The Problem of Certainty and the Changing Status of Probable Proofs

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Abstract: This essay offers a preliminary survey of the development of probabilistic proofs in the early modern period. It examines several disciplines and their adoption of a mode of proof which embraced a scale of probability and whose high point was variously labeled "satisfied conscience," "mind," and "understanding," "moral" as opposed to "mathematical certainty" or "demonstration," and proof "beyond reasonable doubt." Although my focus is on England, I view this essay as part of a broader account that would include French, Italian and Spanish developments and earlier and later periods. I emphasize the long-lived ancient distinction between probability and certain knowledge, and between rhetoric and "science," arguing that these distinctions played a crucial role in shaping thinking about proof. My account highlights the role of witnessing, the criteria for evaluating testimony, and the possibility of reaching moral certainty, that is, belief beyond reasonable doubt. The first discipline to be examined is history, a discipline characterized by tension between the humanist desire for a rhetorically persuasive narrative on the one hand and truth telling norm on the other. The next to be examined are the probabilistic proofs adopted in several religious contexts. There follows a comparison of continental and English approaches to legal proof. The most challenging intellectual area to be examined is the natural sciences. There I examine efforts to find a probabilistic alternative to "science," "demonstration" and "mathematical certainty. Scientists sought to adopt "hypothesis" as a means of linking "matters of fact" with generalizations, principles and theory. A brief treatment of Locke and his philosophical successors suggests how probabilistic proofs penetrated English thinking. The concluding section includes a discussion of disciplinary differences and suggestions for a more complete treatment of probable but believable proof.

1. *Introduction*

This essay offers a preliminary survey of the development of probabilistic proofs in the early modern period. It examines several disciplines and their adoption of a mode of proof which embraced a scale of probability and whose high point was variously labeled "satisfied conscience", "mind", and "understanding", "moral" as opposed to "mathematical certainty" or "demonstration" and proof "beyond reasonable doubt. "Although my focus is on England, I view this essay as part of a broader account that would include French, Italian

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and Spanish developments and earlier and later periods. I emphasize the long-lived and hugely important ancient distinction between probability and certain knowledge, and between rhetoric and "science", arguing that these distinctions played a crucial role in shaping later thinking about proof. My account highlights the role of witnessing, the criteria for evaluating testimony, and the possibility of reaching moral certainty, that is, belief beyond reasonable doubt.

The first discipline to be examined is history, a discipline characterized by tension between the humanist desires for a rhetorically persuasive narrative on the one hand and the truth telling norm on the other. The next to be examined are the probabilistic proofs adopted in several religious contexts. There follows a comparison of continental and English approaches to legal proof. The most challenging intellectual area to be examined is the natural sciences. There I examine efforts to find a satisfying probabilistic alternative to "science", "demonstration" and "mathematical certainty". Scientists sought to adopt "hypothesis" as a means of linking "matters of fact" with generalizations, principles and theory. A brief treatment of Locke and his philosophical successors suggests how probabilistic proofs penetrated English thinking. The concluding section includes a discussion of disciplinary differences and suggestions for a more complete treatment of probable but believable proof.

Before beginning with the early modern disciplines, it should be emphasized that the ancient Greeks, focused on what became the long-lasting Aristotelian division between probability on the one hand and "science" or "demonstration" on the other. For many centuries the term "science" did not refer to what we call "natural science", and instead referred to "certainty" or "demonstration". Although the Roman rhetoricians Cicero's and Quintilian's treatment of forensic oratory emphasized persuasiveness rather than proof or truth, their compilations of personal characteristics such as birth, education, life style and gender, which could be used for positive and negative characterizations of individuals, would, with some additions, be adopted by several early modern truth-seeking disciplines as a means of evaluating witness testimony. The evaluation of witness testimony would play a prominent role in the proofs offered by early modern historians, theologians, jurists and naturalists as would the rhetorical categories of direct and indirect proofs, that is, testimony and "circumstances". Witness testimony was said to provide "direct proof". Circumstances that would later be called "circumstantial evidence" was said to provide "indirect proof".

Early Christianity brought to the fore questions of belief, correct belief and heresy and how these might be identified. During the medieval period several religious institutions including the courts dealt with probability issues.

My focus is on England in the early modern period c. 1500-1800. I discuss how several intellectual endeavors made use of probabilistic approaches to

knowledge-making and the degree to which they rejected approaches that prioritized "demonstration" or "mathematical certainty".

Renaissance humanists played a role in this development when they initiated the revival of classical rhetoric, a discipline that emphasized persuasiveness rather than proof or "certainty" in connection with moral and political issues. They were attracted to considerations of "prudence" which did not aspire to universal principles. In addition to their attacks on scholastic modes of thinking, humanist involvement in poetry or "poesy" resulted in discussions of the relative value of "fact" and "fiction", with some literary voices insisting that the fictions of poetry were superior to factual, historical accounts for instilling moral lessons. The polarity between rhetoric and logic, probability and certainty, remained.[1]

2. *History*

Typically associated with humanist endeavors, early modern historical writing, unlike other disciplines, exhibited tension between the two norms of persuasiveness and truth. Historical writing was to be both persuasive in teaching about morals and politics and committed to truthful reporting. Despite the historian's commitment to reporting nothing but truth, they were nevertheless permitted leeway to create imaginary speeches and reorder events in order to present a persuasive narrative. History, typically centered on the lives and actions of great men, was thought to be best composed by those who witnessed the events in question. The ancient historians, Caesar, Polybius and Tacitus were admired both for their style and their instructive capabilities. Historians were to adhere to norms of truthfulness and impartiality and to the rejection of falsehood and fiction. The truth standard drew historians to epistemological issues of what kind of knowledge might or might not be available for past events and to fact finding methods that focused on the credibility and reliability of witnesses. Cicero's first law of history was to tell nothing but the truth; while the second granted permission to manipulate historical material in order to make the narrative more convincing. This tension is echoed by a seventeenth-century critic of Bulstrode Whitlocke, who wrote that he came "up to the dignity of a historian" on some occasions and at others simply reported "occurrences diary wise" without refining them "to the perfection and true standard of a History (Whitelocke 1682: "To the reader").

Early modern historians did not dispute that history, by its very nature, was incapable of mathematical certainty or metaphysical truth but nevertheless insisted it might make statements worthy of "belief", a term that also frequently

[1] Ramus, however, reduced rhetoric to "style" and "delivery".

appears in other disciplines concerned with probable proof. Some historians, particularly those in France, wrote in opposition to skeptics who denied that any knowledge was possible. The anti-skeptics were necessarily led to consider the nature of historical knowledge.

A succinct description was offered by Seth Ward in the mid-seventeenth century. Ward insists that the absolute certainty of demonstration was inappropriate for matters of fact. If a history claimed to be "within in the bounds of evidence and certainty", it must be considered whether the author "had sufficient means of Knowledge", whether he was "an eye or ear witness" and whether the things reported were "publicly acted and known". It was necessary to consider "the qualities of the relators", and their "understanding, sufficiency and Integrity… as well a possible bias or interest". When reporters met the appropriate criteria one could believe in events, places and other matters of fact that were not "reasonably absurd". It was, therefore, "rational" to believe an unbiased, firsthand account of historians such as Caesar's account of the war against the Gauls" (Ward 1667: 84-88, 98-106).

For mid-seventeenth-century historian, Thomas Fuller, "If the Witnesses be Suborned, the Record falsified, or the Evidence wrested", posterity neither "can judge rightly of the action of the present time" or make a "certain Judgment of the Ages past" (1659: 18). Several decades later Lord Bolingbroke wrote that the number of witnesses as well as the character of witnesses must be considered: "If there be none such he will doubt absolutely; if a little… he will proportion his assent or dissent accordingly" (1971: xxxvii).

Even Thomas Hobbes, who sought a demonstrative civil philosophy, believed, "The register of Knowledge of Fact is called History" and it included both civil and natural history (1962: 69). In many instances facts were "no less free from doubt than free and manifest Knowledge… There being things in which we believe from the Report of Others of which it is impossible to imagine any cause of Doubt" (Hobbes, 1928: pt. l, ch. 6, sec. 9).

Those defending the possibility of historical knowledge typically began with the distinction between demonstration and probability, arguing that the latter category ranged from low to high probability. Well substantiated facts by credible witnesses might yield probable knowledge but not demonstration. Accurate and credible accounts of past events were therefore possible. History fell into the category of the probable, yet could claim a kind of certainty appropriate for "matters of fact" (cf. Shapiro 1985: 119-62). The tension between the literary and rhetorical aspects and the norms of impartiality and truthfulness which characterized early modern historians continues to be heard in modern disputes about the nature of history, its rhetorical features and its commitment to impartiality and truth.

3. *Religion*

Religious practices and controversies frequently centered on issues of probability and certainty. Casuistry, a method of moral decision making, was the creation of medieval clerics to assist priests in guiding those seeking confession. It is relevant to our discussion because it explored decision-making under conditions of uncertainty. It consisted of probable arguments rather than evidence or proof. The introduction of Protestant casuistry is significant because decisions were to be made by individuals without the intervention of a skilled confessor. Judgments of conscience could not simply defer to authority or to the advice of another individual, a modification that brought English casuistry in contact with epistemological issues.[2]

William Perkins, a well-known sixteenth-century Puritan, wrote that God had "erected a tribunal" in "conscience", which was the "highest judge that is or can be under God". The "courts of man and their authority are under conscience" (1966: x, 3, 5, 9, 32). William Ames, another Puritan cleric, stressed that conscience involved rational decision making by the "intellect" (1639: 2-3). Jeremy Taylor in 1660 adopted the familiar distinction between "mathematical" or "demonstrative" certainty and "moral certainty". Taylor stressed the role of the intellect, noting that conscience is the "mind", the product primarily of the "understanding". Although non-demonstrative thinking could only be probable, on some occasions the "probable or thinking conscience" might be "made certain by accumulation of many probabilities operating the same persuasion". Taylor called the result "moral demonstration" (1660: 3-4, 30, 55). Robert South, another Restoration era Anglican cleric, similarly insisted that mathematical certainty was unnecessary in moral decisions. It was "sufficient" if the decision rests "upon the grounds of a convincing probability that shall exclude all rational grounds of doubting it" (1718: 119; cf. also: McAdoo 1949: 77). Conscience must consider reasonable doubts, but not be excessively doubtful.

John Sharp rejected the notion that the "certainty of Moral sciences could rise no higher than probable Opinion". "Sometimes the Evidence is so strong, as to command an entire Assent of his Understanding, an Assent so full that not the least mixture of doubtfulness in it". When evidence was "not as strong… as to exclude all Doubt" it was labeled "opinion" or "probable persuasion". Sharp referred to degrees of probability and to "satisfaction" of the "mind", as well as to the "resolved", "scrupulous", and "erroneous" con-

[2] Many Catholic theologians followed "laxism", a practice allowing one to safely choose a side if approved by a single authority, even though the other side was more probable. "Tutiorism" permitted taking the safer side when positions were of equal weight.

science (1688: 4, 13). It is noteworthy that Sharp now writes about "evidence" rather than arguments or authorities.

Continental philosopher Samuel Pufendorf also rejected the position that the "certainty of Moral sciences" could rise no higher than "probable Opinion". The rightly informed conscience was "true and certain and sees no reason to doubt" (1703: 11, 17-18, 21). Henry Sacheverell expressed similar views in the early eighteenth century (1706: 6-7. This view of conscience was disseminated to a large audience in popular dictionaries and encyclopedias (cf. Chambers 1728: xx, ix [I used 1738 ed]; Johnson, 1755-56: unpaginated).

The convergence of "conscience", "mind" and "understanding" was important because it made it easier for more secular thinkers such as John Locke to explore the "human understanding". It also suggests why in instructing juries some English judges adopted the language of "satisfied conscience", "satisfied understanding" and belief reaching "moral certainty".

A somewhat similar approach to knowledge was to be found in sermons and treatises providing rational proofs for belief in Christianity and Scripture. In the early seventeenth century Hugo Grotius' widely read *Truth of the Christian Religion* adopted the familiar Aristotelian dichotomy between probability and demonstration to argue, again following Aristotle, that there were different proofs for different things. While matters of faith were not as certain as mathematical demonstration or the immediacy of sensation, it was possible to reach sound conclusions in matters of fact. A reasonable person, that is one without an excess of passion or prejudice, could reach sound conclusions as to Christian doctrine" (Grotius 1680: 94).

The need to provide a rational proof for Scripture became a pressing issue in England in the 1640's and 1650's when radical religious sects often claimed that faith was based on intuition or direct illumination from God. This need for rational proofs of Scripture again became pressing during the latter part of the seventeenth century when Christians replied to challenges by atheists, free thinkers and deists. Those claiming the truth of revelation and Biblical miracles relied primarily on the argument from credible witnesses, that is, the Apostles and those who heard them. The criteria for witness credibility were largely derived from classical rhetorical texts.

Cleric Samuel Clarke defended revealed religion relying on testimony of the Apostles that provided "the most credible, certain and convincing Evidence, that was ever given to any Matter of fact in the World". There was "no more reason to doubt" the "principal facts of the Christian saga" than the facts of "any History or any ancient matter of fact" (1711: 13, 258, 327).

Concern with levels of certainty in English anti-Catholic polemic was at its highpoint during the Restoration era when Roman Catholics asserted the infal-

libility of Catholic doctrine and their opponents defended belief in Scripture on the basis of moral certainty. William Chillingworth had already used the moral certainty approach in his 1638 *Religion of Protestants* (cf. Chillingworth 1638: 31-34, 38; see also: Orr 1967). John Tillotson, an influential Restoration latitudinarian cleric, employed similar arguments to refute the possibility of an infallible oral tradition while arguing for the reasonableness of, but not absolutely certainty of, belief in Scripture, history, or the existence of America. Moral certainty was possible in matters of fact and the events reported in Scripture belonged in that category (1666: 20, 30, 94).

Proponents of the "rational" or "natural" theology of the late seventeenth and eighteenth centuries similarly employed the distinction between "science" which admitted no doubt and "probable" reasoning which ran the gamut from disbelief, to doubt, to the summit of probable knowledge, "moral certainty". In 1675 Bishop John Wilkins' often reprinted *Principles and Duties of Natural Religion* provided rational proofs for the existence of God and his attributes, the existence of an immortal soul, and duties that could be proved without revelation. Wilkins' treatise distinguished between physical, mathematical certainty and moral certainty, the last being the highest level of certainty attainable in the realm of probability. Moral certainty was "assent which doth arise from such plain and clear Evidence that doth not admit of any reasonable Cause of doubting". Evidence "may be so plain that every man whose judgment is free from prejudice will consent upon them" and will not "admit of any reasonable doubt concerning them (Wilkins 1675: 7-8, 10-11, 30).

Unlike proof for belief in Scripture, proofs for the principles of natural theology could not be supported by witness testimony. Instead such proofs relied on inferences drawn from the "matters of fact" of the natural world. Natural theology, or physico-theology as it was sometimes called, proved particularly attractive to members of the scientific community who promoted the collection of credible observations of natural phenomena. The inferential knowledge of the natural theologians was similar to the jurists' use of "circumstances" and later "circumstantial evidence".

John Ray's *Wisdom of God Manifested in the Works of Creation*, perhaps the most popular work of natural theology, took its proofs "from the Effects" of nature which were exposed "to every man's view". Plants, animals and other natural phenomenon, he argued, could only have been produced by an infinitely wise beneficent agent. The study of "God's handiwork", proved the deity's existence to a moral certainty (1691: "Preface to the reader"). Boyle lecturer Samuel Clarke relied on "matters of fact", "credible witnesses", "reasonable and sufficient proof" and "moral certainty" (1706: 3). George Campbell argued that belief in God "carries a very high degree of probability, which leaves little room

to doubt": "Why call a thing in doubt of which we have as good evidence as human nature is capable of receiving" (1988: 50; cf. also: Butler 1736: 204, 257, 323, 328-29).

Still another use of "probability" emphasized human fallibility to combat Roman Catholic claims to infallibility that justified religious dogmatism and persecution. Already in the sixteenth century, Erasmus, arguing against Luther, emphasized human fallibility, insisting that religious doctrine fell into the category of "opinion". He recommends that "we define as little as possible, and in many things leave each one free to follow his own judgment" (1961: 5, 7, 9-10). Similar arguments were offered in Sebastian Castellio's attack on the Calvinist burning of Michael Servetus for heresy. Italian Protestant Joseph Acontio emphasized the human capacity for error and noted that differences of opinion were exhibited by even the wisest of men. He distinguished the fundamental articles of Christianity believed by all from lesser doctrines where dispute was acceptable. Persecution on the basis of "opinion", a lower level of probability than moral certainty, was indefensible.

From the early seventeenth century Protestants such as Lord Falkland contested Catholic claims to infallibility by arguing that in religious questions it was necessary to be satisfied with probabilities because there was little in nature capable of demonstration except "lines and numbers". William Chillingworth invoked "moral certainty" for things "believed" but not "known" to argue that the fundamentals of religion could be held with a high degree of certainty. Non-fundamentals remained in the lower category of "opinion". Restoration latitudinarians, many of whom were active in promoting natural religion and rational support for belief in Scripture, adopted the distinction between fundamentals and non-fundamentals. Fundamentals were few. Non-fundamentals, such as ceremonies, vestments, forms of prayer and most theological doctrines, were opinions that might or might not be true, and were not required for salvation. "Opinion" was increasingly being viewed as ranging from doubt to the pinnacle of beyond reasonable doubt. Dogmatism, with excessive zeal about opinions, led to "Disputes, Hatreds, Separations, and Wars" (Glanvill 1676: Essay IV, 27, 53, 54). Latitudinarians believed that a mistaken theory of religious knowledge led to unnecessary persecution and religious war. Concentration on religious fundamentals would permit diversity on less fundamental issues (cf. Glanvill, 1668: 149; Sprat, 1958: 33-34, 53-54; see also: Shapiro 1968).

The numerous publications devoted to rational proofs for Christianity or natural religion, and arguing against claims to infallibility, insured that English readers became familiar with probabilistic ways of thinking about proof, that is, that appropriate evidence might lead to moral certainty and belief beyond reasonable doubt.

4. *Law and Courts*

Decisions in disputes between individuals and prosecution for violation of law for many centuries relied on ordeals and other irrational proofs, until they were outlawed by the Church in 1215. After 1215, two types of legal decision developed. Continental jurisdictions adopted the Romano-canon system in which decisions were reached by professional judges bound by a set of rules that kept judicial discretion at a minimum. Capital crimes required "full proof", which consisted of the testimony of two reliable witnesses, or confession. Nothing else could be substituted. Torture, rigorously controlled, was permitted to elicit confessions. Less than "full proof" could not result in a death penalty but allowed for harsh punishments such as galley service. There emerged a system which calculated "full", "half" and "quarter" proofs. Learned treatises from as early as the mid-thirteenth century, and later ones by Mascardus (1597), Menochius (1607) and Everhard (1620) dealt with presumptions, conjecture and related evidentiary topics. The full, half and quarter proof system did not fundamentally change for several centuries. In the late seventeenth century jurists Pufendorf, Domat, and Pothier began exploring a probabilistic approach to evidence, and Leibniz explored degrees of probability and certainty.

English common law took a different path. Lay jurors, not professional judges, decided matters of fact. Initially jurors decided cases on their own knowledge. With the introduction of witnesses, juries now had to make judgments of guilt or innocence on the basis of witness testimony using the criteria first developed by Cicero and Quintilian. The criteria were also readily available in the sixteenth- and seventeenth-century manuals that guided justices of the peace in making preliminary assessments of those accused of crimes. The criteria included companions, education, social status, gender and reputation for integrity.

By the early seventeenth century, however, Francis Bacon, a prominent lawyer, indicated that English law left "both supply of testimony and the discerning and credit of testimony wholly in the jury's conscience and understanding" (1880; I, 513). The same language was included in a royal proclamation of 1607 (Larkin and Hughes 1973: I, 168). Some years later, the distinguished judge, Sir Matthew Hale, indicated that jury trials were "the best method seeking and sifting out the truth" because they could "weigh the credibility of witnesses and the Force and Efficacy of their Testimonies" (1971: 164-65). As in several other areas of intellectual endeavors, matters of fact were to be established on the basis of credible witnesses.

Although we do not know if and how jurors were instructed in routine case, we can trace the development of judicial instruction in the printed State Trials.

First we hear of "satisfied conscience", a term familiar from casuistry. Testimony was to be evaluated in order to reach the level of the "satisfied conscience", "understanding", "mind" or "moral certainty". We can't determine exactly when moral certainty and its cognate beyond reasonable doubt first appeared in legal proceedings. The first recorded use of the "beyond reasonable doubt" standard was in the Boston Massacre trials of 1770. Used by judges and both prosecution and defense lawyers, there is nothing to suggest that it was introduced then as an innovation. The term beyond reasonable doubt was well known and widely used long before it appeared in the legal sources.

English treatises on evidence began to appear in the mid-eighteenth century. Sir Geoffrey Gilbert's treatise tellingly begins with a Lockean summary. "There are several degrees from perfect Certainty and Demonstration quite down to Improbability and Unlikeness… And there are several Acts of the Mind proportioned to these Degrees of Evidence… from full Assurance and Confidence, quite down to Conjecture, Doubt, Distrust and Disbelief… What is to be done in all Trials of Right, is to range all Matters in the Scale of Probability… And thereby to make the exact Discernment that can be, in Relation to the Right" (1754: 1-2). Law could not reach certain knowledge because trials dealt with "transient events" and required consideration of witness credibility.

Gilbert's treatise was only the first of many to ground legal fact-finding on what at that time was considered to be a sound epistemological foundation. Evidence treatises from Gilbert onward typically cited Locke and later the common sense philosophers. John Morgan's 1789 Lockean based *Essays on the Law of Evidence*, like Gilbert's, included material on degrees of knowledge running from perfect certainty and demonstration down to probability and unlikeliness. In dealing with evidence the mind ranged from "full assurance and confidence, to conjecture, doubt and disbelief". Legal proceedings "must judge on probability", but "nothing less than the highest degree of probability" must govern the courts. When testimony was heard from "honest, credible and disinterested witnesses" one could only "acquiesce… as if one had known it by demonstration" (Morgan 1789: I, 1-5, 12-13, 39, 48-50, 146-64).[3]

Influenced by the Scottish common sense philosophers, James Wilson, a US Supreme Court Associate Justice and law professor, asserted that the law was, and could be, "conformable to the true theory of the human mind". "Belief admitted of all possible degrees from absolute certitude down to doubt and suspicion". Most knowledge of "men and things" arose by "insensible gradation, from possible to probable, and from probable to the highest degree of moral certainty". "The whole stupendous fabric of natural philosophy" had the

[3] Morgan also discusses credible witnesses, circumstantial evidence and presumptions.

same epistemological basis as the law (Wilson, 1967: I, 486, 503-5, 508, 510, 518-19; II, 32). In 1802 Leonard McNally indicated it was a rule of law that if a jury "entertain a reasonable doubt" of witness testimony, it must acquit. "It was their "indefensible duty" to determine "whether they are satisfied, beyond the probability of doubt, that he is guilty" (1802: 3).

Widely used in England and America, Thomas Starkie's early nineteenth-century evidence treatise, stated that although the law sometimes added special conditions such as the exclusion of certain kinds of testimony to ensure that the "search for truth" would not be contaminated. "Legal facts were no different from other kinds of facts". Indeed, everyone "desirous of satisfying himself by inquiry as to the truth of any particular fact" must be guided by the same principles. Even the most direct evidence could produce nothing more than such a high degree of probability as amounts to a moral certainty. Evidence must be sufficient "to satisfy the understanding and the conscience of the jury" and "evidence which satisfied the minds of the jury… to the entire exclusion of every reasonable doubt constitutes full proof of the fact" (1824: 514).

Although the language of "satisfied conscience", "satisfied understanding", "satisfied mind" and "moral certainty" are no longer generally understood to be cognates of "beyond reasonable doubt", American courts still make use of that language.[4]

5. *"Science" and the "Natural sciences"*

We call natural science what early moderns sometimes labeled natural history, natural philosophy, the new Philosophy or the experimental philosophy. "Science" meant certitude, not an investigation of natural phenomena.[5] Our familiar word "scientist" did not exist until the nineteenth century. The early modern period marked the erosion of the meaning of "science" as absolute certitude for most of those seeking knowledge of the natural world. Instead a scale of probability would determine whether a finding had reached "moral certainty".

Hostility to scholastic logic, the rejection of authority and skepticism affected the natural sciences as it did other disciplines, but it was the exploration of America and exposure to other previously unknown locales that produced an enormous expansion of new information that inspired a new flourishing of

[4] The US Supreme Court opinion admitted that "moral certainty" was no longer understood but did not prevent its continued use: Sandoval v Calif. 510 US 1022 (1993); Victor v Nebraska 511.1 (1994).

[5] Natural history for Bacon included "regions, their sites and products" (1857-74: V, 131).

queries as to the truth or accuracy of new information. The Spanish were early in describing newly discovered natural phenomena and practicing what is now called ethnography. English, Dutch and French explorers and naturalists followed.

Credible witness testimony, so central to historical and legal fact-finding, played a similar role in the developing natural sciences, and the criteria for credible witnesses was similar as well (Watt 1724: 84-85, 276, 277, 405, 409, 464). While social status played a role, as it did in establishing historical and legal facts, education, skill, impartiality and integrity also had a place.

René Descartes and Francis Bacon, two of the most innovative thinkers of the early seventeenth century, sought new methods to achieve the certainty of "science". Bacon's influence far exceeded that of Descartes in England. Unlike Descartes, Bacon wished to ground natural history on direct observation and experiments of matters of fact. Although greatly esteemed for his advocacy of credibly reported natural facts, few of Bacon's followers were attracted to his efforts to go beyond natural history to extract universal "forms" that would achieve the status of "science".[6] While evaluations of witness credibility differed little from those of historians and legal fact-finders, those involved in empirical and experimental studies had the advantages of instruments such as telescopes, microscopes and measuring devices and the ability to repeat experiments and reexamine the claims of other natural historians.

Although many naturalists of the post-Restoration period were satisfied with natural history, that is, the collection of well observed phenomena and experiments, and some were attracted to classification, still others wished to link factual data with principles, causal explanations or theory without making claims to "science" in the sense of absolute certainty.

Hypothesis, a concept taken from mathematics, provided naturalists with a means of connecting natural facts to explanations and principles while avoiding claims of demonstration or mathematical certainty. Hypothesis, however, like the term hypothetical, suggested fiction so remained under suspicion. Copernican astronomy, Boyle's atomism, and Harvey's circulation of the blood were treated as hypotheses. Hypotheses allowed scientific theorizing to take its place in the sphere of probability. Doubts about proposed hypothesis might be raised and evaluated, something incompatible with the older concept of "science". Hypothesis might be weakly supported by evidence and thus doubtful, but a well-supported hypothesis might be worthy of belief. This view of hypothesis became common among members of the newly founded Royal Society (cf. Shapiro 2000: 144-60).

[6] Scholars differ on the question of whether or not Bacon considered "forms" to be probable.

For Joseph Glanvill, "without the enlargement of the history of Nature", hypotheses must remain "but Dreams", and our science could merely "conjecture an opinion". Without evidence one could only "describe an Imaginary World of our own making". If treated properly, however, hypothesis might "include many things with security from Error" (Glanvill 1668: "Address to Royal Society"; cf. also: Shapiro 1985: 270, 280). One must not be "fixed eternally "on theories as established certainties but to consider them in the modest sense of hypotheses" (Shapiro 1985: 110). "The best Principles of Natural Knowledge" were "but Hypotheses" (Glanvill 1668: 81, 89). Samuel Parker, who like Glanvill was a promoter of the new science, thought one should "addict" oneself to "true and Exact Histories". He thought that natural history would eventually "lay firm and solid foundations to Erect Hypotheses" (Parker 1666: 44-47). Mathematician John Wallis expressed reluctance to accept newly proposed hypotheses until all sides had been heard, or "until the truth emerges through the very clearness of the thing". Commenting on a hypothesis of Leibniz, Wallis indicated that he considered many parts of it to have "great probability, if not certainty" (Shapiro 1985: 49, 280). Christopher Wren believed that "true theories" were confirmed by "many Hundreds of Experiments". Yet he told Robert Hooke that "I have, I think, lighted upon a hypothesis" concerning the path of comets "which when it is riper and confirmed by your observations, I shall send you" (Shapiro 1985: 48, 279). William Whiston rejected Thomas Burnet's theory of the earth as a "precarious and fanciful" hypothesis that relied on "no known Phenomena of nature" (Whiston 1696: 3).

Both Robert Hooke and Robert Boyle adopted hypothesis as a way of connecting data to explanations and theory. Hooke praised the Society's refusal to espouse hypotheses" insufficiently "founded and confirm'd by experiment" and on one occasion characterized hypotheses of his own as "Conjectures and Queries" not "unquestionable Conclusions, or matters of unconfutable Science". One should not expect "any infallible Deductions or certainty of Axioms" (1665: "Preface", 46, 53, 56-91). Robert Boyle planned, but did not complete, a treatise that would consider the "requisites of a good Hypothesis" and a description of an "excellent one" (1965: 134-35, 234-35). Hypotheses should not be made before making a sufficient number of experiments. Boyle also wrote, "Not that I… disallow the use of reasoning upon experiments, or endeavoring to discern as early as we can the confederacies, and differences, and tendencies of things; for such an absolute suspension of the exercise of reasoning were exceeding troublesome, if not impossible" (1772: I, 302). He referred to his own corpuscular hypothesis (cf. also: Boyle 1772: V, 338, 340, 461, 538-40; 1666: "Preface"; Shapiro 1985: 53-55, 280-82).

So a significant number of English scientists no longer sought absolute cer-

tainty of "science" and instead offered hypotheses, which might or might not merit the label of moral certainty or no reason to doubt. Many experimentally and empirically minded virtuosi attempted to combine well witnessed facts of the natural world that might reach the level of moral certainty with explanations and theories traditionally categorized as "science", but placed such explanations and theories in the category of the probable. Most natural knowledge had become probable knowledge. What had been separated by the distinction between the probable and the certain could now be treated together under the umbrella of hypothesis. As in the case of religion, naturalists suggested that the new, probabilistic approach encouraged moderation in scientific disputes and reduced dogmatic pronouncements about things that could only be probable. Probability and hypothesis promoted a new style of scientific discourse (see Shapiro 1968; Shapiro 1985: 44-67).

A residue of fictionality, however, lingered around the term hypothesis. Isaac Newton, at least on some occasions, rejected the probabilistic view of hypothesis. Hooke's hypothesis of light, he thought, was too close to the suspect "hypothetical physics" of the Cartesians. Of his own "theory" of light, he said, "I would rather have" my work "rejected as vain and simple speculation, than acknowledged as hypothesis". His doctrine of refraction of light and colors "consists only in certain properties of light, without regarding any hypothesis". He famously insisted, "I frame no hypothesis" (1954: 4, 6, 404; cf. also: Shapiro 1985: 56-57, 280-83).

6. *Dissemination*

Dissemination of the notion of probable proofs, that might or might not reach the summit of moral certainty, is to be found in Locke's *Essay Concerning the Human Understanding*, the writings of common sense philosophers and several new logics. It would be hard to overestimate the influence of John Locke. His views on testimony may be seen as a summary of what we encountered in the fields of history, law and natural history. His views on the probability rather than the certainty of human knowledge built on predecessors who contributed to the decline of "science" in the sense of absolute knowledge as the goal of philosophers. For Locke probable knowledge depended on observation, experience, and the testimony of others vouching for their observations and experiences. The testimony of others is to be evaluated on the basis of "the number… the integrity, the skill of the witnesses… the design of the author, where… a testimony out of a book is cited… the consistency of the parts, and circumstances of the relation [and]… contrary testimony" (1959: bk. 4, ch. 4, sec. 4; cf. also: Osler 1970: 3-16). Locke's *Essay* was of enormous importance in

making a probabilistic approach to knowledge acceptable and widely known. It would gradually replace or supplement scholastic logic at Oxford and at several dissenting academies. And we have already noticed its immense impact on the legal treatise writers. Probabilistic thinking on Lockean lines, and later in the Scottish common sense school of philosophy, became commonplace.

The common sense approach to knowledge became well known in the publications of Thomas Reid and his followers. Although these thinkers rejected aspects of Locke's epistemology, postulating a common sense that was known immediately by intuition, they were primarily motivated by opposition to the radical skepticism of David Hume.

Textbooks, especially logic textbooks, were also important is disseminating the Lockean and common sense, probabilistic approaches to knowledge. Isaac Watts, whose numerous editions of Logic were used at Oxford, Cambridge and in New England, offered a "practical" logic that emphasized the degree of assent given to propositions. There were "uncertain or doubtful Propositions" called "opinion" as well as different "degrees of Evidence". When evidence "is greater than the Evidence to the contrary, then it is a probable Opinion". When equal, it was a "doubtful Matter" or "a dubious or doubtful Proposition" of which one should remain "in a State of doubt and Suspense". Assent should be apportioned "to the Degree of Evidence". Despite human fallibility, there were "Instances when… Human Faith, Sense and Reasoning lay a Foundation… and leave no room to doubt". Moral certainty, the highest degree of probability, required testimony of one "capable of knowing the Truth", whether he was an eye or ear witness or reported hearsay. One should accept a "skillful account" of such testimony if there were no "reasonable doubts". Human testimony in many cases is "scarce inferior to natural Certainty". This approach, according to Watts, was relevant to natural philosophy, the affairs of daily life, and to proving the truth of Christianity (1725: 84-85, 27, 277, 405, 409, 464).[7] Textbooks purveying this approach circulated in England, Scotland and the American colonies (see: Oldfield 1707; Waterland 1730; Johnson 1754; Gerard 1755).

Dictionaries and encyclopedias also provided a channel for disseminating the cluster of concepts we have been examining (see: Chambers 1728; Bailey 1730: 69, 488, 51). By the mid-eighteenth century, if not sooner, "degrees of probability", "moral certainty" and "belief beyond reasonable doubt" had become part of an educated person's intellectual repertoire.

[7] David Hartley (1749) discussed true, doubtful and fictitious narrations of fact. Some facts were "practically certain", others, "liable to doubts".

7. *Conclusion*

This essay has examined a number of concepts related to the development of "probable proof" beginning with the long-lasting Aristotelian dichotomy between "science" and "probability". We have repeatedly encountered "witnessing", "testimony", "credibility", "evidence", "doubt", "conscience", "understanding", "opinion", "conjecture", "matter of fact", "hypothesis", "moral certainty" and "belief beyond reasonable doubt" in connection with the increasing acceptance of probable knowledge. Portions of the category "probability", traditionally labeled "opinion", expanded into a form of "knowledge" labeled moral certainty. Fewer and fewer English intellectuals sought the certainty of the gold standard of "science", defined as absolute certainty

This presentation has drawn attention to similarities and differences among the disciplines. Historians had to find a balance between rhetorical norms that permitted invented speeches and other such persuasive devices and the norm of truth telling. Historians were, therefore, heavily indebted to classical norms and contemptuous of their medieval predecessors. They, like others, relied on firsthand witnesses who were to be tested for credibility.

Theologians owed far more to their medieval predecessors. Unlike historians and jurists, their concerns with probability and proof frequently appeared in polemical publications. Casuistry, which dealt with the "court of conscience" and relied on arguments rather than evidence, played an important role in transmitting a graduated scale ranging from doubt to beyond reasonable doubt.

We have briefly examined two approaches to legal fact-finding. Continental jurists established a rational but quite rigid system of full, half and quarter proofs that lasted throughout the early modern period. Judges were constrained by rules such as the two witness or confession rule in capital cases. In England lay jurors assumed the task of evaluating testimony when witnesses became a regular feature of courts which used "satisfied conscience", "satisfied understanding", "moral certainty", and "beyond reasonable doubt", separately or in combination.[8] These concepts received extended treatment in the treatise literature.

The greatest changes occurred in the natural science where the range of "science" in the sense of absolute certainty was much reduced and that of probability greatly increased. The facts of natural history could be believed, as could those in civil history, scriptural history and in the law courts, by evaluating witness credibility. The declining scope of "science" was associated with the

[8] English jurists only gradually considered "circumstances" to be evidence capable of moral certainty or proof beyond reasonable doubt.

growth of Baconian observation and experiment and the Royal Society. Particularly important was the adoption of hypothesis in linking matters of fact to the principles that explained them. Both facts and hypotheses might or might not attain the highest degree of certainty within the category of probability.

Failure to observe disciplines in relation to one another obscures the commonalities of intellectual life and has led to the erroneous belief that the beyond reasonable doubt standard in English law was an innovation rather than a feature of a well-established and widely known tradition of fact finding. A focus only on separate disciplines also has obscured the role of textbooks, encyclopedias and dictionaries in making the idea of probabilistic knowledge familiar to a nonintellectual audience.

This brief survey has exposed how changes in terminology have hindered efforts to trace the development of notions of probabilistic proof. The word "conscience" is no longer associated with rational choices or a graduated scale reaching from doubt to a "sure" or "satisfied conscience", "moral certainty" and "beyond reasonable doubt". The very words "moral certainty", now an obsolete concept, have made it difficult to equate that expression with "belief beyond reasonable doubt". It, therefore, has not been obvious that a "satisfied conscience", or a "satisfied mind" or "understanding", meant the same thing as "moral certainty" or "beyond reasonable doubt", the highest stage of certainty within the sphere of probability. History is now understood to be a field of study that engages the past, not, as earlier, accounts of both past and present objects and events; thus the history of plants, the history of fish, or the history of trade winds. Although the term natural history remains in current use, it is now likely to be associated with particular disciplines such as botany, geology, or biology. "Science" no longer refers to certain knowledge or demonstration. "Hypothesis" was first associated with mathematics only later adopted by the natural and social sciences.

This heavily based English survey obviously requires the inclusion of Italian, French and Dutch developments, and extended treatment of mathematical probability and the "probable" as a literary concept. It will be necessary to bring the twentieth-century views of scientist Albert Einstein and philosophers John Maynard Keynes, Ludwig Wittgenstein and Bertram Russell to the probability narrative.

This essay has shown the centrality and tenacity of the ancient distinction between "science" and "probability" in shaping European thinking about the nature and limitations of knowledge. We have traced a major shift in the European understanding of what constituted knowledge as well as how differences of opinion in both religion and the natural sciences might be handled in a less contentious manner. The increased value given to probable proofs and

the linking of the "probable" with "knowledge" have played a major role in way Europeans came to conduct intellectual investigation and controversy. Looking at these developments over the long term it is clear that the dichotomy between "science" and "probability" created a framework or way of thinking about knowledge for many centuries it was at the same time an impediment to conceptualizing an empirically based probabilistic form of knowledge.

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References

1. Primary sources

Ames, William, 1639*, Conscience: The Power and Cases Thereof*, London.

Bacon, Francis, 1857-74, *Works*, ed. by J. Spedding, R. Ellis, and D. Heath, Longmans, London.

Bolingbroke, Henry St. John, 1971, *Historical Writings*, University of Chicago Press, Chicago.

Boyle, Robert, 1666, *Hydrostatical Paradoxes*, Richard Davis, Oxford.

—, 1772, *Works*, 6 vols, ed. by T. Birch, J. and F. Rivington, London.

—, 1965, *On Natural Philosophy*, ed. by M.B. Hall, University of Indiana Press, Bloomington.

Butler, Joseph, 1736, *The Analogy of Religion*, J. Jones, Dublin.

Campbell, George, 1988, *The Philosophy of Rhetoric*, University of Illinois Press, Carbondale, IL.

Chambers, Ephraim, 1728, *Cyclopaedia,* James and John Knapton etc., London.

Chillingworth, William, 1638, *Religion of Protestants*, Leonard Lichfield, London.

Clarke, Samuel, 1706, *A Discourse Concerning the Unchangeable Obligation of Natural Religion and the Truth ad Certainty of the Christian Religon*, James Knapton, London.

—, 1711, *A Discourse Concerning the Being and Attributes of God; The Obligation of Natural Religion and the Truth and Certainty of The Christian Religion*, London.

Bailey, Nathan, 1730, *Dictionarium Britannicum*, T. Cox, London.

Erasmus, Desiderius, 1961, *Erasmus-Luther: Discourses on Free Will*, trans. and ed. by E.G. Winter, Ungar, New York.

Fuller, Thomas, 1659, *The Appeal of Injured Innocence*, W. Godbil, London.

Gerard, Alexander, 1755, *Plan of Education of Marshal College and the University of Aberdeen*, James Chalmers, Aberdeen.

Gilbert, Geoffrey, 1754, *The Law of Evidence*, Sarah Cotter, Dublin.

Glanvill, Joseph, 1668, *Plus Ultra*, London.

—, 1676, *Essays on Several Important Subjects*, J.D. for John Baker, London.

Grotius, Hugo, 1680, *The Truth of the Christian Religion*, trans. by Simon Patrick, Rich. Royston, London.

Hartley, David, 1749, *Observations on Man, his Duty and his Expectations*, S. Richardson, London.

Hobbes, Thomas, 1928, *The Elements of Law Natural and Political*, ed. by Ferdinand Tonnies, Cambridge University Press, Cambridge.

Hooke, Robert, 1665, *Micrographia*, John Martyn, London.

Johnson, Samuel, 1754, *Elements of Philosophy: Containing the most Useful Parts of Logic*, A. Millar, London.

Larkin, James F. and Paul L. Hughes (eds.), 1973, *Stuart Royal Proclamations*, Oxford University Press, Oxford.

Locke, John, 1959, *An Essay Concerning Human Understanding*, ed by A. Fraser, 2 vols, Dover Publications, New York.

McNally, Leonard, 1802, *The Rules of Evidence on Pleas of the Crown*, J. Butterworth and J. Cooke, London and Dublin.

Morgan, John, 1789, *Essays upon the Law of Evidence*, 2 vols., J. Johnson, London.

Newton, Issac, 1954, *Mathematical Principles of Natural Philosophy*, ed by F. Cajori, University of California Press, Berkeley and Los Angeles.

Joshua Oldfield, 1707, *An Essay toward the Improvement of Reason*, T. Parkhurst, London.

Parker, Samuel, 1666, *A Free and Impartial Censure of the Platonick Philosophy*, W. Hall, Oxford.

Perkins, William, 1966, *Discourse of Conscience*, in *William Perkins, 1558-1602: English Puritanist. His pioneer works on casuistry: "A discourse of conscience" and "The whole treatise of cases of conscience"*, ed. by T.F. Merrill, B. De Graaf, Nieuwkoop.

Pufendorf, Samuel, 1703, *Of the Law of Nature and Nations*, L. Lichfield, Oxford.

Ray, John, 1691, *The Wisdom of God Manifested in the Works of Creation*, Samuel Smith, London.

Sacheverell, Henry, 1706, *The Nature, Obligation, and Measure of Conscience*, L. Lichfield, Oxford.

Sharp, John, 1688, *A Discourse of Conscience. The Second Part: Concerning a doubting conscience*, Walter Kettilby, London.

South, Robert, 1718, *Twelve Sermons*, Jonah Bowyer, London.

Sprat, Thomas, 1958, *The History of th Royal Society*, ed. by Jackson I. Cope and H. Jones, University of Washington at St Louis Press, St Louis, MO.

Taylor, Jeremy, 1660, *Doctor Dubitantium, or the Rule of Conscience*, James Flesher, London.

Tillotson, John, 1666, *The Rule of Faith*, A. Maxwell, London.

Ward, Seth, 1667, *A Philosophical Essay*, A. and L. Lichfield, Oxford

Waterland, Daniel, 1730, *Advice to a Young Student*, John Crownfield, London.

Watts, Isaac, 1725, *Logick, or, the Right Use of Reason in the Enquiry after Truth*, John Clark and Richard Hett, London.

Whitlocke, Bulstrode, 1682, *Memorials of the English Affairs, or an Historical Account*, N. Ponder, London.

Whiston, William, 1696*, New Theory of the Earth*, R. Roberts, London.

Wilkins, John, 1675*, Principles and Duties of Natural Religion*, A. Maxwell, London.

Wilson, James, 1967, *The Works*, ed. by Robert McCLoskey, Harvard University Press, Cambridge, MA.

2. Studies

Cassan, Elodie, 2021, "Introduction: Logic and Methodology in the Early Modern period", in *Perspectives on Science*, 29: 237-154.

Corneanu, Sorana, 2011, *Regimes of the Mind*, University of Chicago Press, Chicago.

Daston, Lorraine, 1988, *Classical Probability in the Enlightenment*, Princeton University Press, Princeton.

Demeter, Tamas, Benedek Lang, and Daniel Schmal, 2020, "Scientia in the Renaissance, Concept of", in *Encyclopedia of Renaissance Philosophy*, ed. by M. Sgarbi, Cham, Springer.

Donahue, C., 1981, "Proof by Witness in the Church Courts of Medieval England", in *On the Law and Custom of England: Essays in Honor of Samuel E. Thorne*, ed. by Arnold Morris *er al*., University of North Carolina Press, Chapel Hill, NC, 27-57.

Franklin, James, 2001, *The Science of Conjecture: Evidence and Probability before Pascal*, Johns Hopkins University Press, Baltimore.

Hale, Matthew, 1971, *History of the Common Law England*, ed. by Charles Gray, University of Chicago Press, Chicago.

Lancaster, James and A.T. Raiswell, 2018, "Evidence before science", in *Evidence in the Age of the New Science*, ed. by J.T. Lancaster and A.T. Raiswell, Cham, Springer, 1-29.

Orr, Robert, 1967, *Reason and Authority: The Thought of William Chillingworth*, Oxford University Press, Oxford.

Osler, Margaret, 1970, "John Locke and the Changing Ideal of Scientific Knowledge", in *Journal of the History of Ideas*, 31: 3-16.

Popkin, Richard, 1979, *The History of Skepticism*, University of California Press, Berkeley and Los Angeles.

Schuessler, Rudolf, 2021, "Casuistry and Probabilism", in *A Companion to the Spanish Scholastics*, ed. by E. de Bom and H. Braun, Leiden, Brill, 334-362.

Sergeantson, Richard, 1999, "Testimony and Proof in Early Modern England", in *Studies in History and Philosophy of Science*, 30: 195-236.

Shagan, Ethan, 2018, *The Birth of Modern Belief, Fact and Judgment from the Middle Ages to the Enlightenment*, Princeton University Press, Princeton.

Shapiro, Barbara J., 1968, "Latitudinanism and Science in Seventeenth-Century England", in *Past and Present*, 40: 16-41.

—, 1985, *Probability and Certainty in Seventeenth-Century England*, Princeton University Press, Princeton.

—, 1991, *"Beyond Reasonable Doubt" and "Probable Cause": Historical Perspectives on the Anglo-American Law of Evidence*, University of California Press, Berkeley and Los Angeles.

—, 2000, *A Culture of Fact: England, 1550-1720*, Cornell University Press, Ithaca, NY.

—, 2001, "Classical Rhetoric and the Law of Evidence", in *Rhetoric and Law in Early Modern Europe*, ed by Lorna Hutson and Victoria Kahn, Yale University Press, New Haven, 54-72.

—, 2014, "'Beyond Reasonable Doubt': The Neglected Eighteenth-Century Context", in *Law and Humanities*, 8: 19-52.

Weizrbicka, Anna, 2010, *Experience, Evidence and Sense: The Hidden Cultural Legacy of English*, Oxford University Press, Oxford.