

THE UNCERTAINTY OF PROOF

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[The judgmental system of dispute settlement emphasizes fact-finding. In this article Mr Ligertwood, whilst remaining cognizant of the criticisms made of 'trial by mathematics', deals with probability theory and the extent to which it can illuminate the fact-finding process.]

1. INTRODUCTION

Conflicts in society can be resolved in one of two ways, by the forward-looking process of mediation, either directly or through a third person, or by the backward-looking process of judgment, whereby a third person, after discovering the facts giving rise to the dispute, applies pre-existing norms to settle the conflict.¹ In our norm-ridden society the latter method is ostensibly used in our courts.² As a result there is a need to discover facts.³ But how are facts discovered? The trier of fact cannot experience the facts in issue for itself, as the facts have already occurred, so it must come to conclusions of fact by relying upon the evidence before it. In some systems the trier of fact itself seeks out evidence. Under our adversary process the trier of fact can conclude the facts in issue by relying only upon the evidence presented by the parties. If the trier of fact's conclusion cannot be supported by this evidence or is against the weight of this evidence then its verdict cannot stand. In some rational way, it is assumed, the evidence presented supports particular conclusions of fact. But unfortunately common lawyers have never elucidated this 'rational way'. Proof is said to be a matter of 'common sense'.⁴

The main object of this paper is to elucidate this rational process whereby facts are concluded from evidence. It is hoped such elucidation will help fact-finders to be less haphazard in reaching their conclusions of fact. It seems wrong that the decisions of fact upon which legal disputes turn are such hit and miss affairs. But before elucidating the rules of proof a preliminary question must be answered: to what extent is our system of

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¹ The distinction is well-drawn in Eckhoff 'The Mediator, the Judge and the Administrator in Conflict Resolution' (1966) 10 *Acta Sociologica* 158.

² 'Ostensibly' for we must examine this assertion more closely in due course; there are also exceptions to this 'ostensible' use e.g. in matrimonial and labour disputes mediation is often attempted.

³ Facts for my purposes are 'events or states of things' Bentham J., 'Rationale of Evidence' (1827) in *Works* (ed. Bowring) (1843) Vol. 2.

⁴ E.g. *R. v. Van Beelen* (1973) 4 S.A.S.R. 353, 383, and *D.P.P. v. Boardman* [1974] 3 W.L.R. 673, 690-1 (per Lord Wilberforce).

dispute settlement dependent upon the discovery of facts? Is fact finding so important that we must go to great lengths in elucidating the theoretical basis of our decisions of fact? It has recently been suggested by Kaplan⁵ that Decision Theory⁶ ought to be employed by triers of fact in courts of law. If this theory is to be employed the emphasis upon fact finding may be considerably lessened. In the first part of this paper Kaplan's suggestion will be examined to show to what extent our system of dispute settlement is dependent upon the discovery of facts. In the second part the rational process whereby facts are concluded from evidence will be elucidated.

2. THE NATURE OF COMMON LAW DISPUTE SETTLEMENT: THE EMPHASIS UPON FACT-FINDING

Decision Theory begins with the premise that all decisions are taken with regard to their consequences and that decisions should be taken which will lead to the greatest expected utility. In the context of a criminal trial the jury has two courses of action open to it; it can either find the facts in a way that the judge directs must lead to a conviction, or it may find the facts in a way which will lead to acquittal. A finding leading to conviction has, according to Kaplan, two possible consequences, the conviction of a guilty man, a consequence of utility, and the conviction of an innocent man, a consequence of disutility. Similarly, a finding leading to acquittal has two possible consequences, the acquittal of an innocent man, a consequence of utility, and the acquittal of a guilty man, a consequence of disutility. The jury should reach that decision which can be expected to bring the most utility, or, to put it another way (as Kaplan prefers; a preference which, for convenience, we will follow), that decision which can be expected to produce the least disutility. But this is dependent upon the probability of the facts giving rise to that disutility. Decision Theory posits that the disutility which can be *expected* to result from any course of action is calculated by multiplying the value placed upon that disutility by the probability of the occurrence of the facts giving rise to that disutility. That course of action with the lowest value of 'expected disutility' is the one which should be pursued. Following this Theory Kaplan derives a formula to be employed by triers of fact:

Let D_i represent the disutility of convicting an innocent person and let D_g represent the disutility of acquitting a guilty person. Let P represent the probability of guilt (the probability of the facts leading to a verdict of guilty). $(1-P)$ is then the probability of innocence. The expected disutility flowing from conviction is $(1-P)D_i^7$ and the expected disutility flowing from acquittal is PD_g .⁸ The jury should convict only where $(1-P)D_i$ is less than PD_g , or to put it the other way around, where PD_g is greater than $(1-P)D_i$. This is expressed in the formula

⁵ Kaplan J., 'Decision Theory and the Fact-Finding Process' (1968) 20 *Stanford Law Review* 1065.

⁶ The best explanation of Decision Theory can be found in Howard Raiffa's book 'Decision Analysis: Introductory Lectures on Choices under Uncertainty' (1968).

⁷ The probability of innocence multiplied by the disutility flowing from the conviction of an innocent man.

⁸ The probability of guilt multiplied by the disutility flowing from the acquittal of a guilty man.

$$PD_g > (1-P)D_i$$

$$\text{which reduces to } P > \frac{1}{1 + \frac{D_g}{D_i}}$$

This formula indicates to the jury that degree of probability which ought to be required before bringing a verdict of guilty. The formula indicates to the rational decision-maker the extent to which the degree of probability required depends upon the consequence of this or that course of action. For example, if you consider the disutility flowing from the conviction of an innocent man to be ten times greater than that flowing from the acquittal of a guilty man⁹ the degree of probability you will require before conviction will be

$$P > \frac{1}{1 + \frac{1}{10}}$$

$$P > \frac{10}{11}$$

As 1 is certainty it can be appreciated that the required degree of probability is high (perhaps beyond reasonable doubt). On the other hand if the Criminal Law Revision Committee is right and as much disutility flows from acquitting a guilty man as convicting an innocent man¹⁰ then the formula produces the following result,

$$P > \frac{1}{1 + \frac{1}{1}}$$

$$P > \frac{1}{2}$$

the degree of probability required before conviction becoming much lower (perhaps on the balance of probabilities).

The essence of Decision Theory is that it is forward looking and designed to settle disputes in a way which will be most useful in the circumstances. The degree to which the trier need be satisfied of the existence of the facts in dispute thus varies according to utilitarian considerations. One can envisage situations where a decision can be reached with little or no regard

⁹ Blackstone thought ten guilty men should be acquitted rather than one innocent man be convicted. 4 *Blackstone Commentaries* 358 (15th ed., 1808).

¹⁰ United Kingdom, *Eleventh Report of the Criminal Law Revision Committee* Cmnd. 4991 para. 27: 'It is as much in the public interest that a guilty person should be convicted as it is that an innocent person should be acquitted'. Sir Brian Mackenna comments ([1972] *Criminal Law Review* 605, 606):

'If the conviction of the guilty is as much in the public interest as the acquittal of the innocent, it would seem to follow that the acquittal of the guilty is not less against the public interest than the conviction of the innocent, which is not the customary view.'

to whether the incident in question occurred at all. The following example is given:

The accused is charged with breaking and entering and stealing. There has been a spate of such crimes in the district. If the accused has been committing all the crimes the disutility which would flow from his acquittal would be enormous. On the other hand the disutility which would flow from his conviction if he is innocent may be regarded as slight having regard to his previous bad character and present state of unemployment and lack of family responsibilities, and having regard to the deterrent value of the conviction in relation to the actual offender. Thus the jury may conclude Dg to be greater than Di and be prepared to convict when the probability of the facts upon which the conviction is based is slight.

But the law has never allowed the jury to act in this way. It is true that the jury is asked to determine the guilt or innocence of the accused and, there being no appeal against acquittal by the prosecution, it is open to the jury to acquit upon utilitarian (forward-looking) grounds.¹¹ There is evidence that juries do acquit on utilitarian grounds, for example, because the accused will lose his job as a result of conviction and such punishment (in their opinion) does not befit the crime,¹² because the dispute is a domestic dispute in which the courts should not intervene¹³ etc. But the law does not encourage juries to acquit guilty men upon utilitarian grounds. The judge directs the jury that their function is to find the facts and to follow his directions upon points of law, so it is only in exceptional circumstances that juries will be forward looking in their decisions. As Glanville Williams points out:¹⁴

The notion that an English jury will, as anything like a regular matter, take the law into its own hands and acquit in defiance of the judge's direction upon the law rests on a misapprehension of its function. The English jury is a trier of fact only, . . .

It is true that in some exceptional cases, of a non-political character, the jury, acting very often with the approval of the judge, has tempered the strict law to the particular defendant where strong sympathy is aroused.

But the jury cannot convict upon utilitarian grounds and, if it does, the accused may appeal on the ground that the verdict is unsupported by the evidence or against the weight of the evidence. Furthermore, if the jury was expected to consider the consequences of its verdict the accused's character would be put before it¹⁵ and the jury would be asked to have regard to the likely penalty in reaching its verdict.

¹¹ Examples of such acquittals are found in McCabe S., and Purves R., *The Jury at Work, a study of a series of jury trials in which the defendant was acquitted* (Occasional Paper No. 4 of the Oxford University Penal Research Unit) (1972) ch. 4, and in Kalven H., and Zeisal H., *The American Jury* (1966) e.g. 306-7 where examples are given of juries acquitting to prevent the accused losing his job.

¹² Kalven H., and Zeisal H., *op. cit.* 306-7.

¹³ McCabe S., and Purves R., *op. cit.* 33-6.

¹⁴ Williams G., *The Proof of Guilt: a study of the English Criminal Trial* (3rd ed. 1963) 260.

¹⁵ The present rules of evidence exclude the accused's character, see *Makin v. Attorney-General for N.S.W.* [1894] A.C. 57; Criminal Evidence Act 1898 (U.K.), s. 1; Evidence Act 1935-72 (S.A.), s. 18. Character is relevant to utility. A man of high standing in the community has more to lose on conviction than a man serving a life sentence (to put the argument in its extreme form).

The jury then is cast in the role of fact-finder: it is asked whether the facts which would disclose a crime have been established beyond reasonable doubt. Only in these circumstances can the accused be held responsible. The degree of proof required does not vary having regard to the consequences of any decision but is fixed, immutable. Decision Theory has no place in our present criminal law. If the trier concludes that the facts disclose a breach of a pre-existing norm then the accused is responsible and should be convicted. If there is no breach he is not responsible and must be acquitted. The finding of facts is crucial. As justices, magistrates and judges who decide criminal cases sitting alone in theory merely perform the function of jury as well as judge, they perform a similar fact-finding role. But do they perform the same role when settling civil disputes?

Traditionally a civil case is proved on the balance of probabilities.¹⁶ This formulation is still used in many cases, in particular in running-down cases¹⁷ which make up such a large proportion of the court's business. Such a formulation fixes a standard of proof which is independent of policy and utility, the question being which hypothesis on the evidence is the more probable, that of the plaintiff or that of the defendant, the merest tilt of the scales one way being sufficient to dispose of the case. Admittedly the application of this formula has often led to differing opinions¹⁸ but these turn on assessment of probability. The point is that utility considerations are not apparent within this formulation, and the trier is mere fact-finder.

But in Australia doubts have been expressed about the application of this formula to all civil cases. Indeed it has been doubted whether it is a proper formulation of the standard of proof for any civil case. The doubts were first expressed by Dixon J. in *Briginshaw v. Briginshaw*, where in a divorce case based upon proof of adultery he said:¹⁹

The truth is that, when the law requires the proof of any fact, the tribunal must feel an actual persuasion of its occurrence or existence before it can be found. It cannot be found as a result of a mere mechanical comparison of probabilities independently of any belief in its reality. No doubt an opinion that a state of facts exists may be held according to indefinite gradations of certainty. . . . [A]t common law . . . it is enough that the affirmative . . . is made out to the reasonable satisfaction of the tribunal. But reasonable satisfaction is not a state of mind that is attained or established independently of the nature and consequences of the fact

¹⁶ The origins of this formulation are obscure, the traditional authorities being a *dictum* of Willes J. in tendering advice to the House of Lords in *Cooper v. Slade* (1858) 6 H.L.C. 746, 772 which refers to *Newis v. Lark* (1571) 2 Plowd. 403, 412. Further authorities usually cited are *Hollingham v. Head* (1858) 4 C.B. (N.S.) 388, 392 and *Davis v. Bunn* (1936) 56 C.L.R. 246, 267.

¹⁷ E.g. *Maher-Smith v. Gaw* [1969] V.R. 371.

¹⁸ Cf. Barwick C.J.'s judgment in *Lopes v. Taylor* (1970) 44 A.L.J.R. 412 with the judgments of the majority in that case.

¹⁹ *Briginshaw v. Briginshaw* (1938) 60 C.L.R. 336, 361-2. Arguably the same approach was taken by Lord Denning in *Bater v. Bater* [1951] P. 35 although this has been strenuously opposed by Cross (see *Cross on Evidence*, (Australian edition, 1970) ch. 5). Of the other judges in *Briginshaw* only McTiernan J. (at p. 372) clearly accepts Dixon J.'s approach. Latham C.J., Rich and Starke JJ. were willing to decide the appeal by holding the trial judge wrong in applying the criminal standard of proof to the case before him, emphasizing that the civil standard applied. But that standard they did not elaborate.

or facts to be proved. The seriousness of an allegation made, the inherent unlikelihood of an occurrence of a given description, or the gravity of the consequences flowing from a particular finding are considerations which must affect the answer to the question whether the issue has been proved to the reasonable satisfaction of the tribunal.

Decision Theorists seem to have a friend. Not only does Dixon J. express proof in terms of a state of mind held by the decision maker, terms which accord with the concept of 'Subjective Probability' employed by Decision Theorists,²⁰ but more importantly in this context he emphasizes that a decision of fact cannot be made until careful consideration has been given to the consequences which will follow from it. Dixon J. points out that the standard of proof in a civil case is not fixed at a point determined by a mechanical comparison of probabilities but argues that it varies from case to case, depending not only on the nature of the issue but also on the seriousness of the consequences in finding the facts proved.

This interpretation receives considerable support in *Helton v. Allen*²¹ where in a civil case involving an allegation of a crime it was held that proof on a mere balance of probabilities was insufficient having regard to the nature of the issue and the consequences of finding that issue proved. *Briginshaw's* case was expressly approved and followed in the joint judgment of Dixon, Evatt and McTiernan JJ.²² And even more recently Dixon J.'s approach in *Briginshaw* has been quoted with approval. In *Maher-Smith v. Gaw*, quoted above for the proposition that in running-down cases the standard of proof is on the balance of probabilities, the Full Court of the Supreme Court of Victoria emphasized that this was because, having regard to the nature of the issue and the consequences of finding it proved, a judge could be persuaded, within the terms of Dixon J.'s approach in *Briginshaw*, on a mere balance of probabilities.²³ And in *Andrijich v. D'Ascanio*²⁴ the Full Court of the Supreme Court of Western Australia decided a breach of promise to marry case by reference to Dixon J.'s judgment in *Briginshaw*. It is difficult to disagree with Eggleston who concluded:²⁵

[T]he jury must be told that it is for them to determine the degree of probability which in fact exists in favour of the affirmative, and also for them to determine, as reasonable men, whether that degree of probability is sufficiently strong for them to feel justified in acting on the basis that the fact is established, having regard to the relative seriousness of the consequences which flow from the finding.

²⁰ This expression of proof in terms of a state of mind raises important issues, in particular the relationship between probability and belief. This issue will be discussed in the next section. The concept 'Subjective Probability' employed by Decision Theorists is discussed in Raiffa H., *op. cit.* ch. 5. Again this concept will be discussed in the next section.

²¹ *Helton v. Allen* (1940) 63 C.L.R. 691. Approved by the High Court in *Rejfeek v. McElroy* (1965) 112 C.L.R. 517.

²² *Helton v. Allen* (1940) 63 C.L.R. 691, 712. Rich J. at p. 696, without mentioning *Briginshaw* approves of Dixon J.'s approach, Starke J. at p. 701 is a little more equivocal, stressing the nature of the allegations rather than the consequences of finding the allegations proved.

²³ *Maher-Smith v. Gaw* [1969] V.R. 371, 374.

²⁴ *Andrijich v. D'Ascanio* [1971] W.A.R. 140.

²⁵ Eggleston R., 'Probabilities and Proof' (1963) 4 *M.U.L.R.* 180, 195.

The only other explanation of the above cases is to argue that the nature of the allegation and its consequences are relevant in determining where the balance of probabilities lies in any case but do not affect the standard of proof. This view is forcefully put by Cowen and Carter²⁶ and Cross²⁷ on the basis that what the standard of proof is in any case is a question of law to be determined in advance and the trier of fact's only function is to determine whether the probabilities reach that standard. But of what relevance are the consequences of any finding to a mere determination of the probabilities? The nature of the issue is clearly relevant,²⁸ but not the consequences. These are only relevant in determining what the standard of proof shall be in any case. If this is accepted, and it is agreed that in Australia regard is had to the consequences, it seems we are forced to turn to Decision Theory to determine the standard of proof in any given case.

But who is to apply Decision Theory? We can accommodate Cowen and Carter's point by assuming that this is a matter for the judge to determine as a matter of law. Having decided the standard as a matter of law he must then in his fact-finding capacity determine whether the probabilities reach that standard. Fortunately in civil cases the arbiter of fact and law is the same man for, although in theory there are these two stages in reaching a decision of fact, in practice it is impossible to separate the two stages, it being impossible to express precisely not only the standard of proof but also the degree of probability of the facts in issue. We can conclude that Decision Theory may be relevant in civil cases in determining as a matter of law what the standard of proof shall be rather than the probability of the facts in issue.

Is the proper approach to apply the Kaplan formula? Again at first sight this seems feasible. Thus if the issue involves a running-down case where both parties are insured D_g will equal D_i which explains why these cases can be decided upon a mere balance of probabilities. On the other hand if the issue involves a crime, say fraud, D_i will be much greater than D_g because to find an innocent man guilty of fraud in even a civil case will involve considerable disutility. Such a disutility being greater than the disutility flowing from failure to find against a guilty man the standard of proof becomes higher than a mere balance of probabilities. But is it as simple as this? Leaving aside the problem of specifying and quantifying the utilities there is the problem that the law just does not have regard to *all* the consequences which flow from its findings. In a case involving an issue carrying considerable social stigma if found proved (adultery, crimes) the

²⁶ Cowen Z., and Carter P. B., *Essays in the Law of Evidence* (1956), ch. 9.

²⁷ *Cross on Evidence* (Australian ed., 1970) 115.

²⁸ This receives support from Ungoed-Thomas J. in *Re Dellow's Will Trusts* [1964] 1 All E.R. 771 where he explains that the gravity of an issue in a civil case must be taken into account in determining where the probabilities lie. He does not say that regard must be had to the consequences in order to determine the standard of proof required in the case. But, of course he is not applying the approach, outlined by Dixon J. in *Briginshaw*, which has been subsequently approved by Australian courts.

law allows the judge to free his intuition and take this consequence into account in assessing the standard of proof. But often the consequences are not so apparent. Thus in a running-down case the judge is (theoretically) not to have regard to the fact of insurance although this has a decisive influence upon the consequences of any decision. This point can be taken further. The wealth of the defendant is again (in theory) irrelevant, although a finding against a poor defendant with family responsibilities can have disastrous consequences. So that although utilities can to some extent be assessed there can be no guarantee that such assessments will be accurate. Should then the law expand the range of consequences to which the judge can have regard? It is suggested that such an approach would not accord with our current judgmental approach to dispute settlement. The effects of an adverse decision may be so harsh that D_i will so outweigh D_g that the degree of probability required will be impossibly high. The result would be that as against some defendants it would appear that the substantive law was not being enforced. One wonders at this point whether Decision Theory is not mediation under another name! This is the major objection to an extensive use of Decision Theory to determine the standard of proof. The standard of proof would alter the substantive rules of law. It is in formulating rules of law, the norms, that policy and utility in general terms must be considered. Once this is done there is under our judgmental system no scope for policy and utility to be considered in particular cases. The law determines the standard of proof in advance. The standard is the balance of probabilities. But in some cases it is not, the standard is reasonable satisfaction. Why? What else can we do but apply Decision Theory?

If we consider the cases where the phrase 'reasonable satisfaction' has been employed it is suggested that we can find answers to these questions. The cases concern civil disputes in which allegations of immorality, fraud and criminal conduct are involved. Such allegations are considered with some seriousness in our society, not because the utilities involved are great but because our moral outlook so dictates. When a civil dispute involves such allegations the ordinary rule governing civil disputes, that such disputes are to be settled by determining the facts on the balance of probabilities, gives way to a more stringent rule demanding that the trier of fact be 'reasonably satisfied' of the facts before holding the party responsible. This standard of reasonable satisfaction is not determined by considering the utilities. The question is whether a party should be held responsible for a serious matter. No formula can determine that question.

It is submitted that despite the *dicta* in *Briginshaw v. Briginshaw* and other cases Decision Theory cannot be employed by our civil courts. To apply Decision Theory is contrary to the fundamental rule that disputes are to be settled by judgment not mediation. The *dicta* are explained not by reference to Decision Theory but by reference to a concept of responsibility which can make the standard of proof higher but not lower. In the result

the newer standard does not lessen the emphasis placed upon fact-finding in civil cases. Rather it increases that emphasis and supports the initial assertion that fact-finding is a crucial function of our courts.

3. DETERMINING THE FACTS

If fact finding is crucial, how do we discover facts? The answer in part lies in the adversary nature of our dispute settlement whereby the parties adduce the evidence upon which each relies to establish the facts in issue. Any conclusion of fact must be based upon the evidence presented by the parties. The evidence presented must prove the facts in issue. But can we explain the reasoning process by which we conclude that evidence proves facts?

A preliminary point is that the reasoning process is not peculiar to courts of law but is employed by scientists and all other seekers of fact. This has been amply demonstrated by legal commentators such as Thayer,²⁹ James³⁰ and Montrose.³¹ Because of this other writers³² have suggested that courts should employ the approach taken to decisions of facts by expert fact-finders, such as logicians, statisticians and mathematicians. The approach of these so-called experts must be examined to discover, firstly, whether it can be justified and secondly, whether, if it can be justified, it can be suitably applied in courts of law.

Logicians distinguish between two kinds of reasoning (argument), deduction and induction.³³ An argument is said to be deductively valid when the truth of the premises guarantees the truth of the conclusion, so that it is impossible for the conclusion to be false if the premises are true. If our premise is that all men standing over bodies with bloodstained knives in their hands are killers, if the accused is so situated then it can be deduced

²⁹ Thayer J. B., *Preliminary Treatise on Evidence at Common Law* (1969) ch. 6.

³⁰ James G. F., 'Relevancy, Probability and the Law' (1941) 29 *California Law Review* 689.

³¹ Montrose J. L., 'Basic Concepts of the Law of Evidence' (1954) 70 *Law Quarterly Review* 527.

³² The literature begins early in the century with Gulson's *The Philosophy of Proof*, followed by Wigmore J. H., *The Science of Judicial Proof* (3rd ed 1937) and Michael J. and Adler M. J., *Trial of an Issue of Fact* (1931). But these works are general analyses of the fact-finding process and the proposals discussed in this paper have been more recently put forward, in particular by Ball V. C., 'The Moment of Truth: Probability Theory and Standards of Proof' (1961) 14 *Vanderbilt Law Review* 807; Kaplan J., 'Decision Theory and the Fact-Finding Process' (1968) 20 *Stanford Law Review* 1065; Finkelstein M. O. and Fairley W. B., 'A Bayesian Approach to Identification Evidence' (1970) 83 *Harvard Law Review* 489 and Tribe L. H., 'Trial by Mathematics: Precision and Ritual in the Legal Process' (1971) 84 *Harvard Law Review* 1329 (and respective comments to each other's articles in (1971) 84 *Harvard Law Review* 1801; Broun K.S. and Kelly D. G., 'Playing the Percentages and the Law of Evidence' [1970] *University of Illinois Law Forum* 27; Walls H. J., 'What is Reasonable Doubt?' [1971] *Criminal Law Review* 458; Coleman R. F. and Walls H. J., 'The Evaluation of Scientific Evidence' [1974] *Criminal Law Review* 276, and Eggleston R., 'Probabilities and Proof' (1963) 4 *M.U.L.R.* 180. Eggleston touches upon some of the issues, without developing them.

³³ For the distinction between deduction and induction see, e.g., Skyrms B., *Choice and Chance; an introduction to inductive logic* (1966), 6-13.

that he is a killer. Given the premise no other conclusion is possible. On the other hand an argument is said to be inductively strong if it is improbable (not impossible) that its conclusion is false while its premises are true. It is unlikely that many would accept the premise of the above example. Rather it would merely be argued that if the accused is standing over a body with a bloodstained knife in his hand he is *probably* a killer, not that he *is* a killer. No conclusion of fact is deductively valid, rather conclusions of fact are inductively strong or weak. To explain conclusions of fact we must analyse this process of reasoning, the argument, 'If evidence e is true then probably hypothesis h is true', for this is the process of reasoning employed by triers of fact when, from the evidence presented by the parties, they conclude that the facts in issue did, or did not, occur. Of course the trier of fact will not merely be concerned with one such inference (argument) but many such inferences (arguments). Wigmore³⁴ has elucidated the inferences involved in fact determinations in quite complicated illustrative cases. It suffices to give a simple example here. The issue is whether A killed B. A witness is called to testify that he found A standing over the body of B with a bloodstained knife in his hand. If the trier of fact is to conclude that A killed B it must argue thus:

- (1) The witness says he found A standing over the body of B with a bloodstained knife in his hand. Therefore A probably was standing over the body of B with a bloodstained knife in his hand.
- (2) As A was standing over the body of B with a bloodstained knife in his hand A probably killed B.

It is accepted that all facts are concluded from evidence by employing chains of inferences, and only in this way can the trier of fact reason from the known to the unknown. But when should triers of fact be prepared to draw inferences and how probable are the conclusions which can be drawn? When can the trier of fact conclude that 'If evidence e is true then probably hypothesis h is true'? What do we mean by 'probably'? Can we calculate mathematically the degree to which hypothesis h is true? As such questions involve fundamental philosophical problems I do not presume to give definitive answers. What I hope to do is to elucidate the theoretical basis of our conclusions of fact to discover whether fact-finding in courts of law can be made more precise.

Wigmore³⁵ was happy to leave the drawing of inferences entirely to the trier of fact. This approach finds strong support in Decision Theory in its concept of 'Subjective Probability'.³⁶ To determine the 'Subjective Probability' of an hypothesis the trier of fact compares his feeling of probability with the probability of picking a coloured ball from a calibrating urn. If he feels indifferent to betting upon the existence of the hypothesis in issue

³⁴ Wigmore J. H., *The Science of Judicial Proof* (3rd ed. 1937).

³⁵ *Ibid.*

³⁶ See Raiffa H., *op. cit.* ch. 5.

and to betting upon the possibility of selecting an orange ball from an urn containing eighty orange balls and twenty blue balls then to him the probability of the hypothesis is .8. If he feels indifferent when the urn contains seventy orange balls and thirty blue balls then to him the probability is .7 etc. In this way it is said an individual subjectively determines the probability of the hypothesis in question, although it could more accurately be said that in this way the individual measures the degree to which he believes that that hypothesis is true. In Decision Theory this may be acceptable³⁷ but the law considers there to be a rationally defensible degree of probability and if the trier of fact acts improperly or mistakenly in determining probability then its assessment will be upset on appeal. The law assumes that the degree of probability can, at least to some extent, be rationally calculated. And the law is not alone. As Mackie points out,³⁸

The concept of probability is an unusually slippery and puzzling one. For one thing, it seems to hover uncertainly between objectivity and subjectivity. Talk about something being probable or likely seems to reflect some mixture of knowledge and ignorance — if there was an omniscient God, it is hard to imagine that he would regard anything as merely probable — and yet most of our probability statements seems to claim some objective or at least interpersonal validity, and we treat probabilities in many cases as being measurable and calculable in a strict mathematical way.

and he continues,³⁹

. . . probability is not an expression of any old subjective belief, but of the beliefs of our idealised gambler, of beliefs that are at least in a minimal respect rationally justifiable . . . this is a first step towards the concept of a rationally justified degree of belief. . . . The sophisticated variety of 'subjectivism' is not thoroughly subjectivist in spirit, but is a minimal, semi-sceptical doctrine about how far beliefs are rationally justified.

But Mackie is a philosopher seeking an eternal justification of probability judgments. Certainly we can seek guidelines which are eternally justifiable but if our search fails will probability determinations be left entirely to the individual? It is suggested that even if eternal justification fails still some probability judgments will be considered rational and some irrational. As a result as well as seeking eternally justifiable guidelines we must also seek those internal guidelines which make probability judgments rational. It is only after these guidelines have been exhausted that probability is left to individual judgment.

In elucidating probability judgments Mackie⁴⁰ considers four other

³⁷ Decision Theory has developed about business decisions, to help individual businessmen decide upon a course of action in a logical and consistent way. Decision Theory points out to the businessman the steps involved in any decision and the utilities and probabilities relevant to a determination of whether to take any particular step. But the values given to these concepts is left entirely to the individual. This may not matter in the field of business decision, but it must be seriously questioned whether it does not matter in the field of legal decisions. Legal decisions must be taken as far as possible by reference to probabilities accorded comparable values. Otherwise parties will not receive equal treatment from the law (the essence of justice).

³⁸ Mackie J. L., *Truth, Probability and Paradox* (1973) 154.

³⁹ *Ibid.* 158.

⁴⁰ *Ibid.* ch. 5.

concepts of probability; the Logical Concept, the Range Concept, the Frequency Concept and the Objective Chance or Propensity Concept. We will consider each concept in turn in our search for those rational guidelines upon which our probability judgments ought to be based.

(i) *The Logical Theory of Probability*

The Logical Theory considers that probability can only be ascertained in relation to evidence. To say that hypothesis *h* is probable is to say that it is probable in relation to evidence *e*. *h* can have no probability on its own. In some logical way *e* makes *h* probable. All we need do is ascertain the rules of 'probabilification'⁴¹ and we have the guidelines which produce rational probability judgments.

Certainly this Logical approach appears appropriate to determining probability in a court of law. Juries are asked to decide cases *upon the evidence*, judges will not allow the case to go on if the *evidence* cannot support a probability finding to a degree of 'beyond reasonable doubt', and an appeal court will quash a conviction where it cannot be supported *by the evidence*. If there is one concept of probability to solve problems in court then it would appear to be the Logical Concept of Probability. This concept will be crucial to our discussion but it is not appropriate at this stage to elucidate the rules of probabilification as they depend considerably on other concepts of probability. These we will now elucidate.

(ii) *The Range Concept of Probability*

Elucidation of this Concept is best given by means of an example of the Range Concept, the classical definition of probability:

[This identified] . . . the probability of a possible event with the ratio of the number of 'favourable' possibilities to the total number of possibilities in a set of equiprobable possibilities. What is essential in this procedure is the use of the principle of indifference (or of insufficient reason) to determine equiprobability, that is, the claim that alternatives are equally probable if we have no reason to expect one rather than another.⁴²

Examples of the Classical Theory are usually drawn from gambling. Thus the probability of drawing an ace from a pack of cards is 4/52; the probability of throwing a double six with a pair of dice is 1/36. The dice example is elucidated as follows: there are 36 possible ways that the dice may fall; each way is equally possible; one of those possible ways results in a double-six; 'the ratio of the number of "favourable" possibilities to the total number of possibilities in a set of equiprobable possibilities' is accordingly 1 : 36; this is the probability of throwing a double-six. The crucial assumptions in this reasoning are; firstly, that there are only 36 possible ways that the dice may fall (one may fall in a crack and come to rest at an angle; or one may disintegrate, for example due to a structural fault, before it comes to rest) and, secondly, that, each of the 36 possibilities is equally

⁴¹ *Ibid.* 166.

⁴² *Ibid.* 161.

possible (the dice may be biased). In mathematics these assumptions may be stipulated, but in real life even if we can assume there are 36 possibilities are we justified in assuming equipossibility in the absence of any knowledge to the contrary?

Mackie argues⁴³ that we are in a sense:

If we have no reason to expect one alternative rather than another, we have reason to expect them equally — I mean to have equal expectations that either should occur, *not* to expect results like these to occur with equal frequency: that is quite another matter. Any other distribution of belief between the alternatives would be arbitrary.

But this justification, although considered rational, cannot be eternal. We cannot be sure that our assumption of equipossibility (the principle of indifference) will ever or always be correct. Nevertheless courts have considered it rational to act upon the Classical Theory. Take the following example:⁴⁴

A man is charged with overtime parking in a one-hour zone. The question is whether his car had remained in the parking space beyond the time limit. To prove that it had not been moved, the government calls an officer to testify that he recorded the positions of the tire air-valves on one side of the car. Both before and after a period in excess of one hour, the front wheel valve was pointing at one o'clock; the rear wheel valve, at eight o'clock. The driver's defence is that he had driven away during the period in question and just happened to return to the same parking place with his tires in approximately the same position. The probability of such a fortunate accident is somewhere between one in twelve and one in one hundred forty-four [depending upon whether the wheels rotated independently or in complete synchrony or somewhere in between]. Should proof of that fact be allowed and, if so, to what end?

On these facts a Swedish court, computing the probability on the assumption that car wheels rotate independently, ruled that the fraction of 1/144 was sufficient to establish a reasonable doubt. This did away with the necessity of computing the exact probability in Classical Terms. At most the probability of coincidence was 1/144. But the determination of probability in this case depended upon the principle of indifference, the assumption of equipossibility, and this principle may, in an eternal sense, be wrong. Each event may have some internal tendency towards one outcome rather than another, as is suggested by the Objective Chance Concept of Probability, which we will shortly discuss.

Where the Classical Theory is used based upon the assumption of equipossibility, it is one example of the Range Concept, expressing probability in terms of the ratio between that part of the range which is favourable and the total range.

(iii) *The Frequency Concept of Probability*

The above concepts of probability determine the probability of a particular event. The Frequency Concept determines the frequency of events of a particular type within a class of events, expressing the result as the

⁴³ *Ibid.* 162.

⁴⁴ Quoted from Tribe L. H., *op. cit.* 1340.

probability of events of that type occurring within that class. In its simplest form the concept expresses frequency within a finite class. But even in this simple form it is clear that the concept is intended to do more than merely express a frequency and is intended to determine the probability of a particular event being of the particular type. To make this point clear by reference to an example:

If you know that 100 events (numbered 1 to 100) have occurred and 70 have been observed to be of type A then the probability of type A events is 7/10. But furthermore if you do not know whether event 49 was a type A or not the Frequency Concept would conclude that the probability of event 49 being of type A is 7/10.

We are concerned with the probability of particular events, not of frequencies within classes, so that we are interested in this conclusion, that if the frequency is 7/10 then the probability of a particular event being of that type is also 7/10. One way of explaining the transition is by reference to the Range Concept.⁴⁵ Confronted with event 49 all we know is that it is a member of a sequence of 100 events. We do not know which of these 100 events are of type A, and applying the principle of indifference this particular event has the same chance of being a type A event as any other event. This chance expressed as the ratio of favourable possibilities to the total number of possibilities is 70 : 100, 7/10. If we are to regard frequencies as an accurate measurement of probability we must accept the principle of indifference, and we have already seen the problems associated with this principle. But even if we are prepared to do this the Frequency Concept will in many cases be an insufficient basis for a probability judgment upon which a court of law (or indeed anyone else) could act. It is rare for an event to belong only to one class. Often we are confronted by differing frequencies in different classes. Which do we follow? To give the well-known example —

Suppose we ask what is the probability that Peterson, a Swede, is a Protestant. Well, 95 per cent of Swedes, let us say, are Protestants, so the odds are 19 to 1 on. But Peterson made a Pilgrimage to Lourdes last year and 95 per cent let us say, of those who make Pilgrimages to Lourdes are Roman Catholics so that the odds are at least 19 to 1 against.⁴⁶

The Frequency Concept cannot solve this conundrum.

The frailties of the Frequency Concept become more apparent when we move from using frequencies within a finite class to determine the probability of a member of that class, to using these frequencies to determine the probability of an event which is outside that class, which is merely one of the infinite number of such events which may occur. Frequency Theory overcomes this problem by talking not in terms of frequencies within a given finite class but of frequencies within infinite classes.⁴⁷ If we could

⁴⁵ Mackie J. L., *op. cit.* 198.

⁴⁶ Ayer A. J., *Probability and Evidence* (1972) 51-2. The example originated with Professor Cooley.

⁴⁷ Which is clearly a contradiction of terms!

consider all past, present and future events of this class there is a limiting frequency of events which are type A. At least this concept of a limiting frequency is an hypothesis. If it is accepted, the application of the Frequency Concept of Probability is considerably extended but its inherent limitations remain.

(iv) *The Objective Chance or Propensity Concept of Probability*

Mackie describes this as 'the most elusive of all our five concepts'.⁴⁸ The Concept posits that given consistent causal conditions there is an objective chance of one result occurring rather than another. That is, within the particular event there is this objective chance. The event is not predetermined by causes, and after the causes have acted objective chance takes over. Objective chance is defined by Mackie⁴⁹ as an indeterministic counterpart of causal necessity. The result of objective chance is a frequency within a class. This frequency could be regarded as the manifestation of the objective chance.

If we return to the Logical Concept of probability we are able to see how these other concepts of probability are relevant to determining the rules of probabilification. The Logical Theory posits that when we regard the evidence we can find a logical relationship between it and the hypothesis we wish it to probabilify. The logical rule which is the strongest candidate for this job is the proportional syllogism. This is an argument of the form:

- X per cent of A's are B
- C is an A
- Therefore C is a B to a degree of probabilification of X%

The analogy with a valid deductive argument is clear.⁵⁰ It is also obvious that if we wish the argument to be logical we must include the general premise, X per cent of A's are B, as part of our evidence. In everyday argument this is usually implicit, not expressed, which makes assessment of probabilification impossible. Thus when we say X intended to kill Y therefore he probably did kill Y the implicit premise is that in X% of cases persons who intend to kill do kill.

But the so-called logical rule to some extent begs the question. Why do we accept that the logical rule produces this degree of probabilification? Are we not perilously close to our Frequency Concept of probability as explained by reference to the Range Concept? Consider the example already cited:

- 70 events of our 100 events are of type A.
- No. 49 is an event.
- Therefore the probability of event 49 being of type A is 7/10.

⁴⁸ Mackie J. L., *op. cit.* 179.

⁴⁹ *Ibid.* 180.

⁵⁰ It should be noted that Wigmore objected rather strongly to using the proportional syllogism (see Wigmore J. H., *The Science of Judicial Proof* (3rd ed. 1937) 21). But James G. F., 'Relevance Probability and the Law' (1941) 29 *California Law Review* 689, 694-700 argues forcefully in its favour. If we accept the applicability of the Logical Concept of Probability, which it is submitted we must, then James must be accepted upon this point.

Consider also the example given of the Classical Theory of probability which can be interpreted by reference to the proportional syllogism thus:

1 of our 36 possibilities is a double six.

The next throw will produce one of those possibilities.

Therefore the probability of the next throw producing a double six is $1/36$.

Not only can the percentage deal with actual things or events. It can also deal with possibilities.⁵¹ The importance of the Logical Concept is that it stresses the dependence of probability upon evidence, and especially in courts, probability judgments are made by reference to evidence. The Concept also brings out the hidden premises of our probability judgments and stresses that these must be included amongst our evidence if the relationship between evidence and hypothesis is to be strictly logical.

It is suggested that where inferences are drawn from evidence the Logical Concept of probability is relied upon but that this concept relies upon the Range Concept of probability (of which the Classical and Frequency Concepts are but examples) to provide the rules of probabilification. To illustrate this suggestion our initial example can be reconsidered. If A is standing over the body of B with a bloodstained knife in his hand we conclude that A probably killed B. Why? Because in X per cent of cases where a man is standing over the body of another with a bloodstained knife in his hand that man has killed the other, A is so standing over B, therefore A probably (to a degree of X per cent) killed B. The relationship between the evidence and the conclusion is thus dependent upon a general proposition which defines the range (all men standing over bodies holding bloodstained knives) and its favourable portion (the number of such men who have killed). When the argument is put in this form the difficulties of precision become apparent. In most situations no attempt will have been made to measure the range and its favourable portion, the frequency of killers among all men standing over bodies holding bloodstained knives. And even if the past frequency has been measured how do we know that the same frequency will continue in the future? The concept of the actual frequency being a limiting frequency⁵² is hypothesized and this is considered rational, not in any eternal sense, but because it is all we have to go on. In addition our suspect may fall within other ranges. He may be an archbishop and in relation to archbishops we accept the general proposition that X per cent of archbishops are not killers. Which inference do we regard as decisive?

As a result of considerations such as these courts have tended to leave the finding of facts to 'common sense'. As the trial judge in *R. v. Van Beelen* pointed out to the jury,⁵³ 'You are thrown back on to observance and common sense, not in terms of arithmetic, but in terms of knowledge of

⁵¹ This extension of the proportional syllogism to possibilities is dealt with by Mackie J. L., *op. cit.* 169-71.

⁵² For an introductory explanation of a limiting frequency see Skyrms B., *op. cit.* 150-4.

⁵³ (1973) 4 S.A.S.R. 353, 383.

life and human affairs attributed to any jury'. Does this mean that probability judgments are left entirely to the individual? It is suggested that it does not. Common sense is rationally justifiable. Common sense intuitively assesses the appropriate range and its favourable portion and an appellate court will disturb a finding of fact which does not accord with its intuition. Our guidelines are not eternally justifiable. To begin with they depend upon the principle of indifference and in some cases upon the hypothesis of a limiting frequency. Furthermore they do not indicate which is the appropriate range. Yet it is suggested that these guidelines are considered rational and should be followed by triers of fact in our courts.

But how can this elucidation help triers of fact? Can it lead to greater precision in the drawing of inferences? It is suggested that triers of fact should isolate the chains of inferences involved in their decisions and should isolate the general propositions upon which their inferences (probability judgments) depend. But can precision be achieved in a strictly mathematical way? Can triers of fact ever precisely (mathematically) measure the range and its favourable portion? Clearly the answer is no, but are there so-called experts who are qualified to measure the range and its favourable portion, and if there are should they undertake such measurement? Again it should be emphasized that any measurement, even by an expert, is in no sense eternally justifiable, yet in an internal sense it may be accepted as rational to act upon the measurement of an expert. It is suggested that it is considered rational and courts do allow experts to provide the trier of fact with measurements, and indeed to specify the appropriate range. The recent case of *R. v. Van Beelen*⁵⁴ is authority for this proposition. To prove that the accused had murdered and raped the deceased the prosecution adduced evidence that certain paint specks were found in the clothing of both the accused and the deceased. The paint specks could be relied upon to infer that the parties had come in contact if it could be established that the specks had a common origin with which only one of the parties had come into contact. To prove the common origin the prosecution called an expert paint analyser who, with the aid of an electron probe micro-analyser, had analysed the paint specks in question (as well as many other paint specks). He was willing to testify that the specks did have a common origin. The Court allowed him to so testify, although holding that he was not sufficiently qualified to quantify the probability of common origin:

Nevertheless, we think that, once expertise has been established, an expert can express opinions on matters within his field in terms of probability or likelihood without being qualified as a statistician, though it may well be that this will be necessary before he can express his views in mathematical terms, for a mathematical expression of the odds may demand statistical or, at least, mathematical expertise.⁵⁵

If then it is rational to accept the measurement of an expert, the trier of fact has at its disposal a technique for calculating probability assessments

⁵⁴ *Ibid.*

⁵⁵ *Ibid.* 384.

in mathematical terms in some cases. But is the technique of any help? To begin with the expert assessment will have to be added to the trier's own probability assessments. Thus in *R. v. Van Beelen* before the expert testifies the trier may feel that the evidence to that point does create a probability of X per cent that the parties came into contact. How is the expert's assessment of the probability of common origin and hence contact (say Y per cent) to be combined with the trier's previous assessment?

Finkelstein and Fairley⁵⁶ have suggested that Bayes Theorem can be used by the trier of fact to indicate how the expert's mathematical judgment affects the probability of the fact in issue. This theorem of Probability Calculus shows how the probability of an hypothesis ($P(H)$), the fact in issue, is increased by the addition of further evidence (E) *i.e.* the theorem determines the probability of H, the fact in issue, given that E exists ($P(H/E)$). As the theorem has been often proved (*e.g.* by Finkelstein and Fairley)⁵⁷ the proof will not be given here. But the operation of the theorem will be shown.

The theorem states:

$$P(H/E) = \frac{P(E/H) \cdot P(H)}{P(E/H) \cdot P(H) + P(E/-H) \cdot P(-H)}$$

or to put it into words:

The probability of the hypothesis given the evidence =	The probability of the evidence given the hypothesis multiplied by the probability of the hypothesis
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(The probability of the evidence given the hypothesis multiplied by the probability of the hypothesis) plus (the probability of the evidence given that the hypothesis is false multiplied by the probability that the hypothesis is false.)

Note that, on the assumption that certainty equals one, the probability that the hypothesis is false is one minus the probability that the hypothesis is true.

i.e. $P(-H) = 1 - P(H)$

To take an example:

The hypothesis (H) — that A met B.

Its negation (-H) — that A did not meet B.

There is evidence that A was in the vicinity and before evidence E is introduced the trier places the probability of meeting, $P(H)$, at .6. The probability of not meeting is thus .4.

The evidence E, to be introduced, is that hairs similar to those from the pullover worn by A on the day in question were found on B's body. If A and B did meet then the probability of the hairs matching will be 1 (*i.e.* $P(E/H) = 1$).⁵⁸ The probability of the hairs matching if A did not meet B (*i.e.* $P(E/-H)$), *i.e.* the probability of a random match, is put by an expert witness at .4 (*i.e.* $P(E/-H) = .4$). Taking the theorem and substituting these figures:

⁵⁶ Finkelstein M. O. and Fairley W. B., *op. cit.*

⁵⁷ *Ibid.*

⁵⁸ I use this figure to simplify. Tribe L. H., *op. cit.* 1361-5 has shown that the presence of hairs does not necessarily prove a meeting *e.g.* the hairs may have been 'planted' on the victim. Calculating such contingencies makes the application of the theorem cumbersome and difficult, and because such contingencies are difficult to quantify there is a real danger they may be ignored.

$$\begin{aligned}
 P(H/E) &= \frac{P(E/H) \cdot P(H)}{P(E/H) \cdot P(H) + P(E/-H) \cdot P(-H)} \\
 &= \frac{1 \cdot .6}{1 \cdot .6 + .4 \cdot .4} \\
 &= .79
 \end{aligned}$$

The probability of meeting has thus been increased to .79.

If there is further evidence that similar paint specks were found on A and B and the probability of a random match is put by experts at .4 the probability of a meeting is increased again, this time to approximately .90.⁵⁹

The theorem is of immediate interest for it shows how circumstantial evidence increases the probability of the fact in issue, and substantiates the rule of law accepted in *Van Beelen's* case that allows the jury to conclude the facts supporting guilt beyond reasonable doubt although each item of evidence is itself equivocal and would not by itself justify the finding of those facts beyond reasonable doubt.⁶⁰ But can the theorem be used by triers of fact? There are many problems with this as Tribe points out in his article 'Trial by Mathematics'.⁶¹

A major problem arises from the assessment of the initial probability to which the expert statistics are to be added.

Few laymen have had experience with the assignment of probabilities, and it might end up being a matter of pure chance whether a particular juror converts his mental state of partial certainty to a figure like .33, .43, or somewhere in between. An estimate of .5 might signify for one juror a guess in the absence of any information and, for another, the conclusion of a search that has narrowed the enquiry to two equally probable suspects.⁶²

The problem is well illustrated by considering the facts in *Van Beelen*. A young girl had been killed upon a lonely beach. The police conducted enquiries and ascertained that at the time of the murder (say) six people were in the vicinity, one of course being the accused. The probability of the accused having met and killed the girl appears to be 1/6. But the jury heard each witness's account of what he (or she) was doing in the vicinity. Only the accused's account was suspicious. What is the probability when these accounts are considered? And of course there may have been other

$${}^{59} \frac{1 \cdot .79}{1 \cdot .79 + .21 \cdot .4} = \frac{15}{17} \cong .90$$

⁶⁰ The main issue in *R. v. Van Beelen* (1973) 4 S.A.S.R. 353 was whether each item of circumstantial evidence had to be proved beyond reasonable doubt before it could be acted upon. The Court held, rightly according to Bayesian analysis, that when such evidence is to be relied upon and is parallel with other items of evidence (all evidence being strands of the same rope!) then each item of circumstantial evidence need not be proved beyond reasonable doubt and the question is whether having regard to all the (dubious) circumstantial evidence the fact in issue can be inferred beyond reasonable doubt. Rather surprisingly the Court also held that where inferences had to be drawn vertically, one from the other, the first did not have to be established beyond reasonable doubt but merely had to be clearly proved. The Court felt that juries would only be confused if they were told that particular inferences had to be proved beyond reasonable doubt. Although logically they may have to be so proved the jury need only be directed that guilt, the final material fact in issue, must be proved beyond reasonable doubt (at pp. 369-80).

⁶¹ (1971) 84 *Harvard Law Review* 1329, 1358-77.

⁶² *Ibid.* 1358-9.

people in the vicinity who were not seen. How do you make a preliminary assessment of the probability that Van Beelen met and killed the girl in these circumstances? Tribe concludes:⁶³

Because the Finkelstein-Fairley technique thus compels the jury to begin with a number of the most dubious value, the use of that technique at trial would be very likely to yield wholly inaccurate, and misleadingly precise, conclusions.

Certainly the technique cannot produce a precise result in the sense that the technique cannot produce a probability assessment that is eternally accurate. However the formulators of the technique do not make this claim. The claim is that Bayes Theorem will indicate how an initial probability assessment is affected by further evidence. If the jury only considers there is a .6 probability that the accused met the deceased after the preliminary evidence and the scientists, on analysing paint specks found on the accused and the deceased place the probability of common origin and thus contact at .4, Bayes Theorem will show the rational relationship between these two assessments of probability. Given that the jury accept the two assessments the Theorem accurately shows their relationship, that is all. It is not argued that the final calculation is eternally accurate but that it is internally rational.

So that although the initial assessment of probability is difficult and not eternally accurate Bayes Theorem can still be of help.

But Tribe has other compelling criticisms. He fears that in making the initial assessment of probability jurors will make improper use of the fact that the police have charged this particular accused (there must be a reason for it, namely that he is guilty!), and of the fact that a magistrate has committed the accused for trial (which he would not do unless there was strong evidence implicating the accused!). This is improper for two specific reasons: firstly the probability estimate should be based only upon the admissible evidence presented at the trial and secondly, police suspicion and committal by a magistrate is based upon evidence which will usually later be introduced at the trial, so to rely upon such matters would result in evidence being counted *twice*. But more generally, if the jury makes an initial probability assessment that indicates guilt, when the jury comes to finally decide the verdict it begins not with the traditional presumption that the accused is innocent but with the presumption that he is probably guilty, and the only question is whether the further evidence has established that guilt beyond reasonable doubt. Perhaps such an approach has the virtue of honesty. It can be appreciated that these criticisms have less application to civil cases, although the basic problem of putting a figure upon initial probability remains.

Yet another problem in applying Bayes Theorem is that after the application of the theorem the trier of fact is left with a figure, denoting

⁶³ *Ibid.* 1359.

the probability of the fact in issue, and it must then be determined⁶⁴ whether this figure satisfies the appropriate standard of proof. This means that the phrases 'on the balance of probabilities' and 'beyond reasonable doubt' must be quantified. Leaving aside the difficulties in agreeing upon a figure, difficulties adverted to by Simon and Mahon,⁶⁵ difficulties which may be approached upon the basis of Decision Theory,⁶⁶ it may be asked whether it is ever desirable to quantify, particularly in criminal cases, for in quantifying the probability of guilt one is also quantifying the probability of innocence. Thus many of the persons surveyed by Simon and Mahon accept .9 as a fair quantification of the phrase beyond reasonable doubt, but would they accept this figure if it was pointed out to them that this would involve convicting one innocent man for every nine guilty men convicted? Will confidence in our system of proof be eroded if courts admit expressly to the public that every now and again, one time in ten perhaps, an innocent man is convicted? At present the law seeks certainty. Any reasonable doubt demands a verdict of innocence. The majority of those interviewed by Simon and Mahon quantified the phrase 'beyond reasonable doubt' at 1.0, at certainty. The system never admits to the sacrifice of an innocent man although in fact this must happen every now and again. This myth of certainty is important to continued confidence in the present system of criminal trial.⁶⁷

It is also important that the public understand the process of proof. This leads to another criticism of the application of Bayes Theorem. Without an understanding of the theorem the public will be confronted with a magic formula which churns out verdicts. This leads to what Tribe calls the 'Dehumanization of Justice':

There is at stake not only the future weakening of the confidence of the parties and of their willingness to abide by the result, but also the further erosion of the public's sense that the law's fact-finding apparatus is functioning in a somewhat comprehensible way, on the basis of evidence that speaks, at least in general terms, to the larger community that the processes of adjudication must ultimately serve. The need now is to enhance community comprehension of the trial process, not to exacerbate an already serious problem by shrouding the process in mathematical obscurity.⁶⁸

We must always remember that our discussion of fact-finding takes place in the context of dispute resolution and society will only have faith in those procedures for settling disputes which reflect beliefs held by that society. If that society is sceptical of statistics and numbers it will be sceptical of proof, and dispute settlement, utilising statistics and numbers. This criticism would seem to apply equally to civil and criminal cases.

⁶⁴ *I.e.* as a matter of law.

⁶⁵ Simon R. J. and Mahon L., 'Quantifying Burdens of Proof' (1971) 5 *Law and Society Review* 319.

⁶⁶ I have already shown how Decision Theory may be used to set the standard of proof.

⁶⁷ The point has often been stressed by the American Realists.

⁶⁸ Tribe L. H., *op. cit.* 1376.

As well as the above criticisms there are other problems with the Bayesian approach. In particular one might ask what reaction a jury would have to the quantification of various issues. It would no doubt be somewhat over-awed and may blindly accept a high probability figure without understanding its significance in relation to the other issues in the case. The probability assessment will relate merely to one factual issue (for example identity) and have no bearing upon whether, for example, the accused had the requisite guilty intent, and the jury must be convinced on both issues before it can record a verdict of guilty. Finkelstein and Fairley⁶⁹ make this mistake of talking in terms of the probability of *guilt* rather than of the probability of the occurrence of a particular material fact. If the Bayesian approach is to be used the trial judge would have to explain its significance to particular facts only, not to the more general question of guilt which requires the finding of a number of facts.

With what then are we left? We have elucidated the process of drawing inferences from evidence without eternally justifying it. But there are difficulties in creating precision because generally measurement is lacking. Where there is measurement there is the problem of combining the figure of the expert with non-mathematical probability judgments. Bayes Theorem can overcome this problem but the result is a number. This obliges us to quantify standards of proof which in turn obliges triers of fact to admit the chances of their being wrong. Whether society would retain confidence in triers of fact under these circumstances is doubtful. We must conclude that quantification is undesirable. Probability judgments must be expressed in general terms and intuitively combined. But it is suggested that triers should still be aware of the chains of inferences involved in their decisions of fact and the general propositions upon which their inferences depend. Conclusions of fact are thus semi-rational.

Are there any alternative approaches that we may take to decisions of fact? Two possible alternative approaches warrant comment.

Firstly, it would be possible to avoid talking in terms of probability and talk instead in terms of belief. This gains support from a *dictum* of Dixon J. in *Briginshaw v. Briginshaw*.⁷⁰

The truth is that, when the law requires the proof of any fact, the tribunal must feel an actual persuasion of its occurrence or existence before it can be found. It cannot be found as a result of a mere mechanical comparison of probabilities independently of any belief in its reality.

The suggestion then is that proof is not so much a matter of probability as a matter of belief. But what do we mean by belief in this context? Hume states that:

[B]elief consists merely in a certain feeling or sentiment; in something, that depends not on the will, but must arise from certain determinate causes and principles, of which we are not masters.⁷¹

⁶⁹ Finkelstein M. O. and Fairley W. B., *op. cit.* 498-500.

⁷⁰ (1938) 60 C.L.R. 336, 361.

⁷¹ David Hume, *A Treatise on Human Nature* (1888) 624.

But belief is nevertheless dependent upon evidence and with new evidence or new criteria for assessing evidence it is possible to change one's beliefs. And because of this dependence upon evidence we talk of some beliefs being reasonable and some being unreasonable, for example the belief of the mad-man that he is Napoleon. We cannot be concerned with unreasonable beliefs. If this is accepted, that we are making rational claims, then it must be concluded, as Swinburn concludes, that a person holds a rational belief when upon the evidence available to him the proposition in which he believes is more probable than any other alternative.⁷² Of course the alternatives include the proposition that none of the other alternatives are true. We are thus driven to the concept of probability. If the belief is to be rationalized the probability of each alternative must be determined before the most probable can be used as the basis of belief. Of course belief does not necessarily follow upon such a determination but belief in a less probable alternative would be considered irrational. So that even though proof may be ultimately a matter of belief the first step for the trier of fact is to determine the probability of the fact in issue in relation to the probability of all possible alternatives. But is proof ultimately a matter of belief? If the trier of fact does (reasonably) consider the fact in issue to be the most probable alternative he must then ask himself whether he is 'reasonably satisfied' or 'satisfied beyond reasonable doubt' that the fact in issue occurred. He may consider the probability of the most probable alternative insufficient basis for such satisfaction. Or to put it another way he may still not believe that the most probable alternative did actually occur. What if he does? Is proof merely a matter of the trier of fact's beliefs? It is suggested it is not. Belief is an entirely subjective concept. We are not concerned with any old beliefs. We are only concerned with beliefs amounting to 'reasonable satisfaction' or 'satisfaction beyond reasonable doubt' *i.e.* the degree of probability of the facts in issue must be sufficiently high to form the basis of a belief amounting to 'reasonable satisfaction' or 'satisfaction beyond reasonable doubt'. Although it is impossible to quantify the probability required yet appellate courts will overrule verdicts based upon beliefs which are not supported by a sufficient degree of probability. The point is that at all stages beliefs are being closely watched for they must be *rational* beliefs. A belief is only rational if the degree of probability is sufficient. We cannot escape the concept of probability by talking in terms of belief.

The other approach is to give up trying to settle disputes by determining facts and applying norms to those facts and to settle disputes by mediation. This raises a whole host of problems which do not fall within the province of this discussion which is centred about the present method of dispute settlement and as has been shown⁷³ dispute settlement in our society is essentially judgmental, dependent upon fact-finding.

⁷² Swinburne R., *An Introduction to Confirmation Theory* (1973) 185.

⁷³ *Supra* pp. 368-75.

4. CONCLUSION

Our judgmental system of dispute settlement emphasizes fact-finding. Originally decisions of fact were left entirely to the jury and could be described as entirely subjective. However, when juries began to act only upon the evidence presented by the parties judges began to demand that any conclusion be rational, in the sense that any conclusion of fact had to be supported by the evidence. Juries, and other triers of fact, are now expected to come to their conclusions of fact in a rational way although the rational guidelines have not to date been elucidated. It is suggested that the first step towards rationality is for the trier of fact to be aware of the chains of inferences that must be drawn in order to come to the desired conclusion of fact. Secondly, the trier of fact ought to concentrate upon the strength of each and every inference. This strength can only be properly appreciated if the general proposition upon which the inference depends is elucidated. The general proposition seeks its validity in the Range Concept of Probability which, although not eternally justifiable as dependent upon the principle of indifference and at times the concept of a limiting frequency, nevertheless is sufficiently accepted to be regarded as a rational guideline for all probability judgments. Experts may elucidate the general proposition in general or mathematical terms. However, in the latter case, although Bayes Theorem may be accepted as a rational guideline, the Theorem should not be employed by triers of fact to combine the expert judgment with their own probability judgments for this would involve the undesirable course of quantifying the standards of proof. This is not to suggest that the standards of proof are at the whim of triers of fact. They are not. But conclusions of fact ought not to be subjected to mathematical precision until society is ready to accept, and be confident in, such a method of dispute settlement. Triers of fact also have sufficient difficulty elucidating their chains of inference without subjecting them to the technicalities of Bayes Theorem. Some courts have so little respect for triers of fact, juries in particular, that they discourage them from analysing their thought processes at all.⁷⁴ It is suggested that this is wrong in view of the acceptance

⁷⁴ *E.g. Green v. R.* [1972] A.L.R. 524, 527: 'A reasonable doubt is a doubt which the particular jury entertain in the circumstances. Jurymen themselves set the standard of what is reasonable in the circumstances. It is that ability which is attributed to them which is one of the virtues of our mode of trial: to their task of deciding facts they bring to bear their experience and judgment. They are both unaccustomed and not required to submit their processes of mind to objective analysis of the kind proposed in the language of the judge in this case. "It is not their task to analyse their own mental process." (Windeyer J., *Thomas v. R.* (1960) 102 C.L.R. 584, 606.) A reasonable doubt which a jury may entertain is not to be confined to "a rational doubt", or "a doubt founded on reason" in the analytical sense, or by such detailed processes as those proposed by the passage we have quoted from the summing up.'

E.g. R. v. Van Beelen (1973) 4 S.A.S.R. 353, 374: '. . . the jury is not, in our view, required to split up the various stages in the process of reasoning leading to the conclusion of guilt beyond reasonable doubt and to apply some particular standard of proof to each of those steps (*c.f. Thomas v. The Queen* [1972] N.Z.L.R. 34) and to instruct them to do so would, in our view, be confusing and possibly misleading and would tend to the imposition of an artificial and scholastic straitjacket on their deliberations.'

of the proposition that decisions of fact are rational conclusions from the evidence presented by the parties.

Difficulties remain. Our rational guidelines are internal and not eternally justified. Assessments of probability vary from individual to individual. Yet we strive for rationality. Decisions of fact are not subjective. There are guidelines. It is important that triers of fact approach their decisions in an orderly way.