Is judicial proof of facts a form of scientific explanation? A preliminary investigation of 'clinical' legal method

By Doron Menashe[*]
Senior Lecturer, Faculty of Law, University of Haifa, Israel

Abstract This article examines the relationship between judicial proof of facts and positivistic explanation in the natural and social sciences. Although these two forms of factual inquiry share evident similarities, it is argued that, on closer analysis, legal fact-finding is not even a proximate model of scientific explanation. Judicial proof more closely resembles clinical deliberations, such as those encountered in a medical context, than classical scientific method. Comparison with clinical practices should therefore promote understanding and serve as a basis for further research, critical appraisal and practical improvement of the processes of judicial proof.

'Proof' is a central term in evidential discourse. Use of this term is considered natural, and its meaning almost self-evident. This article focuses on the relationship between judicial proof of facts and positivistic explanation in the natural sciences and in approaches to social sciences that take the natural sciences as their model. Initially, certain similarities between judicial proof and scientific explanation will be noted. However, the

* Email: dmeashe@law.haifa.ac.il. I thank Professor Paul Roberts for his remarks which improved this article immensely. I am also deeply grateful to Shai Otzari LLB and Rabee' Assi LLM for research assistance.

DOI:1350/ijep.2008.12.1.285

main body of the article will reveal conceptual divergence and dissimilarity between the two modes of explanation and justification. In conclusion I propose the model of reasoning used in clinical practices (such as medicine) as a more appropriate candidate for comparison with the law. So far, that relationship has been neglected in legal scholarship.[1]

Some readers might question the very project of comparing judicial proof to scientific explanation and its justification, for it might seem that the two concepts are so clearly dissimilar that there is no basis for any interesting comparison. To be sure, the scientific method is more methodical than legal proof. Nonetheless, the law does attempt to make generalisations about reality (particularly human reality) and to use these generalisations to produce inferences about events. In similar fashion, science endeavours to discover generalisations about reality—laws of nature, etc.—and it, too, draws on them to make causal predictions, and sometimes postdictions about past events (such as supernovas, the extinction of dinosaurs, and so forth). Other commentators press this parallel further, suggesting that the use of generalisations in law precisely mimics the scientific method, but less successfully. On this view, legal fact-finding is a second-best approximation of science, within the limitations of law.[2] This intuition will be challenged in the following discussion.

This article focuses on the way in which the law creates generalisations about reality, for use in judicial proof; and on the way these generalisations ground specific factual inferences. My conclusion will be analytical, not semantic, in the tradition of analytical jurisprudence. Comparison with the model of scientific explanation is intended to serve as a tool for the illumination and clarification of the concept of judicial proof. Better understanding of judicial proof should serve as a basis for further research, critical appraisal and practical improvement of the processes of judicial proof. Comparison with clinical practices can also generate new ideas and fruitful contrasts. Whilst certain applications will be suggested by way of illustration, it is only possible within the confines of a single article to present a preliminary theoretical analysis.

1 J. H. Wigmore, *The Science of Judicial Proof as Given in Logic, Psychology, and Experience and Illustrated in Judicial Trials*, 3rd edn (Little, Brown: Boston, 1937). See D. H. Kaye, 'Proof in Law and Science' (1992) 32 *Jurimetrics Journal* 313; L. Loevinger, 'Standards of Proof in Science and Law' (1992) 32 *Jurimetrics Journal* 327.

2 See Kaye, above n. 1; J. D. Jackson, 'Two Methods of Proof in Criminal Procedure' (1988) 51 MLR 549, 556–7.

The similarity between judicial proof and scientific explanation

Before attempting to identify points of similarity and difference between 'judicial proof' and 'scientific explanation', these key concepts must be clarified.

Wigmore defines 'proof' in the legal context as 'the persuasive operation of the total mass of evidentiary fact as to a probandum'.[3] The transition from 'evidentiary fact' to the event to be proven (probandum) comprises two stages. First, an inference is made, based on the evidence brought before the court or based on the judge's life experience (the 'data'), to arrive at intermediate factual generalisations. Such generalisations may be divided into two categories: those that originate in, and are confined to, a specific case (derived from the evidence submitted in that case); and those that are used repeatedly in multiple cases, and are rooted in life experience (usually these are generalisations that concern human behaviour). The second stage of the transition, proceeding from the evidence to a decision about the event at hand (the 'postdiction', one might say), is based on those generalisations permitting inferences to be drawn from further evidence to ultimate conclusions. This article is concerned with the first of these two stages.

There is no longer a consensus among philosophers of science regarding the nature of scientific explanation. This article adopts Hempel's deductive-nomological[4] model of explanation, alongside its justificatory twin: Hempel's hypothetico-deductive model of confirmation (with an explicit requirement of causality).[5] It has been said that '[a]lmost everything written on the nature of scientific explanation in the last thirty-odd years derives directly or indirectly from [Hempel]'.[6] Unless one accepts an extreme relativist philosophy of science, according to which 'anything goes',[7] nothing turns on this selection for present purposes. Scientific method is conventionally broken up into four basic components: (a) observations; (b) hypotheses, i.e. scientific explanations of the findings of

3 Wigmore, above n. 1 at 9.

4 C. G. Hempel and P. Oppenheim, 'Studies in the Logic of Explanation' (1948) 15 *Philosophy of Science* 75 (reprinted C. G. Hempel, *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science* (Free Press: New York, 1965)); C. G. Hempel, *Philosophy of Natural Science* (Prentice Hall: Englewood Cliffs, NJ, 1966).

5 This explicit requirement is apparently absent from the model presented by Hempel, who held something of a Humean approach to causality—i.e. causality is seen as an expression of regularity, of the very fact that a law is involved: Hempel, above n. 4 at 360.

6 W. C. Salmon, *Four Decades of Scientific Explanation* (University of Minnesota Press: Minneapolis, 1990) ix.

7 See K. P. Feyrabend, *Against Method* (New Left Books: London, 1977); K. P. Feyrabend, *Science in a Free Society* (New Left Books: London, 1978).

the observations; (c) predictions based on the hypotheses; and (d) experiments to test the predictions. New observations resulting from experiments designed to test predictions may serve as the basis for repeating the cycle.

Systematic testing of hypotheses patently does not have a direct analogue in the law. And yet, it seems that a certain similarity may be discerned between the elements of judicial proof, as characterised above, and at least the first three elements of scientific method. The most prominent similarities between scientific explanations and judicial proof of facts include: (a) a shared object of examination, the empirical world; (b) the use of inductive methods that cannot provide absolute certainty; and (c) insistence on a causal account linking evidence and proof, which extends beyond mere statistical correlations. Let us consider each aspect of the apparent similarity between scientific explanation and legal fact-finding more carefully.

The object of examination: the empirical world

In both science and law the object to be examined is the world of empirical phenomena. The purpose of the examination also seems broadly similar: scientists as well as courts strive to understand empirical reality, to reveal its patterns and identify causal laws. To these ends, both science and the law must create generalisations that can serve as the basis for predictions or 'postdictions' (conclusions about facts).

The use of inductive methods and postulation of theoretical entities

Both judicial proof of facts and scientific explanation apply inductive logic. This involves the discovery and formulation of broad arguments intended to apply to an unlimited set of occurrences, on the basis of findings obtained from a finite number of experimental observations. Moreover, if we look more closely at the structure of the proofs establishing facts in law and in science, a stronger parallel can be seen.

Empirical observation underpins the scientific laws that 'When placed in a Bunsen flame, sodium salt turns the flame yellow', or that 'Blue litmus paper dipped into acid changes its colour'. Similarly, judges make probabilistic assessments which reflect their personal and judicial experience,[8] treating these as valid generalisations regarding human behaviour. For example, if during the course of the trial a witness departs from her previously incriminating version and gives

8 See, e.g. *Martin* v *Osborne* (1936) 55 CLR 367 at 375, in which Dixon J refers to 'the probability or increased probability, judged rationally upon common experience'.

testimony exonerating the defendant, the court may apply the generalisation: 'If a witness retracts an earlier statement, experience suggests that she generally does so, not to correct a mistake, but for reasons that have nothing to do with the truth'. This inductive generalisation may postdict judicial assessments of the reliability of the evidence to which it applies.

Philosophers of science like Hempel and Quine have pointed out that the prevailing patterns of scientific explanation do not involve simple enumerative induction,[9] but rather belong to patterns of explanation that rely, in a more sophisticated way, on the principle of reasoned induction.[10] These patterns overcome the chief weakness of enumerative induction, which by its very nature cannot be used to distinguish between causal laws and mere accidents or coincidences.[11] Thus, Hempel proposed that scientific explanations have a deductive-nomological nature.[12] Briefly, in this explanation pattern, the scientific theory is a hypothesis or group of hypotheses that typically presuppose certain 'theoretical entities'[13] that cannot be directly observed.[14] The hypotheses explain empirical observations[15] and can be used to infer reliable predictions, either on their own or with the help of laws already established. At least part of the justification for continuing to accept hypotheses—and for eventually deeming them

9 In enumerative induction, the weight of an inference is considered to be a function of the number of times the phenomenon has been observed in the past. For example, the induction that 'The sun will rise tomorrow in the east' is considered very powerful, if not absolutely certain, since it relies on a vast number of past sunrises in the east, without a single counter-example ever being observed: see L. J. Cohen, *The Probable and the Provable* (Clarendon Press: Oxford, 1977) 352; I. Copi and C. Cohen, *Introduction to Logic*, 8th edn (Macmillan: New York, 1990) 363–4.

10 See also E. Nagel, *The Structure of Science* (Routledge & Kegan Paul: London, 1961).

11 Copi and Cohen, above n. 9 at 382–4.

12 See C. G. Hempel, *Philosophy of Natural Science* (Prentice Hall: Englewood Cliffs, NJ, 1966) 49–54; C. G. Hempel, *Aspects of Scientific Explanation* in Hempel, above n. 4 at 331–52; M. G. Farrell, '*Daubert* v. *Merrell Dow Pharmaceuticals, Inc.*: Epistemology and Legal Process' (1993–1994) 15 *Cardozo Law Review* 2183 at 2190. See also T. A. Brennen, 'Causal Chains and Statistical Links: The Role of Scientific Uncertainty in Hazardous-Substance Litigation' (1988) 73 *Cornell Law Review* 469 at 480; W. V. Quine, 'Main Trends in Recent Philosophy: Two Dogmas of Empiricism' (1951) 60 *Philosophy Review* 20 at 42.

13 On the ontological status of theoretical entities, see Hempel, above n. 12 at 77–82; Quine, above n. 12 at 42–3.

14 For example, electromagnetic waves, Newtonian forces of gravitation, various bodies of gas in kinetic theory, and subatomic particles in the atomic theory of material. None of these 'entities' is visible, even with the help of microscopes, etc.

15 This does not imply that empirical observations are 'objective' in the sense of preceding any theoretical commitment; that would be an overly simplistic view of scientific method: see N. Warburton, *Philosophy: The Basics* (Routledge: London and New York, 1992) 84. However, as long as we reject complete relativistic abandonment of the observation/theory dichotomy, this description of the logic of scientific explanations remains meaningful and comprehensible.

theories or even laws[16]—depends on their undergoing empirical tests and re-examinations of the predictions they imply.[17]

Does an explanatory pattern with similar characteristics also apply to judicial proof of facts? I believe it does. In important ways, legal reasoning mimics deductive-nomological explanatory structures. As one illustration, consider a case in which a judge must decide on the applicability of the *res gestae* exception to the hearsay prohibition. The judge might hold that an injured accident victim is more likely to experience anxiety, confusion and a diminished capacity for fabricating testimony than an uninjured bystander. In doing so, the judge posits a psycho-juridical theory predicated on a general hypothesis about the factors contributing to the ability of people involved in an accident to manipulate evidence. This theory presumably draws on personal or forensic experience, as well as on general considerations of logic and common sense. The theory presupposes, or at least appears to presuppose, abstract mental entities like 'confusion' and human capacities like the ability to manipulate evidence, from which it draws, more or less deductively, conclusions regarding the facts of the case.

Causality

If we examine the last example more closely, the similarity between scientific explanation and judicial proof of facts becomes even clearer. In both areas we are dealing with causal explanations.[18] Purely statistical correlations between phenomena lack any dimension of causal explanation. Any inference or prediction based on a distribution of random variables cannot, as a rule, serve as judicial proof or as a scientific explanation[19] (apart, perhaps, from highly unusual cases, such as those in which the probability is near the extremes $p(x) = 0$ or $p(x) = 1$).[20] Thus, courts are usually reluctant to admit or rely on naked statistical

16 Copi and Cohen, above n. 9 at 422–3.

17 See B. Black, J. F. Ayala and C. Saffran-Brinks, 'Science and the Law in the Wake of *Daubert*: A New Search for Scientific Knowledge' (1994) 72 *Texas Law Review* 715 at 755; J. F. Ayala, 'Biology as an Autonomous Science' (1968) 56 *American Scientist* 207; B. L. Diamond, 'Scientific Method and the Law' (1967) 19 *Hastings Law Journal* 179 at 181.

18 Or, as Aristotle called them, 'demonstrative syllogisms': see R. Jeffrey, *Probability and the Art of Judgement* (Cambridge University Press: Cambridge, 1992) 203–12.

19 As shown, e.g. by L. Jonathan Cohen's well-known 'Paradox of the Gatecrasher': see Cohen, above n. 9 at 75.

20 Cf. Jeffrey, above n. 18 at 203–15; Hempel, *Philosophy of Natural Science*, above n. 12 at 58–9 (referring to 'certainty for practical purposes'). Excluding the extremities answers Glanville Williams' objection to the Gatecrasher Paradox, that if $p(x) = 0$ (no tickets were sold) the plaintiff stadium owner would rightly succeed in every case on a purely probabilistic basis: see Glanville Williams, 'The Mathematics of Proof' [1979] Crim LR 297.

evidence, such as raw epidemiological evidence. This is not a question of reliability: epidemiological evidence, for example, is often highly reliable at the level of statistical correlation. Nor does it only betoken an aversion to subjective probability assessments by judges or other fact-finders. On the contrary, objective probabilities could be employed in forensic fact-finding.[21] The 'causal-explanatory character' of judicial proof stems from the very nature of its investigation of factual findings and its anchoring of these findings in evidence.[22]

It is often said that all evidence must be statistical in some sense, for we can only understand the probative power of evidence through generalisations expressing the correlation between the information the evidence contains and the facts that are to be proved. But fact-finding in law also requires the demonstration of causal relationships, as cause or effect, with other evidence and with the facts in question. The causality involved in legal fact-finding concerns the relationship between the evidence and the direct and indirect facts in question (including facts regarding credibility).

The basic requirement of causality in legal fact-finding should not be confused with contemporary tort law doctrines such as evidential damage, compensation for lost chances, or market-share liability.[23] Whilst all of these doctrines are straightforwardly probabilistic, none of them relates to the concept of proof. They apply, rather, to the concept of liability, and function to widen the scope of tortious liability. As far as proof *per se* is concerned, the law's requirements are unchanged. The claimant must still establish an explanatory-causal relationship between the evidence and the head of tort in question. A mere statistical-probability correlation between the evidence and the lost chance of loss avoidance or recovery is not enough. Likewise, market-share liability is a method for calculating apportionment between defendants, not a new conceptual outlook on the proof of legal liability that dispenses with causal patterns of proof.

Insistence on causality crucially distinguishes both law and science from other ostensibly inductive theories or practices claiming to produce knowledge of empirical phenomena. Consider, for example, astrological explanation which purports to be inductive to the extent that it relies on past experience. Even if

21 M. Redmayne, 'Objective Probability and the Assessment of Evidence' (2003) 2 *Law, Probability and Risk* 275.

22 Cf. Wigmore, above n. 1 at 24, citing A. Sedgwick, *Fallacies: A View of Logic from the Practical Side* (1884) 270.

23 For discussion, see A. Porat and A. Stein, *Tort Liability under Uncertainty* (Oxford University Press: Oxford, 2001).

astrological claims are phrased in causal terms (for example, 'Your marriage is successful because Neptune was aligned with Mars on your wedding day'), and understood as such by those who make them, such explanations are entirely grounded in correlations between past phenomena. There is no general causal theory underlying general or specific astrological explanations or predictions, no account of *how* the heavenly bodies are supposed to influence human affairs. An explanatory-causal mechanism must be linked to existing theories and knowledge about the world. It cannot be assumed just because there is a correlation between phenomena. Astrology, unlike experimental science and the law, apparently does not even aspire to create a causal-explanatory mechanism of this kind.

The divergence between judicial proof and the scientific explanation

Despite these superficial similarities between judicial proof and scientific explanation, the intellectual activity involved in judicial proof of facts, on the basis of legal evidence, should not be considered 'scientific'. This section identifies four key distinguishing attributes: (a) judicial proof aspires to individual generalisations; (b) law involves a 'softer' form of causality, which cannot be depicted as a matter of necessary or sufficient causes; (c) the distinctive use of analogy in judicial proof; and (d) the absence of a 'strong' separation between discovery and justification in law.

The law's aspiration to individual generalisations

Let us begin with a simple distinction: While science attempts to form predictions anticipating the future, judicial proof of facts is primarily concerned with postdictions regarding the past. In and of itself, this disparity does not affect the rules of inductive logic or probability axioms, since nothing prevents their application as predictive tools in relation to incidents that have already occurred but are unknown.[24] Science, too, sometimes looks to the past and applies its generalisations there. However, the distinction between predictions and postdictions is important in a different sense. A legal postdiction centres on a single incident that happened in a specific time, place and manner. Science, in contrast, usually seeks to provide a general interpretation of empirical phenomena that is unlimited, as far as possible, to circumstances of time, place, and other contingent constraints.[25] It strives to shed light on the particular

24 See R. M. Eggleston, *Evidence, Proof and Probability*, 2nd edn (Rothman: Littleton, 1983) 25–6.

25 See S. Haack, 'Inquiry and Advocacy, Fallibilism and Finality: Culture and Inference in Science and the Law' (2003) 2 *Law, Probability and Risk* 205–6. See also *Daubert* v *Merrell Dow Pharmaceuticals Inc.* 125 L Ed 2d 469, 481 (1993) in which Justice Blackmun describes science as 'an exhaustive search for cosmic understanding'.

through the general[26] and so is generally uninterested in unique incidents unlikely to be repeated.[27]

Furthermore, the assumption latent in scientific activity is that the particular can always be reduced to the more general. Even where uncommon events are concerned, like certain geological processes, supernovas, or the mass extinction of the dinosaurs, science assumes that a general explanation in terms of necessary causes should apply. This inclination is reflected in the meta-theoretical principle that, among rival theories with equal explanatory power, the more general and less circumscribed theory is to be preferred;[28] as well as in the manner in which inductions are actually made in scientific thought—that is, by the use of a similar cognitive preference.[29]

In contrast, the law's theoretical aspirations, in a sense, run in the opposite direction. The law seeks to discover the 'exceptional', the distinguishing details of a concrete event,[30] and to anchor them in 'personal' evidence,[31] that is, evidence that relies as far as possible on individual generalisations that pertain to the litigant, the type of act involved and the circumstances of the events in question.[32] The law must aspire to distinctive evidential details. It cannot make do with broad scientific generalisations, the validity of which is unlikely to ensure their relevance and probative power when applied to a specific case with unique characteristics. Often, the quest for distinctions is so powerful that it can lead judges to

26 This does not imply that science seeks to elucidate the strange and unknown in terms of the known. On the contrary, sometimes science clarifies what is already known—e.g. the regular, cyclical nature of day and night, the progress of the seasons, thunder and lightning, or heavy bodies' tendency to fall when their support is removed—through the unknown. As Hempel writes, the aim of scientific explanation is 'an objective kind of insight that is achieved by a systematic unification, by exhibiting the phenomena as manifestations of common underlying structures and processes that conform to specific, testable, basic principles': Hempel, above n. 12 at 83.

27 See Loevinger, above n. 1.

28 This methodological principle is known as Ockham's razor or the principle of parsimony. See, e.g., http://plato.stanford.edu/entries/simplicity, accessed 28 October 2007, and references noted therein.

29 Cf. N. Goodman, *The New Riddle of Induction: Problems and Projects* (Bobbs-Merrill: Indianapolis, 1972).

30 See Justice Blackmun's statement in *Daubert* v *Merrell Dow Pharmaceuticals Inc.* 125 L Ed 2d 469, 481 (1993) that litigation concerns 'particularised resolution of legal disputes'; Farrell, above n. 12 at 2204. This is also the basis of L. Jonathan Cohen's theory of inductive probability: see Cohen, above n. 9.

31 This is seen, e.g. in legal rules of relevancy and standards of proof, which always pertain to the particularised facts of the instant case. Legal proof must rely on 'personal' evidence, i.e. individualised evidence concerning the parties and the circumstances of the matter at hand.

32 See A. E. Acorn, 'Similar Fact Evidence and the Principle of Inductive Reasoning: Makin Sense' (1991) 11 *Oxford Journal of Legal Studies* 63; Redmayne, above n. 21 at 280.

confine their findings solely to 'the special circumstances of the case'.[33] Statements of this nature cannot, however, be taken at face value. The very discussion of proof and inference, of law as an information system (albeit a relatively unsophisticated one), assumes some pattern of generalisation on which any inference must rely. Thus it seems that such judicial reservations are best interpreted as calls for judicial proof that is as specific as possible.

The disparate aspirations of science and law for particularised proof are also partly attributable to the absence of experimental method and systematic observation in judicial proof. Science, on the other hand, strives for broad explanations partly because the more generalised a hypothesis is, the more testable it is.

Causality in law is not a matter of necessary or sufficient causes

A second difference between judicial proof of facts and scientific explanation concerns the nature of causal relations within each realm. Law seeks causal explanations relevant to the application of juridical norms, and which accord with the cognitive categories, interests, and presumptions of legal discourse in general.[34] For example, suppose a court investigates the cause of a fire on the claimant's property, which the insurance company defendant contends was set by the claimant himself. In this case the court will not be interested in the necessary conditions for fires, such as the presence of oxygen in the air, or in any of the physical conditions sufficient for the fire in question to erupt. What the court must uncover is the event or action that, along with the ordinary background conditions, made the difference between the event happening and the event not happening. Simply put, the court must examine whether the cause of the fire was arson by the claimant, for the epistemological category the court is working with is 'legal liability'. The court will be satisfied if it finds that enough evidence exists to indicate that the fire was set by the claimant, without concerning itself with more distant causes along the causal chain. A detailed list of the personal or social precursors of the arson would be superfluous. Thus, causality in the law cannot be explained simply in terms of necessary or sufficient causes. Judicial proof does not, then, parallel causal explanations in the natural sciences,[35] nor in the social

33 See A. Scolnicov, 'On the Relevance of "Relevance" to the Theory of Legal Fact-Finding' (2000) 34 *Israel Law Review* 260.

34 According to Van Frassen's theory of constructivist empiricism, sensitivity to the inquirer's cognitive interests is a general quality of all explanations: see B. C. Van Frassen, *The Scientific Image* (Clarendon Press: Oxford, 1980).

35 See, e.g. Scolnicov, above n. 33 at 299. 'Discrimination' among causal factors characterises historical research as well, see H. L. A. Hart and A. M. Honoré, 'Causal Judgment in History and the Law' in W. H. Dray (ed.), *Philosophical Analysis and History* (Greenwood Press: Westport, 1966) 219; R. Taylor, *Metaphysics*, 3rd edn (Prentice-Hall: New Jersey, 1983) 86–7.

sciences to the extent that they adopt a natural science explanatory structure as their model.

Scientific explanations endeavour to discover necessary patterns and definite causal laws. While the social sciences often discover mere correlations rather than definite rules, this is not their objective. Even when the laws discovered are mere correlations, they are defined in a general statistical form. The model for positivist social science is still the natural sciences, even if in practice experimental methods are sometimes very difficult to extrapolate from the laboratory to the social world. Although likewise based on causality, judicial explanations make do with a 'softer' variety of causation, grounded in reasonableness. The factual generalisations that judges try to establish are informed by the evidence in the case and by their knowledge of the world. Usually, such generalisations apply only under 'normal' circumstances, i.e. in open-ended contexts with an unquantifiable structure or with only a general characterisation of cases presented as 'exceptions to the rule'.[36] Take, for example, a legal generalisation such as 'A suspect's refusal to participate in a line-up stems from his fear of being positively identified'. Whilst this may be a valid generalisation, it is patently not a universal law.

Presumptions, conceived as generalisations applicable to most relevant cases but which can nonetheless be refuted,[37] further illustrate the distinction between causality as a basis for juridical inferences and causation in scientific explanations. A scientific law posits an explanation involving a cause and its necessary effect, like the expansion of gas under heat or the boiling point of water. This is quite different from a legal presumption, such as the presumption that 'a person is generally aware of the consequences of her behaviour as far as its physical nature, the circumstances, and the possibility that certain natural results will ensue from it'.[38] From the outset, such presumptions are merely generalisations that apply to the majority of cases. The rebuttal of a legal presumption in a particular concrete case does not negate that presumption's general validity. On the contrary, the refutation of presumptions in concrete cases is part of the logic of presumptions in law.[39] The legal system does not subscribe to the (highly problematic) epistemological assumption that the very existence of a presumptive generalisation (of any kind) combined with the absence of contradictory evidence

36 Some argue that natural laws may adopt a similar logical pattern. So-called 'ceteris paribus laws' remain true despite the existence of counter-examples that would be considered refutations of universal generalisations: see N. Cartwright, *How the Laws of Physics Lie* (Clarendon Press: Oxford, 1983); S. Smith, 'Violated Laws, Ceteris Paribus Clauses and Capacities' (2002) 130 *Synthese* 235.

37 See E. Ullmann-Margalit, 'On Presumption' (1983) 80 *Journal of Philosophy* 143.

38 This is the presumption of awareness: see C.A. 3158/00 *Magidish* v *The State of Israel* 54(5) PD 80 at 85.

39 Ullmann-Margalit, above n. 37.

in a particular case (whatever the circumstances) necessarily implies that the presumption is valid in that case. A presumption of fact typically relies on inductive logic. But the generalisations of inductive logic can be rebutted by the facts of the instant case.

The use of analogy

Analogy is perhaps the most common inductive pattern employed in judicial proof of facts. By 'analogy' I mean a logical pattern of inference, rather than metaphorical allusion for the sake of example, illustration, or comparison. Analogy in this sense is used to draw conclusions and to make assessments on the basis of past experience; to learn from the known about the unknown,[40] as with induction in general.

There are significant differences between the pattern of analogy in law and the 'stronger' inductive pattern known as enumerative induction, where the antecedents are identical with the conclusion that must be inferred (and the power of such inductions therefore depends on the number of antecedents). First of all, conclusions inferred from enumerative induction are more general.[41] While an enumerative-inductive generalisation usually relates to an infinite group of cases, an analogical argument may address a finite group of cases, or even only one additional case. A second difference is that analogy permits considerable flexibility in the required similarity between antecedents. Thus, analogy progresses not as a simple generalisation, but according to principles of relevance, similarity and distinction. Induction, in a scientific context, implies the need to construct experiments that isolate the relevant variables and thus keep them almost identical and unchanging. Analogy, on the other hand, has a more flexible character, and is satisfied by adequate similarity, considering the circumstances, between relevant antecedents and between the antecedents and the conclusion. Although it adopts an explanatory-causal form, analogy has no pretension to establish an all-encompassing causal-explanatory thesis regarding the entirety of the information contained in the antecedents.

40 See M. P. Golding, *Legal Reasoning* (Alfred Knopf: New York, 1984). In formal terms, argument by analogy proceeds in the following way:

Let the antecedents be:

(1) X, Y are entities with the common qualities P, Q;

(2) X has an additional quality R;

(3) P, Q are relevant qualities for the existence of quality R;

Conclusion: In the absence of conflicting characteristics, Y has quality R.

41 Copi and Cohen, above n. 9 at 381–2.

Extensive use of analogy in the law is linked to the aspiration to individual generalisations in judicial proof. Both features are correlated with the divergent cognitive interests of law and science. A preference for analogy also reflects the law's lack of two significant elements of scientific explanation—the experimental method and systematic observations.

Discovery and justification

A long tradition in the philosophy of science holds that the process and the manner in which a scientific discovery is arrived at are unimportant, as long as its validity has been confirmed. A hypothesis does not *per se* have to meet any standards of rationality. The history of science is packed with riveting accounts of discoveries made through personal-experiential insights, mystical or theological beliefs,[42] mistakes, nightmares, hallucinations or dreams.[43]

The grounds for separating the context of a particular discovery from the justification of its validity are fairly self-evident, and can be illustrated by a simple hypothetical example.[44] Suppose that a computer performs a random sampling of letters, digits, and ordinary mathematical symbols, creating a series of signs, separated intermittently by spaces. One day, the computer operator is amazed to discover that the computer output contains the entire formulation of Einstein's Theory of Relativity, including its mathematical formalisation. Obviously, the random generation of the theory does not constitute grounds for rejecting the theory's validity. It would be correct but irrelevant to argue that the probability of making such a chance discovery is infinitesimal (or more generally, that there is little probability of discovering valid theories by methods that science now considers 'irrational').[45] The question is not 'What is the probability of making a discovery using one method or another?', but rather: 'Assuming that a valid theory has been discovered, should it be rejected simply because it was discovered by fluke?' The answer is clearly negative. Moreover, the fact that a certain discovery was made under strange circumstances is not even a *prima facie* reason for rejecting a theory derived from it. There are other methods, independent of the

42 A. Koestler, *The Watershed: A Biography of Johannes Kepler* (Heinemann Educational Books: London, 1960).

43 The chemist Kekule reportedly discovered the structure of the benzene molecule in a dream: see Hempel, above n. 12 at 15–16. A better-known (if possibly apocryphal) example is the story of Isaac Newton sitting under an apple tree in Woolsthorpe, Lincolnshire, and being prompted to think about the force of gravity when an apple fell on his head.

44 For a similar example, see Z. Bechler, 'The Essence and Soul of Seventeenth-Century Revolution' (1987) 1 *Science in Context* 94.

45 To the contrary, strange methods of discovery can provide powerful impetus to creative thought, since they challenge prevailing institutionalised paradigms of classification. See also E. D. Bono, *I Am Right You Are Wrong* (Viking: New York, 1990) 51–3, 90–1.

history of a hypothesis's discovery, for examining the soundness of a scientific theory.[46]

How does this compare with judicial proof of facts? There is good reason to suspect that the 'Separation Thesis', differentiating discovery from justification, does not apply in the law, at least not in the strong sense it carries in science.[47] This appears to follow from the intrinsic importance ascribed to logic, rationality and morality in legal adjudication.[48] These elements underpin the justification of general inference structures and concrete factual determinations in law. The rationality of the fact-finding process, as a part of judicial procedure generally, is therefore seen as contributing to the justification of legal verdicts. Discovery and justification are fused in the law.

In scientific thought, it really does not matter at all how one arrives at a genuine discovery. It makes no difference, for example, if a new hypothesis was formulated in order to refute the theories of a despised rival. But a judge cannot decide a legal case on the basis of her affection for one party or dislike of another. Legal discovery is purposive and intentional, subordinating the process to some theory of the objectives of the procedure. In fact, the very concept of judicial proof assumes dependence on procedure, and judicial discovery is a central part of that procedure (whether or not the process involved is fully transparent to the fact-finder, or adequately articulated in a reasoned judgment).

The dependence of judicial proof on legal procedure imposes important constraints on judicial research undertaken in search of the facts. Such constraints are not characteristic of scientific research, and further serve to distinguish legal fact-finding from scientific explanation. First, legal procedure imposes temporal limitations on fact-finding, and demands conclusive results.[49]

46 Until a few decades ago, the separation of discovery from justification in science was accepted as almost self-evident, but has more recently been challenged by Thomas Kuhn's highly influential *The Structure of Scientific Revolution* (University of Chicago Press: Chicago, 1996). Also see, e.g. S. Jasanoff, 'What Judges Should Know about the Sociology of Science' (1992) 32 *Jurimetrics Journal* 345 at 349; T. F. Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists' (1983) 48 *American Sociological Review* 781.

47 See Z. Bankowsi, 'The Jury and the Reality' (1990) 11 *Law, Interpretation and Reality* 226; cf. R. Wasserstorm, *The Judicial Decisions* (Stanford University Press: Stanford, 1961).

48 See also R. J. Allen, 'A Reconceptualization of Civil Trial' (1986) 66 *Boston University Law Review* 479 (arguing that parties to civil procedure may opt for unorthodox evidentiary mechanisms, such as relying on raw statistical evidence, so long as they observe the fundamental principle that disputes must be settled rationally and logically).

49 See Kaye, above n. 1.

Secondly, the parties, as well as the judge, are constrained in their factual investigations and case preparation, in order to ensure timely verdicts. Thirdly, fact-finders in the common law tradition are bound by procedural arrangements that determine, among other things, the form in which information is presented to them. Common law judicial proceedings adopt an adversarial structure, and dictate that certain information is excluded from the trial on grounds of unfairness, bias, confusion, or to maintain procedural integrity.[50] The process of forming a judicial opinion is doubtless also a function of these procedural arrangements.[51] Fourthly, judicial process is necessarily a response to disputes that happen to be litigated, as distinct from a proactive, focused, meticulously planned investigation of all relevant facts and circumstances. Fifthly, legal procedure typically[52] obliges fact-finders to draw positive inferences on the evidence presented. They cannot defer their decision or conclude that the information available to them is insufficient. Sixthly, the conditions under which legal proceedings take place are often sub-optimal from a cognitive perspective, for example in maintaining alert and attentive fact-finders. Seventhly, judges in the common law tradition work with a given body of information, and largely depend on the litigants to provide it. Judges' opportunity to collect observations and to perform their own 'experiments' is quite limited, owing to limited time and resources. Above all, this limitation stems from the nature of judicial observation. A trial is a procedure that reconstructs specific events that occurred in the past, through testimony—i.e. reports of non-replicable observations—and through the application of general theories, the soundness of which cannot be corroborated during the inquiry. Much of the evidence presented in court is based on testimony whose reliability and applicability to the matter in question cannot be guaranteed in advance.[53] Eighthly, the law is a closed system of decision-making. There is no other judge or fact-finder, who is external to the legal system of trial and appeal, to whom litigants, witnesses, or anyone else can turn for a second opinion (setting aside special legal procedures allowing for external review).

50 See, e.g. Rule 403 of the US Federal Rules of Evidence, discussed by Haack, above n. 25 at 208. See also R. J. Allen and B. Leiter, 'Naturalized Epistemology and the Law of Evidence' (2001) 87 *Virginia Law Review* 1491 at 1502.

51 See Wigmore, above n. 1 at 47, citing S. Jevons, *The Principles of Science: A Treatise on Logic and Scientific Method*, 2nd edn (1877, reprinted 1907).

52 When information is regarded as insufficient, fact-finders may fall back on burden-of-proof rules. However, this very procedure exemplifies the difference between judicial proof and scientific explanation.

53 Hence the centrality of cross-examination in the common law tradition of adjudication, famously characterised by Wigmore as 'the greatest legal engine ever invented for the discovery of truth', despite the absence of solid scientific or experimental grounds demonstrating its efficacy, see J. H. Wigmore, *Treatise on Evidence* (Chadbourn rev. 1974) § 1974.

No such procedural limitations constrain scientific research, which is based on an open-ended process of collaboration, transparency and peer review. The data that scientists work with are in the public domain, available to any qualified researcher. Scientists provide a wealth of detail when reporting their experiments, in order to enable other researchers to reproduce their experimental designs and test their results. The law, too, recognises a principle of publicity, but this principally entails passive observation by anyone who is not a formal participant. Another publicity rule requires that legal rulings be published, but this only allows general criticism, usually detached from the context of concrete inferences and decisions and based on incomplete information. The public nature of science is much stronger. Facts that are the subject of a scientific examination must be publicly available and open to rigorous examination by anyone.[54] In this sense scientific research is a collaborative and participatory exercise.[55]

The fact that judicial discovery is not detached from the justification of judicial findings does not, in and of itself, establish a lack of scientific validity, either in relation to general method or particularised findings. However, underlying law's emphasis on the rationality and non-arbitrariness of the process of judicial discovery is the absence of any external criterion, independent of the process itself, against which the correctness of factual findings and general inferences may be measured. This sets judicial proof apart from scientific explanation, for as Hempel observed, 'the nature of scientific argument is its ability to withstand the test of observation'.[56] Indeed, if there is a single characteristic that distinguishes between science and pseudo-science or metaphysics, it is exactly the testability and refutability of scientific hypotheses and theories.[57] External examination of theories and data is considered vital, even by approaches that question the very possibility of external empirical examination and refutation.[58] Even in relation to specific past events, the generalisations used by science to arrive at conclusions can be re-examined and retested.

Scientific theory and practice are distinct from systems that deal with naturally non-replicable and unrepeatable events, or those that insulate themselves in

54 See *Daubert* v *Merrell Dow Pharmaceuticals Inc.* 125 L Ed 2d 469, 481 (1993); Farrell, above n. 12 at 2203–4.

55 See Copi and Cohen, above n. 9 at 441–2.

56 Hempel, above n. 4 at 1.

57 See K. R. Popper, *The Logic of Scientific Discovery* (Hutchinson: London, 1959). Cf. *Daubert* v *Merrell Dow Pharmaceuticals Inc.* 125 L Ed 2d 469, 482–3 (1993).

58 Some assert that refutation does not mean refutation of a specific theory but rejection of a conjunction of theories—perhaps of all scientific knowledge as such: see, e.g. P. Duhem, *The Aim and Structure of Physical Theory* (Athenaeum: New York, 1962); Quine, above n. 12 at 37–42. This kind of refutation is, of course, relatively weak, though not uninformative.

advance against any attempt at refutation (or examination).[59] Nevertheless, it would be premature to ascribe to judicial proof a strong circularity. Judicial inferences are partially open to updated information flowing in from 'external' sources, such as expert witness testimony, scientific evidence, academic commentary and comparative law. Additionally, there is some, albeit limited, scope for informal feedback through judicial experience; for example, by testing judicial hypotheses against more or less dependable forms of proof (DNA, fingerprinting). These processes are vital for enabling the judicial system to process information in dynamic spheres of activity.

Whilst adjudication is therefore not devoid of learning mechanisms, they are flawed to the extent that updated information is partial, arbitrary, and strongly biased towards confirmation of existing data. An additional psychological constraint is the human tendency to 'lock on' to assumptions and refrain from investigating matters any further. Without the scientific ethos of learning from errors and systematically seeking refutations, legal fact-finding is in danger of 'spinning out of control'. Institutional and psychological constraints become mutually reinforcing. Indeed, a pivotal factor affecting the quality of organisational learning and information updating in the judicial system is its degree of openness to criticism levied by attorneys, scholars and scientists. Openness and criticism should find expression, not only in limited permissions to express differing positions or to state reservations, but in the creation of institutions whose essential brief is to be critical of orthodox practice.[60]

Judicial proof and alternative models of human knowledge—history and clinical practice

If judicial proof is fundamentally different from explanation and its justification in the natural and social sciences, might other fields of inquiry provide a better model? This section of the article first examines the parallels between judicial proof and research in the humanities, specifically historical inquiry, before concluding that clinical practice in medicine provides the closest analogy to legal fact-finding.

Comparison to the study of history initially seems promising, since both fields deal with events of the past. Professor Allen has indeed pointed to some lines of similarity between the epistemology of historiography and the epistemology of

59 See Popper, above n. 57.
60 See K. Popper, *The Open Society and Its Enemies* (Routledge & Kegan Paul: London, 1945).

judicial proof of facts.[61] But at least in relation to the process of creating and utilising generalisations, the differences between historiography and judicial proof are significant. Historiography goes beyond merely depicting past events, to seek a deeper level of understanding. Legal fact-finding is, by contrast, localised and relatively superficial. An illustration of this contrast can be found in their disparate approaches to motivation. Motives are often the central focus of historical studies, whereas the law is notoriously unconcerned with actors' motives *per se*. In law, motive functions at most as evidence that events transpired in a certain way.

This fundamental distinction between the cognitive interests of historiography and law also leads to different uses of generalisations and analogies. As law does not seek complete causal explanations, reasoning by analogy will often suffice. Not so in history. For example, the historical 'folly' (i.e. actions against the best interests of the actor) affords nice analogies, but it would not suffice for serious historiographical writing without comprehensive elucidation, as in Barbara Tuchman's *The March of Folly*.[62] In order to explain why the US betrayed itself in Vietnam, as Tuchman suggests, would it be enough to point out that the British also acted against their own best interests in their attitude toward the American Colonies? Or, to go further back, to recall that Rehab'am betrayed his own best interests in his treatment of the northern Israelite tribes? At most, such analogies supply an interesting basis for further research into the causes of these events. In the law, on the other hand, cases can be settled by the use of analogies. Historiography bears greater resemblance to law only at the margins, where it tries, detective-style, to solve particular mysteries ('cases'), such as whether or not Richard III murdered the princes in the Tower.[63]

Greater similarities can be found between judicial proof and clinical practices. Both areas of inquiry focus on specific cases and strive to reach particularised conclusions, not just to discover general patterns. Moreover, just as the law cannot leave questions unanswered for lack of evidence, clinical practices are limited by a similar practical constraint. This may be expressed in terms of Alex Stein's theory of risk allocation,[64] a function apparently shared by both law and clinical practices. When a doctor attempts to diagnose a certain illness, for example, the

61 R. J. Allen, 'The Nature of Juridical Proof' (1991) 13 *Cardozo Law Review* 373, 383–96. Also see D. Menashe and M. E. Shamash, 'The Narrative Fallacy' (2005) 3(1) *International Commentary on Evidence*, Article 3, available at http://www.bepress.com/ice/vol3/iss1/art3, accessed 29 October 2007.

62 B. W. Tuchman, *The March of Folly: From Troy to Vietnam* (Knopf: New York, 1984).

63 Allen, above n. 61 at 391.

64 A. Stein, 'The Refoundation of Evidence Law' (1996) 9 *Canadian Journal of Law and Jurisprudence* 279; A. Stein, 'Against "Free Proof"' (1997) 31 *Israel Law Review* 573.

implications likely to result from different types of error figure prominently in her decision-making process. Doctors are usually trained to use their judgement conservatively, by assuming, when in doubt, that a patient is ill rather than healthy.

These points of similarity find expression in the manner in which both clinical practices and the law create and employ generalisations. In clinical practices and judicial fact-finding alike, analogy is the prime diagnostic tool. Wigmore gives the following example of analogical argument in law:

> To show that a certain boiler was not dangerously likely to explode at a certain pressure of steam, other instances of non-explosion of boilers at the same pressure would be relevant, provided the other boilers were substantially similar in type, age, and other circumstances affecting strength.[65]

Medical diagnosis and prescribed treatments follow similar reasoning patterns. Where blood tests reveal a certain bacterium in the patient's blood, the physician may consider several medications, each with a certain level of efficacy and different side-effects for different patients. The doctor must identify the most suitable medication by consulting medical literature and relying on her own professional experience with patients with similar characteristics (physical condition, age, sex, health record, etc.) to the instant now requiring treatment. In other words, the doctor constructs a generalisation of an explanatory-causal nature, generated from past experience, and employs it in a specific case. A similar process occurs when a doctor attempts to determine whether a cancer patient's illness resulted from exposure to dangerous substances. Here, too, the doctor will consider the progression of the illness, the patient's family history, and any other relevant factors, to try to reach a conclusion regarding causation. She constructs the closest analogue, based on explanatory-causal considerations, of known cases from the medical literature or her own professional experience.

As in these typical clinical settings, judicial fact-finding also relies on the uncritical, largely dogmatic application of many theories underpinning the fact-finder's knowledge and beliefs. Judges and clinicians alike are obliged to proceed in this fashion owing to their inability to plan and perform proper experiments, to analyse data using statistical tools, and to rely on simplifying assumptions. But this is also justified because clinical investigation intends only to steer us towards one given conclusion, action or inaction, over other

65 Cited in Copi and Cohen, above n. 9 at 366.

alternatives. The theory of Inference to the Best Explanation (IBE) emphasises the relationship between scientific clinical discretion and more mundane intuitive thinking.[66] Judicial proof of facts also fits the patterns of IBE, for which the question is not 'Why this way?', but rather: 'Why this way, and not another way?' In other words, IBE describes the choice from a list of available or accessible explanations, on the basis of similarity and difference and the logic of cause and effect. In this way, IBE highlights the link between the investigator's cognitive interests and her inferential conclusions.

Medical diagnosis may sometimes be more structured and rule-bound than judicial proof of facts, but the difference is easily explained. A disease is a 'theoretical' fact, determined by medical classification. This is particularly apparent for mental illnesses, but is also true for illnesses in general. Medical classification is usually based on symptoms and factors that can be examined in the present, without the need for making inductive inferences. Thus, a diagnosis of intestinal cancer does not require a physician to distinguish between cancers resulting from exposure to dangerous substances as opposed to hereditary disease. When the cause of an illness, or its prognosis or responsiveness to prescribed treatments, is in question, however, clinical practice closely resembles judicial proof of facts.

Conclusion

This discussion has indicated certain similarities between judicial proof and the accepted patterns of scientific explanation in the natural and social sciences. Both employ inductive logic and deductive-nomological-like explanatory structures. More importantly, in both fields proof has a causal-explanatory nature. However, more careful examination suggests that judicial proof is not even a proximate model of scientific explanation. Explanations in the natural sciences aspire to generality. Judicial proof, on the other hand, proceeds by differentiation and analogy, a process more closely resembling clinical deliberations, particularly in medicine, than classical scientific method.

These differences can be traced to the divergent cognitive interests of science and law, and they are reflected in contrasting procedures. Law does not employ systematic experimentation. Moreover, in the absence of any external criterion for testing the validity of general theories and for verifying first-order factual arguments, the law emphasises the process of discovery itself. Discovery in law is

66 See, e.g., P. Lipton, *Inference to the Best Explanation* (Routledge: London, 1991). There have been some attempts to examine legal thought from the IBE perspective. See, e.g., K. Abimbola, 'Abductive Reasoning in Law: Taxonomy and Inference to the Best Explanation' (2001) 22 *Cardozo Law Review* 1683.

strongly linked to the idea of procedural justice, and conducted within the cognitive, conceptual, and ideological categories of legal theory. A great deal more might be said about the positive characteristics of legal discovery, and their implications for the rationality and legitimacy of judicial proof. However, the preliminary analysis presented in this article should serve as an illuminating starting point for critical appraisal of judicial proof.

The conclusion that judicial proof differs fundamentally from scientific explanation does not in itself imply that legal fact-finding is irrational or fails to do justice, although it may help us to understand the type of justice that the judicial system dispenses, and shed light on its boundaries and limitations.[67] More profound understanding of the logic of judicial proof calls for a fuller normative and descriptive account of fact-finding, as a component of broader theories of evidence, adjudication, and law. Absent a more complete theory of factual discovery in law, it would be premature to conclude that judicial proof is circular in a 'strong' sense. Although the risk of embedded and irreversible errors cannot be denied, accumulated judicial experience counts for something. Moreover, the insulation of legal fact-finding from external review is reinforced by other values of finality, stability, consistency and *res judicata*.

Judicial discovery of facts is an elusive, puzzling phenomenon, and its processes are largely hidden from direct observation. To paraphrase Oliver Wendell Holmes' famous dictum, the life of judicial proof of facts is a matter of both logic and experience. And as another Holmes (Sherlock)[68] astutely remarked,

> Most people, if you describe a train of events to them, will tell you what the result would be. They can put those events together in their minds, and argue from them that something will come to pass. There are few people, however, who, if you told them a result, would be able to evolve from their own inner consciousness what the steps were which led up to that result.[69]

67 See T. Adorno, *Einleitung in die Erkennthistheoris* (Junius: Frankfurt, 1958) 19–31.

68 The instructive methods of Sherlock Holmes have been analysed from the perspective of IBE; see U. Eco and T. Seboek (eds.), *The Sign of Three: Dupin, Holmes, Pierce* (Indiana University Press: Bloomington, 1983).

69 A. Conan Doyle, *A Study in Scarlet* cited in Copi and Cohen, above n. 9 at 436. The asymmetry noted by Holmes may be explained by the fact that the future is generally more accessible than the past to recognition and prediction through inductive inferences. This reflects our unidirectional conception of causation (running from past to future), and also because there may be several alternative causes that all lead to the same outcome. See, further, Y. Steinitz, *Etz Ha'Da'at* [*The Tree of Knowledge*] (Dvir Press: Tel-Aviv, 2004) 96–108 (in Hebrew) (citing the example of entropy).