose we wish to determine whether the cause-in-fact of a plaintiff's exposure to a particular disease lies with her choice of residence between Edmonton and Calgary. And suppose that, thanks to researchers who recently considered this question by examining one hundred residents of Edmonton and one

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[121] See text accompanying note 106-10.

[122] For this reason, Wright ("Bramble Bush", *supra* note 31 at 1047) cites the work of Papineau (*supra* note 120).

[123] I am grateful to Duane Szafron for our discussion of this point. For a recent and rare example of a trial court discerning a reference class problem in the opinion evidence of a scientific expert, see *Duncalf v. Capital Health Authority*, 2009 ABQB 80, 4 Alta. L.R. (5th) 201 at para. 96, 64 C.C.L.T. (3d) 237.

[124] Brennan, "Helping Courts", *supra* note 84 at 23; Brennan & Carter, *supra* note 106 at 44. On statistical causation generally, see Margaret A. Berger, "Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts" (1997) 97 Colum. L. Rev. 2117 at 2125-26; Steve Gold, "Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence" (1986) 96 Yale L.J. 376 at 384.

hundred residents of Calgary, we now have access to generalized data. Assume the data show that fifty of the Calgarians and twenty of the Edmontonians share a propensity to the disease. Without refining their reference class of city of residence, we might conclude that living in Calgary increases the propensity to that disease by a factor of two or greater. Because, however, the researchers found their Edmontonians living in the suburbs and their Calgarians living downtown, their chosen reference class has led us into false causality. That is, were we simply to take the figures as given, we would be wrongly connecting propensity to disease with city of residence, instead of urban living (or other potentially influential reference points such as ethnicity, health, or economic status). The reference class problem thus poses the risk that we might misidentify the cause by failing to distinguish a genuine causal influence from a spurious covariation.[125]

In addition to the normative objection for detracting from individualized justice, there are lingering pragmatic concerns over relying upon statistical probabilities for the purposes of legal fact-finding. One practical reason for eschewing statistical analysis of cause-in-fact lies in the complex nature of trial evidence, of which discrete bits accumulate and intersect with one another, forcing fact-finders to perform continual adjustments of their perceptions both of the parties' dispute, and of particular evidence in light of new discoveries. Most probabilistic attempts to answer the objection about accounting for the complexities of accumulating evidence have relied upon Bayesian decision theory.[126] In essence, Bayes's

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[125] I should concede that the reference class problem is not unique to expressly probabilistic or other formal mathematical expressions of evidence. All evidence is inherently probabilistic (*United States v. Shonubi*, 895 F. Supp. 460 at 514 (E.D.N.Y. 1995)), because any factual generalization necessarily implies a reference class. The reference class problem is therefore an unavoidable concomitant of inference causation to at least some degree. The problem runs deeper, however, where naked statistical evidence is used in isolation from one's own reasoning. Unlike other forms of evidence (whether in documentary, testimony, or physical form), any interpretation drawn from statistical evidence is *entirely* dependent upon the reference class. This is only making explicit a pervasive and inherent feature of scientific fact-finding in cases of forensic uncertainty: "quantitative theories, such as statistical approaches, all require knowledge of the interdependencies of data" (Allen, "Factual Ambiguity", *supra* note 76 at 620). That is, elements of statistical evidence are mutually dependent in a way that must be discerned before any reliable interpretation can be derived.

[126] Kaplan, *supra* note 49; Finkelstein & Fairley, *supra* note 49; Lempert, "Modeling Relevance", *supra* note 49; Richard D. Friedman, "Route Analysis of Credibility and Hearsay" (1987) 96 Yale L.J. 667; Peter Tillers & David Schum, "Hearsay Logic" (1992) 76 Minn. L. Rev. 813; Dale A. Nance & Scott B. Morris, "Juror Understanding of DNA Evidence: An Empirical Assessment of Presentation Formats for Trace Evidence with a Relatively Small Random-Match Probability" (2005) 34 J. Legal Stud. 395.

theory furnishes a mechanism for incrementally revising probability estimates in light of new information, thereby allowing a fact-finder to update continually an opinion about the relative likelihood of a fact. This requires two pieces of data, the first being an a priori estimate of the probability that a fact is proven or not. Bayesians posit that a fact-finder begins with an original estimate of the likelihood of a fact, such as a causal link. That prior probability is then continually revised to reflect the statistical impact of new, relevant information as it is received and incorporated into the probabilistic calculation of the likelihood of the fact. In Bayesian terms, the statistical impact of new information constitutes the second piece of data, being a likelihood ratio, which is multiplied by the prior probability to create the posterior possibility. The process is repeated until finally, the fact-finder supposedly arrives at the final modification of the probability of the causal linkage.[127] The claim for Bayesian methodology and for its superiority over "intuitive" fact-finding was neatly summarized by Michael Saks and Jonathan Koehler:

> The Bayesian approach can have a clarifying effect on one's thinking about evidence. By using Bayes' Theorem, we can see what information about the evidence is needed, where the absence of data is replaced by assumptions of the witnesses or fact findings, and, ultimately, what impact the evidence should have on our preexisting beliefs. In contrast, the intuitive decision-maker has few helpful guideposts for updating beliefs, and risks falling victim to some of the many biases associated with the heuristic strategies intuitive decision-makers employ.[128]

Bayesian methodology suffers from several defects, however, making it incompatible with legal fact-finding.[129] The principal objection challenges prior probability: it is in essence a reference class, since it forms the a priori basis from which the probability of a proposition such as a

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I do not propose here to describe the mathematical underpinnings of Bayesianism, preferring to leave them to the more technically competent; I wish instead to focus on whether Bayes's theorem furnishes an adequate model for legal fact-finding. For the mathematical underpinnings, see generally Tribe, *supra* note 69 at 1351-52; Michael J. Saks & Jonathan J. Koehler, "What DNA 'Fingerprinting' Can Teach the Law About the Rest of Forensic Science" (1991) 13 Cardozo L. Rev. 361 at 364, n. 17. See especially Judea Pearl, *Probabilistic Reasoning in Intelligent Systems: Networks of Plausible Inference*, 2d ed. (San Francisco: Morgan Kaufmann, 1988) c. 2 at 29ff.

127 Tribe, *supra* note 69 at 1350. See also Saks & Koehler, *supra* note 126 at 364.

128 *Ibid.* at 364-65. See also Jonathan J. Koehler & Daniel N. Shaviro, "Veridical Verdicts: Increasing Verdict Accuracy Through the Use of Overtly Probabilistic Evidence and Methods" (1990) 75 Cornell L. Rev. 247 at 274-75.

129 Bayesian analysis was first attacked by Tribe (*supra* note 69). Tribe did not, however, challenge the Bayesian epistemological claim to describe the structure of rational thinking about inference, but rather focused on what he saw as Bayesianism's pragmatic, moral, and social implications.

causal link is made. Everything that follows—the continual updates of the prior estimate in light of discovered bits of evidence relevant to cause-in-fact, and the final modification of the assessment of the proposition's likelihood—depends upon that starting point. Unless, however, that pre-existing probability is truly a priori—that is, an analytic proposition that derives from logic and reason,[130] as opposed to a synthetic proposition based on experience and observations[131]—there is no reason to accept that pre-existing probability's status within Bayesian methodology is inherently reliable. And, without that reliable starting point, the posterior or ultimate probability that is the subject of later calculation and recalculation is unreliable. In other words, the new statistical probability is just as suspect as the prior.[132] Its relevance is determined only with reference to an initial hypothesis, formulated without the sophisticated probabilistic thinking that is ostensibly brought to bear upon later aggregations. Given the scientific fact-finder's claim to formal objectivity, the Bayesian process is ironically totally dependent upon the intuition that probabilists eschew as fuzzy and unreliable, and which statistical evidence ostensibly allows fact-finders to avoid.

Another objection to statistical evidence and to its processing in litigation in a Bayesian manner derives from the empirical limitations of human computational capacity. The notion of a fact-finder who continually and mathematically refines accumulating data is simply implausible. The nature of evidence itself, moreover, defies easy Bayesian statistical reduction. Take again the problem of soft variables in evidence. Bayesian analysis cannot account for the significance to be ascribed to the meaning of a witness's smile in describing a possible causal sequence because both the factual question of whether it was more a smirk than a smile, and the contrasting hypotheses (derision or humour) pose difficulties and perhaps impossibilities for statistical reduction. In other words, probabilistic analysis of evidence, including evidence of cause-in-fact, is futile because evidence does not speak for itself by stating its own probative qualities or

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[130] Examples of such logical analytic propositions are: one plus one equals two; only women can give birth; and the sun rises in the east and sets in the west. It is admittedly possible, in statistical terms, to have such a proposition where the reference class is objectively determinable and exhaustive, but it only seems imaginable in an experimental setting, free of competing versions of historical events. Bergman and Moore give the example of a sack of 100 marbles, 50 of which are red. As a matter of logic and reason, there is a prior probability of {0.50} that the first marble removed from the sack will be red (Bergman & Moore, *supra* note 115 at 597).

[131] Examples of such synthetic propositions are: Norway is colder than Greece; London is larger than Vancouver; and all owls hunt at night.

[132] See Tribe, *supra* note 69 at 1350.

weight.[133] As Keynes explained, "weight ... measures the *sum* of the favourable and unfavourable evidence, [while] probability measures the *difference*."[134]

IV. The Inferential Quality of Legal Fact-Finding

A. Infusing Evidence Theory into Causal Inference

Evidence, then, acquires legal meaning only through the complex cognitive processes that fact-finders bring to bear upon it. Benjamin Cardozo (writing extrajudicially) observed, "We may try to see things as objectively as we please. None the less, we can never see them with any eyes except our own."[135] This is particularly so for statistical evidence, which requires first "transforming it from evidence about the *generality* of cases to evidence about the *particular* case before us."[136] Statistics alone prove nothing, because "[n]o datum or object has an inferential value standing alone."[137] They are, in short, just something else to be interpreted;[138] their probative value will depend on the strength that they lend to a particular inference at trial.[139] This is the upshot of the problem Wright averred

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133 Ronald J. Allen, "On the Significance of Batting Averages and Strikeout Totals: A Clarification of the 'Naked Statistical Evidence' Debate, The Meaning of 'Evidence,' and the Requirement of Proof Beyond a Reasonable Doubt" (1991) 65 Tul. L. Rev. 1093 at 1103 [Allen, "Batting Averages"].

134 Keynes, *supra* note 120 at 77 [emphasis in original]. This explains why, even where the probability might increase as a plaintiff accumulates supportive evidence, a legal fact-finder can still reject evidence: the truth of the underlying proposition might still be unreliable despite its probabilistic superiority over the competing proposition.

135 Benjamin N. Cardozo, *The Nature of the Judicial Process* (Mineola, N.Y.: Dover, 2005) at 9.

136 Tribe, *supra* note 69 at 1346 [emphasis in original].

137 Craig R. Callen, "Cognitive Science and the Sufficiency of 'Sufficiency of the Evidence' Tests" (1991) 65 Tul. L. Rev. 1113 at 1129.

138 Allen & Pardo, "Mathematical Models", *supra* note 82 at 135-36.

139 Indeed, it is not obvious that statistics ought to be considered by legal fact-finders *at all*, let alone in isolation from other evidence. The disparity to which I have already referred (between probability theory and human reasoning when confronted with uncertainty) suggests that they ought to be excluded altogether, and there is support for this argument. See Callen, "Kicking Rocks", *supra* note 81; Tribe, *supra* note 69 at 1350, 1365. There is also support for the inclusion of statistics within a pluralist understanding of what qualifies as evidence. See Allen & Pardo, "Mathematical Models", *supra* note 82 at 136-37; Roberts, *supra* note 120 at 251-52; Stein, "Uncertainty", *supra* note 91 at 301; Tillers, *supra* note 47 at 888-89. Pardo also seems to have taken Robert Rhee as having argued for exclusion (Pardo, *supra* note 119 at 257); however, Rhee has expressly stated that statistics are not a question of "exclusion, but rather one of appropriate weight" (Rhee, *supra* note 81 at 291). I do not attempt to resolve this dispute in this paper. My

when he wrote that probabilities provide, *at most*, evidence supporting the applicability of different causal generalizations, but "do not in themselves indicate which of the possibly applicable causal generalizations actually applies to the particular concrete occurrence."[140]

My argument here is that evidence submitted at trial—particularly circumstantial evidence of correlation, such as the temporal proximity between surgery and blindness—is, on its own, underdeterminative of the true significance that legal fact-finders may (or may not) ascribe to aspects of the historical event that is the subject matter of the lawsuit.[141] Such ascription is accomplished by an inferential process in which documents, testimony, and physical exhibits become evidence through arguments that interpret them with relation to that event.[142] This goes to a more fundamental point, also anticipated by Wright: particularizing cause-in-fact—that is, determining what happened on a particular occasion—requires us to *infer* that a "causal generalization and its underlying causal law have been fully instantiated on the particular occasion."[143] In other words, inference is a ubiquitous and immanent part of causal determination. Fact-finders *always* find facts by choosing whether or not to infer. We infer (or do not infer) from the fact that the morning newspaper reports that the Toronto Maple Leafs lost last night's hockey game that they did; we infer (or do not infer) from the fact that history books represent that Horatio Nelson died in victory at the Battle of Trafalgar that he did. Indeed, present knowledge of "historical past" is a construction composed of "what the evidence obliges us to believe."[144] Historical fact, then, is not a question of "what was" or "what really happened", but rather what the historian *infers* to have happened.[145] Tort claims requiring legal fact-finders to fill gaps in order to construct a historical account of cause-in-fact entail the same inferential process.[146]

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point is to defend inference causation, which is supported by both sides of the issue of whether the evidence that scientists can offer in the face of factual uncertainty ought to be considered.

140 Wright, "Bramble Bush", *supra* note 31 at 1047 [footnote omitted].

141 *Ibid.*

142 Ariel Porat & Alex Stein, "Liability for Uncertainty: Making Evidential Damage Actionable" (1997) 18 Cardozo L. Rev. 1891 at 1891, 1900.

143 Wright, "Bramble Bush", *supra* note 31 at 1049.

144 Michael Oakeshott, *Experience and its Modes* (Cambridge: Cambridge University Press, 1933) at 102-12.

145 *Ibid.*

146 This is conceded even by Klar, who goes further than I do in describing the legal fact-finder's options: Klar, *Tort Law*, *supra* note 34 ("The court must *guess* at what would have occurred, using its best judgment, intuition, common sense, experiences, expert

Consider a plaintiff who, at the material time, suffered from type I osteogenesis imperfecta, or brittle bone disease, meaning that his bones break easily in the course of ordinary daily activities. He does not experience symptoms of having a broken arm until after he is hit by a negligently operated automobile while crossing a marked crosswalk. A subsequent X-ray reveals that he has suffered a broken arm. No one would seriously suggest that a scientific expert is required in this case to demonstrate cause-in-fact, nor would anyone seriously challenge a legal fact-finder's conclusion that the driver's negligence was the cause-in-fact of the plaintiff's broken arm. The factual causal link is nonetheless being inferred, not "demonstrated". Evidential sources—in this case, the plaintiff's evidence as to his medical condition—do not speak for themselves by demonstrating the mechanical coincidence of negligence and suffering; their significance is inherently ambiguous.[147] That ambiguity is resolved, either to the plaintiff's or the defendant's benefit, by the drawing of an inference.

Recall Klar's criticism of inference causation, and in particular its assumption that scientific evidence is inherently reliable, or at least more reliable than an inference drawn in the absence of scientific evidence.[148] For that criticism to be evaluated, it is first necessary to know what is meant by scientific evidence. On that point we are given a hint in his accompanying critique of *Scott (Crick) v. Mohan*,[149] a decision of the Alberta Court of Queen's Bench. We are told, "despite the fact that *no statistical studies could provide a clear link to the causation issue*," an inference of cause-in-fact was drawn.[150] It appears, then, that this critique of inference causation presupposes that naked statistics, on their own, constitute evidence. As I have shown, however, the idea of naked statistical evidence is nonsensical in a juristic context because it presupposes an epistemological perspective that does not conform to the epistemology that is characteristic of legal fact-finding. What probabilists skip is the linkage between propositions derived from observations of phenomena, and the implications of these propositions allowing us to draw conclusions about legal liability.

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evidence, and *whatever else may be of assistance*" at 432 [emphasis added]). The text does not attempt to reconcile this statement with his rejection of inference causation in the absence of scientific evidence (see text accompanying notes 38-40).

147 Ronald J. Allen, "The Nature of Juridical Proof" (1991) 13 Cardozo L. Rev. 373 at 395 [Allen, "Nature of Juridical Proof"].

148 Klar, *Tort Law*, *supra* note 34 at 447, n. 91.

149 (1993), 142 A.R. 281, 41 A.C.W.S. (3d) 1148 (Q.B.).

150 Klar, *Tort Law*, *supra* note 34 at 447, n. 91 [emphasis added].

Criticisms of inference causation[151] are therefore based upon an impoverished understanding of the nature of evidence. No account of inference causation can satisfactorily theorize precisely how the linkages between evidence of risk augmentation and factual conclusion are to be made and justified, because evidence itself is "theory laden".[152] As such, it can be interpreted in different ways, instantiating what Peter Tillers calls the "nomological structures" of evidence whereby a party's theory of the evidence becomes part of the totality of the evidence itself.[153] Evidence of causation—that is, Goldman's "total evidence"[154]—might therefore be usefully distinguished from an evidential source.[155] The former is an amplification of the latter (as opposed to a reiteration), which, on its own, carries no weight. Evidence of causation simply exists; it is left to the fact-finder to ascribe significance to the evidential source, which in turn becomes part of the evidence. Just how that is done—how weight is ascribed to evidential sources—is complex, and further complicated by trial conditions.[156] The cogency of that ascription is the nub of the problem that critics discern in inference causation: because it is non-demonstrable and inductively uncertain, its acceptance depends on a theory of evidence that affords a fact-finder the discretion of saying that she has sufficient or insufficient reasons for making an inference from evidential sources. I will conclude this paper by referring to such a theory, but my point here is that such criticisms are futile, considering inference causation's immanence within legal fact-finding and its complexity that defies mathematical reduction.

An argument that might be raised in objection to all this is that my example of the brittle-boned plaintiff is an obvious case where scientific evidence is unnecessary. Such obviousness is presumably derived from the observable mechanical linkages: a hitherto asymptomatic plaintiff is struck by an automobile, he experiences symptoms of a broken arm, and is shortly thereafter diagnosed with a broken arm. Being able to relate his broken arm to a mechanism such as being struck by an automobile is undoubtedly more comforting to a legal fact-finder determining cause-in-fact, since "knowledge of a mechanism usually implies knowledge of when

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151 See text accompanying note 38-40.

152 Robert P. Burns, "Some Realism (and Idealism) About the Trial" (1997) 31 Ga. L. Rev. 715 at 757 [Burns, "Some Realism"].

153 Tillers, *supra* note 47 ("theory is built into all evidence—that nomological structures are part of the fabric of evidence" at 891).

154 See text accompanying notes 61-64.

155 See Stein, "Refoundation", *supra* note 91 at 287, 308.

156 *Ibid.* at 308-309.

it is or is not likely to be active."[157] Conversely, knowledge of a correlation does not typically imply knowledge of when risk is or is not likely to materialize into suffering. The case of the brittle-boned plaintiff is, however, not a case solved by mechanical knowledge because we do not know whether the broken arm was caused by the mechanism of {automobile + plaintiff} or by the pre-existing risk. Given the plaintiff's contrasting pre– and post–accident symptoms, however, we might infer correlation between the defendant's negligent driving and the plaintiff's suffering. Indeed, that is all we can ever do since we can never know with certainty whether the mechanisms by which a risk could materialize into suffering were instantiated in a given case.

Given the ubiquity and immanence of inference causation in legal fact-finding, there is no obvious demarcation between so-called obvious cases where one can safely infer a causal link between risk augmentation and suffering, and cases requiring scientific evidence.[158] The point is that fact-finding, including fact-finding for determining cause-in-fact, always involves evidentiary gaps that are filled by ascriptions of meaning to evidential sources. *Ex hypothesi*, causal determinations can be conditioned upon any evidential sources containing any amount of information. Since the fact-finder does not know what evidence is not before him or her,[159] "[a]n argument that relevant allegations are more probable than not may be constructed upon virtually any amount of evidence"[160] by bringing to bear upon it those qualities that Cardozo identified as "a stream of tendency ... [giving] coherence and direction to thought ... [and comprising] inherited instincts, traditional beliefs, [and] acquired convictions."[161]

While this carries an obvious risk of reaching a factually incorrect conclusion, that risk diminishes where, as Wright has described it, "some credible causal generalization links conditions of that type to results of that type."[162] As such, a legal fact-finder is persuaded that an incompletely known causal law was probably fully instantiated on a particular occasion. The question on which I conclude this paper addresses whether and how we can give structure to that linkage generated by the causal generalization—that is, to the fact-finder's reasoning process—such that the evidential sources and concomitant information can be assessed in rela-

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[157] Danks, *supra* note 97 at 19. See also Hart & Honoré, *supra* note 31 at 28-30 (discussion of "Cause and Effect").

[158] I am grateful to Lewis Klar for discussions of this issue.

[159] I make this point at *supra* note 91.

[160] Stein, "Uncertainty", *supra* note 91 at 300.

[161] Cardozo, *supra* note 135 at 8.

[162] Wright, "Bramble Bush", *supra* note 31 at 1046.

tion to all other evidential sources before the fact-finder. As I have argued elsewhere, the devil is in the details.[163]

B. The Structure of Inference Causation

I have argued in this paper that the structure of juristic proof, while veritistic, is distinct from the structure by which propositions are scientifically verified. As a result, neither the existence of an evidentiary gap nor scientific demurral from bridging that gap excuses the fact-finder from proceeding further in the causal inquiry. Reliance on scientific demurral as being determinative is, quite literally, unjust.[164] Moreover, because complete evidentiary knowledge is impossible (i.e., always laden with gaps), legal fact-finding would grind to a halt were it to operate in isolation from the human judgment inherent in the cognitive processes brought to bear upon the evidence.[165] This is particularly so where the legal fact-finder is called upon to adjust her understanding of the case in order to account for the complex nature of accumulating and intersecting trial evidence and soft variables such as trial phenomena.

On the one hand, the reality of legal fact-finding[166] requires that we acknowledge the role of explanatory considerations as guides to the inferences that legal fact-finders draw. And, where several propositions might explain a given event, legal fact-finders are naturally inclined to infer as a fact the proposition that best explains it. On the other hand, legal fact-finders, in choosing to draw such an inference, must conform to the law's concern for veritism.

I now proceed to consider whether reconciliation of these conflicting imperatives—accounting for the rough justice that underlies how legal fact-finders assess the relevance of particular bits of evidence, and the requirement that facts that are found be not merely plausible but probable—can be achieved by applying the insights of evidence theory. In doing so, I will attempt to bring some structural discipline to the cognitive processes, which Pennington and Hastie demonstrated.[167] Ultimately, I seek to defend those processes as comprising a normative phenomenon.

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[163] Brown, "Expanding Hegemony", *supra* note 5 at 442. It may be a matter of ecumenical preference; Burns writes that "*God* is in the details": Burns, "Some Realism", *supra* note 152 at 757 [emphasis added].

[164] See text accompanying note 85-86.

[165] I am understanding "evidence" here as "total evidence" (see text accompanying notes 61-64).

[166] See especially Pennington & Hastie, "Cognitive Theory", *supra* note 97.

[167] *Ibid.*

Structural discipline requires a measure of veritistic rigour that is not obvious, for example, in some of the most important, recent theorizing of the trial as an instance of "storytelling".[168] Robert Burns, for example, while viewing evidence as being "necessarily organized [by legal fact-finders] in narrative form," argues that narratives are generally persuasive because of "normative considerations that emerge from the narratives themselves."[169] While Burns's positive account of legal fact-finding is unobjectionable—indeed, it simply reiterates the epistemic reality revealed and explicated by Pennington and Hastie[170]—his normative claim arguably drifts into emotivism by privileging the legal fact-finder's own preferences. At the very least, his focus on "normative considerations that emerge from the narratives themselves"[171] fails to privilege the evidence and ignores the particular question of fact to be determined. While any purely narrative model is logically and epistemologically superior to the probabilistic models because it dovetails with how legal fact-finders treat evidence,[172] the normative significance of any narrative must be drawn, at least *inter alia*, from the fact that it accounts for evidence, and not from the narrative itself. In short, the plaintiff should win where the legal fact-finder thought the plaintiff's account of the facts seemed the most probable and plausible of all competing accounts, and not because the plaintiff's story itself evoked considerations that the legal fact-finder thought to be normatively significant. Otherwise, the plaintiff might as well succeed on account of the cut of his jib.

For this paper's purposes, however, any tenable theory must account for the empirical fact that the process of legal fact-finding entails generating potential explanations of the evidence. Having heard the explanations, the fact-finder then turns to selecting the best probable explanation (the one that best explains the evidence) as more likely than all the others to be true, and thus to stand as "truth". Various evidence theorists—Ronald J. Allen in particular—have conceptualized this structure as also comprising the framework of a normative process dubbed as "inference to the best explanation"[173] (IBE), which is shorthand for "the idea that explanatory

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[168] This lack of rigour also opens inference causation to criticism from probabilists. See James Brook, "The Blue Bus Stop: On Professors' Stories and the Stories Plaintiffs Tell" (1991) 13 Cardozo L. Rev. 621 at 623 (Comment on Allen, "Nature of Juridical Proof", *supra* note 147).

[169] Burns, "Some Realism", *supra* note 152 at 756-57.

[170] Indeed, Burns cites Pennington and Hastie's work (see *ibid.* at 751-53).

[171] *Ibid.* at 757.

[172] Pennington & Hastie, "Cognitive Theory", *supra* note 97.

[173] Amalia Amaya, "Inference to the Best Legal Explanation" in Hendrik Kaptein, Henry Prakken & Bart Verheij, eds., *Legal Evidence and Proof: Statistics, Stories, Logic*

considerations guide inferences during the proof process and that these considerations therefore themselves explain the ... phenomena under discussion."[174] IBE mirrors the two-stage process of legal fact-finding: potential explanations are offered by the parties or constructed by the fact-finder, and are then assessed with reference to explanatory criteria.

> [I]n civil cases fact-finders ought to infer the best explanation (and find for the party whom it favours) from the competing explanations offered by the parties or additional explanations fact-finders construct for themselves.[175]

In the first stage, the parties themselves do the heavy lifting, offering competing versions of events in order to explain the evidence. The plaintiff (or the party with the burden of proof) offers versions that address the formal substantive elements comprising his claim, while the defendant offers versions that omit one or more of those elements and addresses the formal substantive elements of any affirmative defences. In the second stage, those explanations of events—and any other explanations that have been constructed by the legal fact-finder—are considered for plausibility relative to the evidence. The defendant's strongest counterargument to the plaintiff's case, then, will be a competing narrative—that is, "another way to order the information into coherency."[176]

IBE, at least as Allen conceives it, thus conforms to the empirically demonstrated cognitive reasoning processes of legal fact-finders. Factual conclusions are formulated by developing narratives of events to account for the evidence.[177] These narratives will consist of various subsets of the events that are said by one party or another to suggest a causal relationship. Ultimately, based on the preferred narrative, cause-in-fact may or may not be inferred by the legal fact-finder. The preferred narrative, moreover, might be one constructed by the fact-finder herself; although Allen has equivocated on this point,[178] there is no reason to restrict the ac-

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(Farnham, U.K.: Ashgate, 2009) 135 at 135; Allen, "Factual Ambiguity", *supra* note 76; Allen & Callen, "Juridical Management", *supra* note 81; Allen & Pardo, "Mathematical Models", *supra* note 82; Ronald J. Allen & Michael S. Pardo, "Probability, Explanation and Inference: A Reply" (2007) 11 Int'l J. of Evidence & Proof 307 [Allen & Pardo, "Probability"]; Pardo, *supra* note 119.

[174] Allen & Pardo, "Probability", *supra* note 173 at 315.

[175] *Ibid.* at 316.

[176] Jonakait, *supra* note 109 at 347.

[177] See also Callen, "Kicking Rocks", *supra* note 81 at 443; John Leubsdorf, "Stories and Numbers", Comment, (1991) 13 Cardozo L. Rev. 455 at 458.

[178] Ronald J. Allen, "A Reconceptualization of Civil Trials" (1986) 66 B.U.L. Rev. 401 at 432-34. Compare Allen & Pardo, "Probability", *supra* note 173 at 316.

ceptable alternative scenarios to those posed by the parties.[179] Otherwise, fact-finding might not be as accurate as it could be. Parties will, after all, propose narratives that are untrue, sometimes because the truth is unhelpful, and sometimes because they simply do not know what happened. At the very least, parties have incentives to propose the narrative that favours their interests. Legal fact-finders should be free to accept any narrative that makes sense of the evidence, even if it means accepting their own account rather than accepting one party's version of events or striking a compromise between the parties' competing versions of events. Because any conclusion by a fact-finder that contradicts her own judgment regarding the forensic possibilities lacks epistemic justification, justice requires a fact-finder to reject any account that simply does not *sound* right.[180]

However the explanations are constructed, the essential idea remains that the parties tender evidential sources, whose probative value depends on the strength of these explanations that they support.[181] Determining the strength of the respective explanations is a matter of asking not only which inferences are reasonably supported by the evidence, but also whether the facts are compatible with one or more hypotheses. As Allen and Pardo have explicated:

> An item of evidence is relevant if it is explained by the particular explanation offered by the party tendering the evidence, assuming the explanation matters to a fact of consequence to the substantive law. The probative value of this evidence will depend on the strength of the pertinent explanation: the more it is explained, the more probative; the less it is explained, the less so. The strength of the desired inference will depend on all the other relevant evidence and any competing (contrasting) explanations.[182]

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[179] I am presupposing here that where a judicially constructed account favours the plaintiff, such an account can reasonably be said to fall within the factual scope of the plaintiff's pleadings. Otherwise, as a matter of natural justice, the defendant cannot be liable, since she has not had the opportunity to know the case to be met.

[180] See also Allan Beever, "Cause-in-Fact: Two Steps out of the Mire" (2001) 51 U.T.L.J. 327 ("the findings of a court should not be inconsistent with the laws of nature or of logic" at 344).

[181] Tillers, *supra* note 47 at 917, n. 59:

> The judge, when inquiring into the relative strength of [a particular hypothesis against a competing hypothesis], is not a scientist trying to determine which general laws are most strongly supported by the available [statistical] data. The judge typically asks which factual hypotheses are most strongly supported by the evidence in the case.

[182] Allen & Pardo, "Probability", *supra* note 173 at 317.

As Wright expresses it, "we cannot infer that the causal law underlying the causal generalization also has been instantiated unless we can rule out competing causal generalizations."[183] Here again, the reference point must be the evidence put before the fact-finder.[184]

Of course, there is a circularity to IBE in that the explanation and the underlying evidence are mutually reinforcing.[185] The evidence under consideration justifies the belief that the explanation is correct, while the explanation is used to clarify the evidence. As Allen and Pardo have demonstrated, however, scientific hypotheses are also circular in that they are mutually reinforced by the same phenomena they seek to explain.[186] Moreover, this understanding of the circular structure of juristic proof has the advantage of being able to aggregate the evidence in a way that accounts for actual cognitive capacities and processes, unlike Bayes's theorem. Potential explanations are considered in light of new evidence in a manner that accords with a legal fact-finder's provisional assessment of the "original" evidence. This provisional assessment, like the Bayesians' prior probability, will not be expressed in statistically reliable terms. My claim is not that inference causation is without problems, but that it is reflective of the epistemology and the (relatively) relaxed threshold of legal fact-finding. Hence, for juristic purposes, it is normatively superior to slavish adherence to scientific fact-finding.

Inference causation's superiority can be maintained, however, only if IBE's process of constructing and comparing narratives is undertaken with reference to the evidence, free of idiosyncratic value judgments. While critics of IBE (or of inference causation generally) may be suspicious of the inherent risk that a legal fact-finder might fudge cause-in-fact on emotivist grounds, that risk is an unavoidable concomitant of the epistemology of legal fact-finding. To reduce that risk, one can scrutinize judgments to ensure that the underlying factual conclusions are oriented

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[183] Wright, "Bramble Bush", *supra* note 31 at 1051.

[184] Wright adds:

> [P]articularistic evidence can negate the instantiation of one of the abstract elements in a competing causal generalization or lower the *ex post* probability that it was instantiated, thereby eliminating the competing causal generalization or lowering the *ex post* causal probability associated with it. On the other hand, particularistic evidence can support the competing causal generalization by establishing that one or more of the abstract elements in the competing causal generalization was actually or probably instantiated (*ibid.*).

[185] Michael S. Pardo & Ronald J. Allen, "Juridical Proof and the Best Explanation" (2008) 27 L. & Phil. 223 at 233 [Pardo & Allen, "Juridical Proof"].

[186] *Ibid.* at 233 ("The law of gravity explains why everyday objects fall and the speed at which they do so; these observable events justify belief in the accuracy of the theory under ordinary conditions").

toward the evidence. Assuming that sources of evidence and inference are dual bases for conclusions about past events,[187] evidentiary sources must be taken seriously because they immunize the process from pure caprice.

What happens, however, when both parties offer improbable explanations? In this event, the solution advanced by Allen and Pardo drifts from the legal imperative of veritism: "If both parties offer poor explanations, jurors should find for the better of the two parties' explanations (unless they can construct a better one for themselves, based on the evidence they have heard)."[188] More recently, they have explained, "[T]he key point is the comparative aspect of the process. A verdict will (and should) be rendered for the *better* (or best available) explanation, whether one of the parties' or another constructed by the fact-finder."[189] The sole reference point, according to Allen (here writing alone) is "the commitment to rationality."[190] A verdict is therefore entered for whichever party offers the more plausible account, however implausible it may be, and irrespective of whether it satisfactorily accounts for the totality of the evidence at trial.[191]

This solution is deeply flawed. As I have already pointed out, legal fact-finding occurs within a range below a total probability of {1.0}. A court will never have before it all the explanatory hypotheses; thus all the known possibilities, taken together, will never add up to a total probability of {1.0}. The legal fact-finding challenge is not, then, to ensure that the account chosen in aggregate adds up to {1.0}. It remains necessary, however, for the account to meet a threshold of probability. The problem with Allen and Pardo's solution—that we infer to the best explanation, even if that explanation is not even likely to be true—is that it does not conform, or at least does not *necessarily* conform, to the legal imperative of meeting a probability threshold. I have attempted to show that inference causation is not only immanent in a particular process of rational reasoning, but is also normatively desirable because it is veritistic. It takes seriously the reference point of evidence, albeit subject to the inherently uncertain civil standard of proof that legal fact-finders apply. Inference causation is therefore insufficient to form the substance of an inference of fact with an

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[187] Jerome Frank, *Courts on Trial: Myth and Reality in American Justice* (Princeton: Princeton University Press, 1950) at 80 (the trial process involves "an intelligent inquiry" based on the evidence).

[188] Allen & Pardo, "Probability", *supra* note 173 at 316.

[189] Pardo & Allen, "Juridical Proof", *supra* note 185 at 238 [emphasis in original].

[190] Allen, "Factual Ambiguity", *supra* note 76 at 629.

[191] Allen, "Batting Averages", *supra* note 133 at 1093. Jolowicz makes a similar proposition to the effect that the legal fact-finder need only be satisfied that there is enough evidence to rule out that a particular proposition is not *in*correct (*supra* note 68 at 518-19).

explanation that is merely the most easily justified in reference to the inferential criteria. The fact-finder must view the chosen explanation not only as a rational explanation or the best among several possible rational explanations, but also as a *probable* account of the linkage (or absence thereof) between the defendant's negligence and the plaintiff's suffering. In short, IBE ought to be IBPE: inference to the best *probable* explanation.

What if the explanations are equally good (or bad)? Again, Allen and Pardo offer a method of deciding that, with a qualification, is acceptable: "If the explanations are so bad (or good) that the jurors cannot decide between them, then the decision should go against the party with the burden of persuasion on the issue."[192] It follows from this method that the judgment should go against the party with the burden of persuasion not only when all explanations are equally bad, but also when they are unequally bad, yet still bad enough that none of them meets the threshold of probability. If an explanation is not even likely to be true, it must be rejected.

To be found liable, the defendant must have somehow increased the risk to the plaintiff under circumstances that allow us to infer that he *probably* caused the plaintiff's suffering—that is, under circumstances that allow us to compensate for our lack of knowledge of whether causal mechanisms were actualized in a particular case by applying our knowledge of a correlation between risk and suffering.[193] But what are those circumstances? More specifically, what are the criteria that tend to make one particular narrative more likely to be true than its competitor, thereby making an inference of cause-in-fact more reliable than its negation? A complete answer is impossible. If Wright's observation that cause-in-fact is a "complex and subtle" concept that "long has resisted efforts to articulate a precise definition"[194] is correct, it follows that a Rosetta stone decrypting the cognitive processes by which "the mind can reassure itself"[195] in determining cause-in-fact must be even more elusive. Evidence theorists and others have postulated various (and occasionally inconsistent) factors, including simplicity,[196] consistency,[197] coherence or consil-

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192 Allen & Pardo, "Probability", *supra* note 173 at 316.

193 See text accompanying note 157.

194 Wright, "Causation", *supra* note 114 at 1826.

195 Weinrib, "A Step Forward", *supra* note 52 at 523.

196 Allen & Callen, "Juridical Management", *supra* note 81 at 28 (reference to Occam's Razor); Allen & Pardo, "Probability", *supra* note 173 at 315.

197 *Ibid.*

ience,[198] "coverage",[199] "uniqueness",[200] and the temporal association between risk and suffering.[201] Some of these qualities have been emphasized by Pennington and Hastie, whose work has demonstrated that, as an empirical matter, jurors appear to focus on coherence, completeness, and uniqueness in selecting the preferred narrative.[202] David Danks, a computational cognitive scientist whose work involves developing models to predict linkages between causal observations and inference, has emphasized *inter alia* the temporal association between risk and suffering.[203] Epidemiologists have also devised criteria for when an inductive leap from statistical association to causation might be justified, including some of the foregoing, including temporality.[204] "Temporal precedence" of the risk relative to the suffering is also emphasized by computer scientist Judea Pearl and engineer T.S. Verma as being significant and possibly necessary for linking statistical association and causation, although they caution that, on its own, temporal precedence may be insufficient to distinguish genuine cause-in-fact from spurious associations caused by unknown factors.[205]

Temporal precedence suggests an explanation for the divergent treatment of the respective plaintiffs in *Snell* and in the House of Lords decision in *Wilsher*,[206] the case that Justice Sopinka relied on (in addition to *McGhee*) as an authority for inference causation. In *Wilsher*, the premature infant, while only hours old, was negligently oxidized through his umbilical vein instead of an artery, resulting in his being supersaturated

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198 Coherence or consilience refers to the absence of internal contradictions, whether with regard to elements of the narrative or the evidence found to be true (*ibid.*). See also Cohen, "Should a Jury", *supra* note 62 at 476; Burns, "Some Realism", *supra* note 152 at 753; Stein, "Refoundation", *supra* note 91 at 312 (refers to "cogency", although this is tautological, since a factor is by definition "cogent" as it renders the truth of a conclusion more probable).

199 "Coverage" refers to the extent to which *all* the evidence is explained by the narrative. See Burns, "Some Realism", *supra* note 152 at 753.

200 "Uniqueness" refers to the absence of a plausible competing narrative (*ibid.*).

201 Judea Pearl & T.S. Verma, "A Theory of Inferred Causation" (Paper presented to the Second International Conference on the Principles of Knowledge Representation and Reasoning, Cambridge, Mass., April 1991) [unpublished]; Danks, *supra* note 97 at 18; Wright, "Bramble Bush", *supra* note 31 at 1014.

202 Pennington & Hastie, "Cognitive Theory", *supra* note 97.

203 Danks, *supra* note 97 at 18.

204 Miller, *supra* note 87 at 547, citing Sir Austin Bradford Hill, "The Environment and Disease: Association or Causation?" (1965) 58 Proc. R. Soc. Med. 295 (listing nine criteria). See also Mervyn Susser, "The Logic of Sir Karl Popper and the Practice of Epidemiology" (1986) 124 Am. J. Epidemiology 711.

205 Pearl & Verma, *supra* note 201.

206 *Supra* note 18.

with oxygen. From one week to nearly six weeks after birth, the plaintiff was monitored negligently; as a result, he was again exposed to dangerously high levels of oxygen. The plaintiff subsequently developed retrolental fibroplasia (RLF), resulting in blindness. While RLF could have been caused by the overoxydization, it was likely (but not certain) that the plaintiff suffered from one or more of five possible conditions, any of which might have caused RLF on its own. In the House of Lords, Lord Bridge made the observation that the majority in *McGhee* had concluded that it was a legitimate inference of fact that the defenders' negligence had materially contributed to the pursuer's injury.[207] On the facts of *Wilsher*, however, it was not possible to make that inference.[208]

Why were there different outcomes as to whether it was possible to judge where the balance of probabilities lay in *Snell* and *Wilsher*? Although the reasoning in both cases is peremptory, the facts and outcomes suggest that the temporal association between the defendant's risk and the plaintiff's suffering may have been seen as significant. In *Snell*, we are not told how long the plaintiff had suffered with the pre-existing sources of risk, but given her advanced age, it is likely that she had suffered from them for a substantially longer period of time than the few hours of lifespan that preceded the negligent treatment of the plaintiff in *Wilsher*.

In considering the factor of temporal association, then, a legal factfinder might be less reluctant to infer a causal link from facts resembling those in *Snell* than she would be from those in *Wilsher*. In *Snell*, perhaps sufficient time had passed since the onset of the pre-existing sources of risk for the temporal association between the defendant's negligence and the plaintiff's blindness to support a finding of cause-in-fact. Even if the temporal association did not support a definitive causal link, it might have still been possible to conclude that the facts of *Snell* were *more* suggestive of a causal link than those of *Wilsher*, where there was no case history and therefore no information about whether the pre-existing sources of risk had ever become symptomatic.

I do not, however, intend to suggest that the criteria for inference causation can be reduced to temporal association, or even to any of the other criteria that I have mentioned. Nor do I propose to consider in this paper the individual or collective strengths and weaknesses of these criteria. If the cognitive dynamics surrounding proof are complex, then debates over

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[207] *Ibid.* at 566. Lord Bridge's observation was later rejected by a majority of the House of Lords in *Fairchild* (*supra* note 29).

[208] Moreover, Lord Bridge held that the trial judge wrongly applied the test for causation and ordered a retrial.

the criteria according to which those dynamics support inferences of proof are even more so. The work of evidence scholars like Allen has led to doubts about the feasibility of describing or reproducing those processes of cognitive dynamics.[209] Moreover, efforts to borrow from the insights of other disciplines inevitably suffer from "severe problems of communication," not only because of mutual inaccessibility but because of divergent understandings of what is relevant: "What is viewed as interesting or vital in one discipline may be viewed as tedious and boring in another."[210]

I can only note that these criteria might usefully serve as qualities against which the narratives constructed from the evidence can be measured, thereby reconciling the veritistic reference point of the evidence with the epistemology of legal fact-finding. Briefly put, these criteria may contribute to what H.L.A. Hart and Tony Honoré describe as "special cogency" in the evidence.[211] This statement might invite the objection that such special cogency is not enough because it still allows fact-finders to fudge cause-in-fact. This objection, however, falls flat, and not merely because of the need for finality in adjudication or the unavoidably inferential nature of legal fact-finding. Complaints about fudging also fail because they are grounded upon the dubiously pessimistic assumption that legal fact-finders do not act in good faith by observing the ethical imperative of applying good *judgment* to the evidence. Judgment, as Anthony Kronman reminds us, is not the same as intuition:

> If judgment is conceived of as a process of reflection followed by a moment of intuitive insight, then our assessment of the soundness of a particular judgment can never depend on the reasons given to support it, since ... [its quality] will be a function of its intuitive brilliance and originality and these are qualities that, by assumption, no reasoned argument can express.[212]

This conclusion is wrong because for good judgment to be seen as such, it must provide not only insight but also a compelling account. In other words, judgment's "argumentative dimension" distinguishes it from intuition,[213] bringing it within the category of what Hart described as "charac-

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209 MacCrimmon, "Common Sense", *supra* note 1 at 1436-37. See also Mirjan Damaška, "Truth in Adjudication" (1998) 49 Hastings L.J. 289 at 292.

210 MacCrimmon, "Common Sense", *supra* note 1 at 1438.

211 Hart & Honoré, *supra* note 31 at 422.

212 Kronman, *supra* note 71 at 849.

213 *Ibid.* at 850.

teristic judicial virtues" that judges should use in cases requiring discretion.[214]

Justly applied, then, IBE is no more an instance of intuition than it is of deductive, scientific reasoning. Rather, it entails drawing and ultimately justifying a factual determination, including one of cause-in-fact. IBE requires simply that a legal fact-finder "give each alternative its due" and "entertain all the possibilities by feeling for himself what is most attractive in each."[215] In the end, consigning cause-in-fact to a judgment call, literally speaking, should not leave an observer in the dark about why cause-in-fact is or is not found in a given instance. Legal fact-finders must be able to offer some rational explanation that earns public acceptance of the factual determination being made. For example, the temporal association between the defendant's negligence and the plaintiff's blindness in *Snell*, combined with the prior asymptomology of the pre-existing sources of risk, might offer a rational, coherent, and deliberative (and therefore acceptable, if not universally agreed upon) grounding for a causal link.

Conclusion

Critics of inference causation may dislike its lack of determinacy, but indeterminacy is a plainly unavoidable concomitant of legal fact-finding, not a defect in inference causation. The mere fact that inference causation leaves open an opportunity for substituting emotivist fudging for good-faith, deliberative fact-finding is, on its own, a feeble indictment; tort law is replete with opportunities to fudge—on the "reasonableness" of the defendant's conduct, on the "closeness and directness" of her relationship in law to the plaintiff, and on the "foreseeability" of the suffering. The alternative espoused by critics of inference causation—relying upon scientific fact-finding, which operates at a more severe threshold—has been shown to be untenable. Moreover, critics' insistence upon probabilistic evidence connecting risk with suffering has obscured the mutually distinct epistemologies of legal and scientific fact-finding. In the end, even though encouraging legal fact-finders to confine inference causation to the "best probable explanation" leaves room for indeterminacy, it may be the closest we can come to facing epistemic reality without falling into emotivist error.

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[214] Hart specifically listed among such virtues "a concern to deploy some acceptable general principle as a reasoned basis for decision": H.L.A. Hart, *The Concept of Law* (Oxford: Oxford University Press, 1961) at 200.

[215] Kronman, *supra* note 71 at 853.