

CHAPTER 20

Earman on Hume on Miracles

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John Earman, in his book *Hume's Abject Failure: The Argument Against Miracles* (2000) and his chapter in this volume "Bayes, Hume, Price, and Miracles" subjects Hume's essay on miracles (in Section 10 of the *Enquiry concerning Human Understanding*) to an abusive and merciless attack. According to Earman, Hume's argument is "a confection of rhetoric and *schein Geld* [German for *false money*]" (Earman 2000, 73), and "a shambles from which little emerges intact" (see p. 269 above). More specifically, he alleges that it is "tame and derivative [and] something of a muddle," presenting a hopelessly obscure thesis (see p. 260 above), based on a "proof" that amounts to little more than the dogmatic assumption that "uniform experience in favor of a lawlike generalization leaves no room for doubt" (see p. 262 above). According to Earman, Hume's only achievement in the essay is to disguise the crudity of his position through misleading "posturing and pompous solemnities" (see p. 262 above) which have seduced his readers into viewing his key "maxim," in the final paragraph of *Enquiry* 10 Part 1, as an expression of "profound wisdom." Instead, alleges Earman, this maxim is at best merely trivial and tautological, amounting to "the correct but unhelpful principle that no testimony is sufficient to establish the credibility of a miracle unless the testimony makes the miracle more likely than not" (see p. 263 above). He goes on (in §5) to criticize what he calls Hume's "diminution principle"—that the evidential force of testimony for any event diminishes in proportion to the unusualness of that event—and to propose (§6) that multiple witnesses can provide a clear counterexample to Hume's apparent belief that a miracle could never be established by testimony.

Earman then turns to the specific case of religious miracles (§7), arguing—here more against Mill and other Humean sympathisers than against Hume himself—that there is no reason in principle why testimony for a miracle should not support a religious doctrine. Earman is doubtful, however, whether such support could ever amount to an objective proof, though for reasons quite different from Hume’s (§8).

All this might seem quite damning for Hume, but let us see what can be pleaded on his behalf. I shall argue that his essay on miracles does indeed have some significant flaws, but it is far better than alleged by Earman, whose interpretation of it can indeed be decisively refuted.

Hume’s “Proof” Against Miracles

Since he is so confidently abusive about Hume’s argument and the obscurity of its main thesis, it is especially disappointing that Earman himself is so careless in his exposition of it, for example talking quite inappropriately of “Hume’s ‘proof’ against miracles” as though this referred to his overall philosophical argument. In fact, when Hume talks of a *proof* in *Enquiry* 10 he always means a strong *inductive* argument, extrapolating from uniform experience of a specific phenomenon, and providing full assurance *when taken alone*. As he makes clear in a 1761 letter to Hugh Blair:

The proof against a miracle, as it is founded on invariable experience, is of that *species* or *kind* of proof, which is full and certain when taken alone, because it implies no doubt, as is the case with all probabilities.

(Hume 1932, 1.350)

Earman (see p. 261 above) suggests—perhaps with a hint of caution—that Hume “seems to be saying” that if *L* is a lawlike generalization backed by such a proof, then *L* should be assigned a probability of 1 (i.e. 100%), thus effectively ruling out from the start any possibility of testimonial evidence counting significantly in favor of any violation of *L*. In his earlier book, Earman was far more forthright in presenting this interpretation:

So here in a nutshell is Hume’s first argument against miracles. A . . . miracle is a violation of a presumptive law of nature. By Hume’s [principles], experience confers a probability of 1 on a presumptive law. Hence, the probability of a miracle is flatly zero. Very simple. And very crude.

(Earman 2000, 23)

On this interpretation, once “the proof against a miracle” has been established, there is no way that any further observation or testimony—however good it might be—could make any difference whatever to the miracle’s probability,

which even if multiplied by an enormous factor (due to that further evidence) must remain fixed at zero. But this is entirely contrary to much that Hume says, not least the final clause of the sentence quoted above from his 1761 letter to Blair: “. . . but there are degrees of this species, and when a weaker proof is opposed to a stronger, it is overcome.”

Earman (2000, 23, and see p. 261 above) omits this final clause, but it is crucial to Hume’s position, providing the entire basis for the main scenario of his essay on miracles, in which there is “proof against proof” (E 10.11), with new testimonial evidence potentially *overruling* a previous proof from experience. So we have very strong grounds for rejecting the crude interpretation that Earman initially proposes.¹

Earman on Hume’s Maxim

Earman then moves on to another simplistic reading, but seems curiously unwilling to engage in careful consideration of Hume’s text, gliding above it by referring vaguely to other commentators’ views, while including not a single quotation from Hume himself:

Hume recognized that his “proof”² only applies when the evidence consists of uniform experience . . . The real issue is joined when that proof is opposed by a counterproof from eyewitness testimony. Many commentators from Hume’s day to the present have read Hume as saying that . . . uniform experience always trumps testimony . . . Let’s be charitable to Hume by not subscribing to [this] reading . . . The issue then becomes how to tell when the balance tips in favor of one or the other. Hume’s famous “maxim” might be thought to provide just such a prescription.

(see p. 262 above)

It seems odd to describe this treatment as “charitable,” when no evidence has been presented to suggest that Hume’s argument is anything like as crude as “many commentators” have thought. Moreover in other circumstances, Earman himself is quite happy to dismiss the views even of “most commentators,” as we find when he gives his own—somewhat uncharitable—account of Hume’s maxim. Here is how Hume himself states it:

The plain consequence is (and it is a general maxim worthy of our attention), “That no testimony is sufficient to establish a miracle, unless the testimony be of such a kind, that its falsehood would be more miraculous, than the fact, which it endeavours to establish . . .”

(E 10.13)

And here are Earman's comments on the quoted "maxim":³

Most commentators have seen profound wisdom here. I see only triviality . . . the relevant probability of the event which the testimony endeavors to establish is $P(M | t(M) \& E)$, while the relevant probability of the falsehood of the testimony is $P(\neg M | t(M) \& E)$. To say that the falsehood of the testimony is more miraculous than the event which it endeavors to establish is just to say that the latter probability is smaller than the former, i.e.

$$P(M | t(M) \& E) > P(\neg M | t(M) \& E) \quad (1)$$

which is equivalent to

$$P(M | t(M) \& E) > 0.5. \quad (2)$$

On this reading, Hume's maxim is the correct but unhelpful principle that no testimony is sufficient to establish the credibility of a miracle unless the testimony makes the miracle more likely than not.

(see p. 263 above)

Earman's argument for this reading—both in this chapter and his earlier book—makes very little further reference to Hume's text, but consists mainly of criticism of rival probabilistic interpretations, which are shown to fail in various ways.⁴ But all of the rivals that Earman considers share the same fault, of completely ignoring the significance, within Hume's maxim, of the words "testimony . . . of such a kind." They are all thus *token* interpretations of the maxim—focusing on the probability of *individual items* of testimony—rather than *type* interpretations, which take seriously Hume's apparent concern with the typical probability of *kinds* of testimony.⁵

It is fairly easy to show that Earman's interpretation is incorrect, by examining Hume's argument leading up to his maxim, and the evidential weighing operation that generates it. Hume starts by pointing out that all evidence about the unobserved is derived from experience, with the weight of such evidence determined by the consistency of the relevant experience. "A wise man, therefore, proportions his belief to the evidence" (E 10.4). He then emphasizes that this principle of inductive rationality applies not only to inference from personal observation but also to arguments from testimony, for "our assurance in any argument of this kind is derived from no other principle than our observation of the veracity of human testimony, and of the usual conformity of facts to the reports of witnesses" (E 10.5). That being so, it is important to recognize that not all kinds of testimony are found to be equally reliable:

And as the evidence, derived from witnesses and human testimony, is founded on past experience, so it varies with the experience, . . . according as the conjunction between any particular kind of report and any kind of object has been found to be constant or variable . . . Where . . . experience is not entirely uniform on any side, it is attended with an unavoidable contrariety in our judgments . . .

This contrariety of evidence . . . may be derived from several different causes; from the opposition of contrary testimony; from the character or number of the witnesses; from the manner of their delivering their testimony; or from the union of all these circumstances. . . . There are many other particulars of the same kind, which may diminish or destroy the force of any argument, derived from human testimony.

Suppose, for instance, that the fact, which the testimony endeavours to establish, partakes of the extraordinary and the marvellous; in that case, the evidence, resulting from the testimony, admits of a diminution, greater or less, in proportion as the fact is more less unusual.

(E 10.6–8).

In this last sentence, the unusualness of the reported event is identified—alongside contrary testimony and the character, number, and manner of the witnesses—as one additional factor that bears on the credibility of testimonial reports. But Hume then immediately isolates this particular factor, and views it as balanced *on the other side of the scale* against the characteristics of the testimony that incline us to believe it, resulting in “a counterpoize, and mutual destruction of belief and authority” (E 10.8).

After a couple of short paragraphs illustrating such “destruction of belief” (through the famous examples of Cato and the Indian prince), Hume quickly goes on to present the most extreme possible case of “counterpoize,” where the reported fact;

instead of being only marvellous, is really miraculous; and . . . *the testimony, considered apart and in itself*, amounts to an entire proof; in that case, there is proof against proof, of which the strongest must prevail, but still with a diminution of its force, in proportion to that of its antagonist.

(E 10.11, my emphasis)

Two very important points should be noted here. First, Hume’s argument so far has treated a miracle as just an extreme case of an extraordinary (i.e. inductively improbable) event, and the general principles involved in this treatment are no different from those that he applies to any other extraordinary event.⁶ Second, in sketching out how the counterpoise takes place, Hume has understood the strength of the testimony—“considered apart

and in itself”—as yielding a single overall measure of *proof* which can then appropriately be weighed against the strength of the counter-proof that arises from the miraculousness (i.e. the extreme lack of conformity to our uniform experience) of the alleged event. The stronger of these two proofs “must prevail, but still with a diminution of its force, in proportion to that of its antagonist.” So the confidence we place in the testimony (or—depending on which is weightier—in the inductive evidence against the supposed event) will depend on the extent to which the testimonial proof (or alternatively the proof from experience) over-balances its antagonist. We have “proof against proof,” *with the overall credibility given not by either “proof” individually, but by the result of weighing them against each other.* Neither side of the contest alone yields the appropriate credibility measure: that comes only from the *comparison* between them.

This point, which is absolutely clear from Hume’s text, refutes Earman’s interpretation outright. For on his account, Hume’s intended criterion of credibility is:

$$P(M \mid t(M) \ \& \ E) > P(\neg M \mid t(M) \ \& \ E) \quad (1)$$

On this criterion, *both* sides of the inequality represent an overall probability measure, on the left-hand side the probability of the miracle (conditional on the testimony and our past experience), and on the right-hand side the probability of no such miracle (conditional on the testimony and our past experience). Hume’s own maxim is nothing like this. On the contrary, as we have seen clearly from his text, his maxim involves a comparison between two quite different “proofs,” one concerning the relevant *kind* of testimony “considered apart and in itself” (in terms of the character, number, and manner of the witnesses etc., but *not* the specific event reported), and the other concerning the event reported (in terms of its lack of conformity to our experience). We have yet to see whether this maxim can be given a suitable probabilistic representation, let alone one that is philosophically defensible. But what is quite clear is that Earman’s interpretation of Hume’s maxim is seriously mistaken.

A “Type” Interpretation of Hume’s Maxim

If the preceding discussion is correct, then Hume’s maxim must be understood in such a way that the probability of the testimony “considered apart and in itself” is distinguished from, and weighed against, the improbability of the reported event considered independently of that testimony.⁷ Hume’s idea seems to be that different “kinds” of testimony (specified in terms of the character and number of the witnesses, the manner of delivery etc.) carry a different typical probability of truth and falsehood *independently of the event reported*.⁸ Let us call this his *Independence Assumption*. Suppose, then, that we

focus on a particular kind of testimony—whose characteristic probability of falsehood is f —which either asserts, or denies, the occurrence of a particular type of event M —whose probability of occurrence is m . If the reliability of that kind of testimony is probabilistically independent of what is being reported, then we can apparently calculate the probability of a “true positive” and a “false positive” report as follows (as before using “ $t(M)$ ” to mean that M is testified to have occurred):

True positive (M occurs, and is truly reported)

$$P(M \& t(M)) = P(M) \times P(\text{true report}) = m \cdot (1 - f)$$

False positive (M does not occur, but is falsely reported as having occurred)

$$P(\neg M \& t(M)) = P(\neg M) \times P(\text{false report}) = (1 - m) \cdot f$$

If positive testimony has been given, therefore, this testimony will be probably true only if a “false positive” is less likely than a “true positive,” and hence in accordance with the formula:

$$P(M/t(M)) > 0.5 \rightarrow (1 - m) \cdot f < m(1 - f)$$

which simplifies to:

$$P(M/t(M)) > 0.5 \rightarrow f < m$$

This result neatly corresponds to Hume’s maxim, since its right-hand side is exactly equivalent to saying that *the falsehood of the testimony, considered apart and in itself* is more miraculous (i.e. less probable) than *the event reported, considered independently of the testimony*. Hume’s own route to this result was not, of course, so mathematical: he seems to have viewed the situation as involving a relatively simple trial of strength between the inductive evidence for the testimony and the inductive evidence for the relevant “law of nature.” But given his apparent Independence Assumption, this yields exactly the formal result calculated above, which can thus stand as a faithful mathematical elucidation of his position, rather than an anachronistic distortion.⁹

The Non-Triviality of Hume’s Maxim

If Hume’s Independence Assumption applies to testimony for miracles in this way (for doubts, see the next section), then his maxim can indeed be of real practical value. To illustrate with a non-miraculous example, suppose that

Fred wants to know whether he suffers from some genetic condition *G* which afflicts one person in a million. He has no other evidence either way, but a test is available which seems very reliable, in that whoever is tested, and *whether they actually have the condition or not*, the chance that the test will give a correct diagnosis is 99.9%, and an incorrect diagnosis only 0.1% (so Hume's Independence Assumption plausibly applies: the test can be assigned a consistent probability of delivering truth rather than falsehood, independently of what the facts happen to be). When Fred later leaves the clinic in distress at having tested positive for *G*, how convinced should he be that he does indeed have that condition?

Most people would, in my experience, judge Fred's likelihood of having *G* in this situation to be very high, but in fact the reverse is the case, as Hume would recognize. As Fred stumbles out despondently through the clinic door, Hume might greet him with a consoling comment something like this: Consider whether it be more probable, that this kind of test should be mistaken, or that you should really have condition *G* (cf. E 10.13).¹⁰

Given that the test is wrong one time in a thousand, while *G* afflicts only one person in a million, there is clearly a far greater likelihood of a mistaken test than of Fred's actually suffering from *G*. And so a positive test report does relatively little to indicate that he actually has the disease: in fact, it changes the probability from a negligible one in a million to the only slightly more worrying 1 in 1,002.¹¹ Hume's maxim, therefore, is entirely correct in this case, and it also gives the correct answer for other relevantly similar cases. If, for example, we increase the "initial probability" of the disease to over one in a thousand, then the test indeed becomes credible. And this last point demonstrates a kernel of truth in what Earman calls Hume's "diminution principle": whether some alleged fact can be rendered rationally credible by some testimony depends on its prior probability (or in Hume's terms how "miraculous" or "unusual" the alleged fact is) as well as on the characteristics of the testimony.

We have already seen enough to counter Earman's insultingly dismissive view of Hume's treatment of miracles. Certainly there are problems, as will become apparent shortly, but Hume deserves credit for enunciating a principle which clearly anticipates—by two and a half centuries—the identification of the *base rate fallacy* by psychologists Amos Tversky and Daniel Kahneman.¹² This is a very common error in human thinking, whereby we naturally find it all too easy to ignore the background "base rate" of some phenomenon when assessing the significance of evidence for it. So on receiving a disappointing test report for condition *G*, most people would be far more struck by the specific immediacy of that result—and the test's apparent reliability of 99.9%—than by the memory of the general probability for *G* of one in a million. They would thus be seriously mistaken, and Hume's maxim is potentially of considerable value as a vivid reminder of the need to take base rates into account.

Difficulties for Hume's Position

Let us now take a more critical look at Hume's implicit Independence Assumption: that it is in general possible to consider a *kind* of testimony as conferring a typical evidential probability, independently of what it reports. Admittedly this assumption was not confined to Hume, and some of his opponents—notably Richard Price (1768, §2, pp. 413–6)—themselves took it for granted when arguing *in favor* of miracle stories. Earman (§5) discusses Price on just this theme:

Price responded that “improbabilities as such do not lessen the capacity of testimony to report the truth” (Price 1768, 413). This is surely right, as was Price's further claim that the diminution effect operates through the factors of the intent to deceive and the danger of being deceived, either by others or by oneself. Unfortunately Price overstepped himself in claiming that when the first factor is absent, testimony “communicates its own probability” to the event.

(Price 1768, 414)

Hume's argument, however—somewhat paradoxically—itself undermines the Independence Assumption from which it apparently starts, since the upshot of the argument is precisely to show that the same *kind* of testimony can yield very different probabilities, depending on the prior probability of what it reports. In the diagnostic example of the section above, a positive test report yields a probability for G of 1 in 1,002; but a negative test report yields virtual certainty for $\neg G$ (with the probability of G now close to one in a billion).¹³ Moreover there is no good reason for expecting such a diagnostic test to have the same probability of error in both directions: for example an over-sensitive test for G might have a relatively high chance of erroneously identifying G (a false positive), while having very little chance of failing to detect its presence (a false negative). Likewise, there is no reason why someone, gazing over a foggy Scottish loch at twilight, should mistake a floating log for a sea monster with exactly the same probability as he would mistake a sea monster for a floating log. Indeed Hume himself is clearly aware that such mistakes are likely to be biased in one direction rather than the other, given “the strong propensity of mankind to the extraordinary and the marvellous” (E 10.19). So his own attachment to the Independence Assumption seems to be at most lukewarm, and his argument in “Of Miracles” is perhaps best understood as *starting* from the assumption but then *discarding* it, on the basis of both his maxim and also the psychological considerations presented in his Part 2. Price, by contrast, holds firm to the assumption, and hence has an untenable position.

Price nevertheless raises a serious problem for Hume's position through his examples such as the lottery discussed by Earman (§5). The same problem—

identified previously by Joseph Butler (1736, II ii 3 [§11]) and George Campbell (1762, I §1, p. 31)—also arises in the case of everyday reports, which we very reasonably believe even when the prior probability of the fact reported is far less than the prior probability of a false report. Imagine listening to a BBC radio announcement on 8th April 1967:

Foinavon, a 100-to-1 outsider ridden by John Buckingham, won the 1967 Grand National after a dramatic pile-up stopped all the leading horses at the 23rd fence.

What is the prior probability that the radio announcer would get something wrong here? To be very ungenerous to the BBC, let us suppose that it is 5% (so 1 in 20 such announcements will involve a mistake). This is clearly *vastly* greater than the prior probability that a 100-to-1 horse with that particular (previously unfamiliar) name, ridden by a jockey with another particular (unfamiliar) name, should win after such a specific and unlikely calamity at that particular fence. So the testimony is *not even close* to being “of such a kind, that its falsehood would be more miraculous, than the fact, which it endeavours to establish”;¹⁴ and yet we quite properly believe it. Hence Hume’s maxim is mistaken.

The fundamental flaw in Hume’s reasoning, as I have interpreted it, derives from the faulty calculation of a “false positive” report:

False positive (M does not occur, but is falsely reported as having occurred)

$$P(\neg M \ \& \ t(M)) = P(\neg M) \times P(\text{false report}) = (1 - m) \cdot f$$

Imagine if the 1967 Grand National had been an unremarkable race won by one of the favorites, but reported *falsely* on the radio. How likely is it, in those circumstances, that the report would be false *in precisely the way quoted above*—naming Foinavon (wrongly) as the winner, alleging (falsely) a dramatic pile-up, and so forth? Clearly it is vanishingly unlikely; indeed it is so unlikely that the probability of such a “false positive” is far less than the probability of Foinavon actually winning as described. So any listener to the report is quite right to believe it, albeit with some slight reservation in proportion to the general fallibility of BBC reports. And Hume’s maxim is indeed refuted, as likewise in Price’s lottery example, where again the crucial point is that the probability of ticket number 79’s being *falsely* reported as winning is even less than the prior probability of its *actually* winning.¹⁵

So Hume’s maxim fails, except in a limited range of (typically artificial) cases such as the diagnostic test, where it serves as a useful warning against the “base rate fallacy.” However, I believe that much more can be salvaged from

Hume's position by dropping his Independence Assumption and taking his arguments as pointing instead towards a revised maxim which encapsulates the point just made:

No testimony is sufficient to establish a miracle M , unless the testimony is of such a kind, that the occurrence of an M report of that kind (*given that M does not in fact occur*) would be even less probable than M itself.

Such an approach would shift the emphasis from Part 1 of Hume's essay towards Part 2, from abstract probability to the psychological factors that falsely generate miracle reports. But further discussion of all this must wait for another occasion.¹⁶

Multiple Witnesses and Religious Miracles

Since Hume does not attempt to rule out the *possibility* of testimony sufficient to establish a miracle,¹⁷ and he never denies that a genuinely established miracle could provide evidence for a religion, Earman's discussions in his sections six and seven do not refute any position that Hume is committing to holding. From a Humean point of view, however, Earman's treatment of independent multiple witnesses seems surprisingly complacent, especially his suggestion that "there seems to be no in-principle difficulty in arranging the circumstances so as to secure the independence condition" (see p. 266 above). Note that his results here *crucially* depend on the assumption that the multiple witnesses are indeed *independent*, so that the probability of some witness w_2 reporting that M occurs is completely unaffected by what another witness w_1 reports: they must not be colluding, or subject to any other common influence except for their perception of M itself (or its absence). But Hume's own main concern is *epistemological*, so it is not enough that the multiple witnesses be *actually* independent (as assumed in Earman's calculations); they must also be *known to be* independent. And in any situation involving miracle stories propagated by the adherents of a particular religion, it is almost inevitably going to be more reasonable—our experience of human nature being what it is—to suspect that the witnesses are *not* independent (through either collusion or delusive influences, external or psychological), rather than to believe that some astonishing event favoring their religion has actually happened. That, at any rate, will be the natural Humean suspicion, and Earman has done nothing to refute it.¹⁸ So again, although he makes some interesting points on the Bayesian treatment of miracles, his discussion sheds relatively little light on Hume's philosophy, which is far richer and more defensible than such a narrowly mathematical treatment can reveal.

Notes

1. There is no space here for further interpretative discussion of Hume's understanding of probabilities and proofs, which can be found in Millican (2011, §2, §6) and Fogelin (2003, 43–53).
2. Note here the point I make in the first paragraph of the first section above.
3. In what follows, M is some potential event (typically a would-be miracle), $t(M)$ is the occurrence of testimony for that event, and E is the background evidence (typically the observation of uniformities in accordance with the law of nature of which M would be a violation).
4. Earman's only substantial further quotation of Hume in this discussion is his (correct) point that the final sentence of E 10.13 treats the maxim as providing a *sufficient* as well as *necessary* condition for credibility. The previous two sentences of E 10.13 also suggest this, and the three sentences together strongly corroborate Earman's presumption (which he explains in a part of section 4 omitted from the chapter in this collection) that "sufficient to establish a miracle," for Hume, means to render the miracle *more likely than not*, rather than to render the miracle *certain*.
5. To illustrate the type/token distinction, consider how many letters the word "error" contains. Two different answers are possible, because the word contains five *token* letters ("e," then "r," "r," "o," "r"), but only three letter *types* ("e," "r," "o"). The related distinction between kinds and individual items of testimony is applied to Hume's maxim in Millican (1993), which independently proposes essentially the same formula that Earman favors as a *relatively* plausible *token* interpretation (Millican 1993, 490). But Earman also expresses serious reservations about it, indicating the likely superiority of a *type* interpretation (Millican 1993, 490, 491, 495 n. 8), though without attempting to work out the latter. Earman's book references the paper (Earman 2000, 93), but unfortunately he ignores the reservations expressed there about his favored formula.
6. In a note to the paragraph which mentions the Indian prince's incredulity about ice (E 10.10), Hume sketches a distinction between *extraordinary* and *miraculous* events, but this plays no significant role in his argument. Unlike Earman (see pp. 262–263 above), therefore, I do not see Hume's relative lack of engagement with these sorts of examples and complications as particularly relevant to the assessment of his position.
7. Note that this distinction cannot easily be drawn within a *token* interpretation of Hume's maxim, which can only consider "the probability of the testimony" to refer to *the probability of the particular item of testimony* (in favor of some specific reported event), which is therefore hard to distinguish—given that the testimony has been presented—from *the resulting probability of the reported event itself*. Hence it is not surprising that Earman's attempts to identify a coherent token interpretation lead quickly to triviality.
8. In his maxim, Hume talks of the falsehood of a *kind* of testimony as being "more miraculous" than the event reported, and in the following sentences, he clearly understands miraculousness as the inverse of probability. So he indeed seems committed to viewing *kinds* of testimony as having a typical probability.
9. Nor is there anything un-Humean about attempting to make these things mathematically precise. Hume himself did not have our modern probability theory to hand, but at E 10.4 he explicitly recommends calculation in cases of opposing probabilities, "to know the exact force of the superior evidence."
10. Note that this is quite different from asking: "Which is more probable, in the light of this result: that this specific test is mistaken in saying that you have condition G , or that you really have condition G ?" which would be trivially equivalent to asking whether the test result makes it more probable than not that Fred has the condition. Earman reads Hume's maxim as expressing just this useless equivalence.
11. Consider a population of a billion, of whom one thousand have the disease while 999,999,000 do not. If all were tested, we would expect 999 true positives against 999,999 false positives.
12. Their best-known article is Tversky and Kahneman (1974), with a striking example of the

base rate fallacy at pp. 1124–1125, under the heading “*Insensitivity to prior probability of outcomes.*”

13. Testing a billion people, we could expect just one false negative result, and 998,999,001 true negatives. We might notice here that the test, in either case, impacts on the initial probability of *G* by a factor of approximately 1,000, which corresponds to the 1 in 1,000 probability of a mistaken test occurring. This might seem to revive the idea that the test can be seen as having a consistent force, and perhaps Hume himself was thinking along these lines, because the same sort of pattern will indeed hold for any similar case in which the relevant initial probability is very small (as with miracles). But unfortunately it breaks down as soon as we move to examples which involve more than two possible outcomes, as in the racing report and lottery cases discussed in the main text.
14. Recall that “more miraculous” here is simply to be understood as “less probable,” and that Hume’s argument purports to be based on general considerations of probability (n. 8 above). So he would be begging the question against miracles if he attempted to erect some special hurdle against them without providing an argument to justify such discrimination.
15. The difference in Earman’s urn example (see pp. 264–265 above) is that the prior probability of reporting a black ball as a white one is taken to be constant, irrespective of the number of balls in the urn, whereas in the lottery case, as the number of available tickets rises, the probability that a mistaken report will happen upon the number 79 reduces. The urn case would become closer to the lottery case if the reporter were under the mistaken impression that the balls are all of different colors; then his reporting “white” when in fact the ball is black will get less probable as the number of balls increases.
16. For a sketch, see Millican (2011, §§19–20).
17. For more discussion of this point, see Millican (2011, §12).
18. Moreover his talk of “arranging the circumstances so as to secure the independence condition” is rather bewildering: are we supposed to organize some rigorous experimental setup, and then just wait for a miracle to present itself?

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