Critical Notice: D. H. Mellor, *The Facts of Causation*[*]

Phil Dowe[†]
Department of Philosophy, University of Tasmania

D. H. MELLOR, ***The Facts of Causation.*** London: Routledge (1995), xii + 251 pp.

The Facts of Causation claims to be a "complete account of causation and its implications." Mellor's concern is with singular causation; that is, where causes and effects are singular (he takes general causation to be a generalization concerning singular causation (pp. 6–7)). Singular causes and effects come in two sorts. Firstly, there are facts. Facts are actual states of affairs, and states of affairs correlate with whatever can be expressed in a sentence (so facts correlate with whatever can be expressed in a true sentence) (8–9). For example, that Don falls and that Don dies are facts, if actual. In general terms, the causation of one fact, E, by another, C, fits under the designation 'E, because C'.

The other kind of thing that a cause or effect can be is a particular. There are two kinds of particulars which can be causes and effects: things, including people, and events (10). For example, Don, Don's falling, and Don's dying are particulars. The causation of one particular, e, by another, c, will fit under the designation 'c causes e'. It turns out that while both facts (Ch. 9) and particulars (Ch. 10) can be linked by causation, nevertheless when causation does link particulars, it does so by linking facts in which those particulars figure, so that causation between particulars reduces to causation between facts (Ch. 11). Thus all singular causation is or reduces to causation between facts (Ch. 11.4).

Deterministic causation Mellor takes to occur when causes are necessary (the non-existence of the cause ensures the non-existence of its effect) and sufficient (the existence of the cause ensures the existence

*Received December 1996; revised July 1997.

†Send requests for reprints to the author, Department of Philosophy, University of Tasmania, GPO 252–41, Hobart 7001, Australia.

Philosophy of Science, 65 (March 1998) pp. 162–170. 0031-8248/98/6501-0009$2.00

of its effect) for their effects (13). The sense of necessity here is 'without which not'—causes are necessary for their effects just if their effects do not exist without them (16). Mellor requires that deterministic causes be necessary for their effects "for convenience," it being possible to treat sufficient but unnecessary causes as indeterministic causes (13).

Mellor takes the causal conditional 'if C then E' involved in deterministic causation to be a closest world conditional in the manner of David Lewis (1986), but with the consequent being of the form 'the chance of E is one' (20). Alternatives, shown for various reasons to be inadequate, include English counterfactuals or subjunctive conditionals (14–15), material conditionals (15), strict conditionals (16–18), and Lewis' version of closest-world conditionals where the consequent is simply 'E' (18–19).

This brings us to the question of chance. "Chances," Mellor says, "measure a kind of contingent and quantitative kind of possibility" (21), which corresponds to the appropriate sense of not-possibly-not necessity, where C gives E no chance of not existing. We will come in due course to Mellor's detailed theory of chance, but at this stage, Mellor makes three claims about chance.

First, chances are probabilities, so they must satisfy some application of the probability calculus (21). Second, in general facts that have chances have many chances, for example, by having them at different times (22). Third, every chance is a property of (strictly speaking 'a fact about') another fact or set of facts without which the chance would not exist. Mellor writes this as:

$$ch_F(P) = p$$

where p is the value of the chance that fact P obtains and F is the fact of which the chance is a property (22). This means that P's chances are logically independent of P; in fact, they can exist when P does not.

Applying this to causation, it follows that the chance of an effect, $ch_C(E)$, is a property of another fact C, or a conjunction of other facts C&S, where S is the relevant circumstances in which C obtains. This conjunction is roughly localized in space and time. The chance a cause bestows on its effect in general will depend on the circumstances, unless one takes the cause to be the total cause of E, namely, the complex fact whose property ch(E) is not contingent on circumstances in which E is caused (24–25).

Mellor makes two claims about such chances of effects. The first claim is that for every cause C and effect E there exists such a chance, $ch_C(E)$. The second claim is that every effect E has a chance (perhaps zero) of existing in the circumstances S without C; ie $ch_{\sim C}(E)$ exists (25). Just what this latter chance is a property of is a problem since C

does not exist while the chance does. Mellor argues that it is a property of the circumstances, in particular, of local instances of the laws of nature (26–27).

The truthmaker of $ch_C(E)$ Mellor takes to be E's chances in the closest world to ours where C is true, and the truthmaker of $ch_{\sim C}(E)$ is E's chances in the closest world to ours where ~C is true (27). This ties in with the closest-world account of causal conditionals '⇒' mentioned above, so that, with 'ιp' for 'the p such that',

$$ch_C(E) = (\iota p)(C \Rightarrow ch(E) = p) \qquad 1(a)$$
$$ch_{\sim C}(E) = (\iota p')(\sim C \Rightarrow ch(E) = p') \qquad 1(b)$$

(28)—although this is qualified later (178). This entails that E's chance is $ch_C(E)$ when C is true and $ch_{\sim C}(E)$ when ~C is true. (For a detailed critique of this account, see Dowe 1997).

This leads to a natural reading of deterministic causes: C is sufficient for E just if $C \Rightarrow ch(E) = 1$ and C is necessary for E just if $\sim C \Rightarrow ch(E) = 0$. These are not causal conditionals in the usual sense of 'if C then E' and 'if ~C then ~E' because the consequent is ch(E) not E. However, Mellor asserts, nothing fits the normal sense of causal conditionals, and these closest-world conditionals come closest. On the grounds that nothing fits the bill Mellor proceeds to put the term to use by denoting such closest-world conditionals by 'causal conditionals' (29). (For a critique of this notion of causal conditionals, see Dowe 1997).

Next, Mellor turns to interpretations of probability. He argues that none of the standard interpretations is an adequate account of chance, but that on examination of these, certain conditions on an account of chance emerge. First, that the chance of P is one entails P, for at the very least this is what a sufficient cause must do, or it would not in any sense ensure or guarantee its effect. Mellor calls this the necessity condition (31–32). Second, although chance and credence are not the same thing, for amongst other reasons credences do not always meet the necessity condition (33–36), it still holds that if all the evidence I have about P is that $ch(P) = p$, then my degree of belief that P, Cr(P) should be p. Mellor calls this the evidence condition (44). Nor can chances be evidential or logical relations because chances are contingent on the circumstances S (37–38). Third, although chances cannot be frequencies since among other things frequencies are not local whereas chances are (39–43), still any collective of facts of a kind Q* with the property $ch(P^*) = p$ will have the limiting frequency $F_\infty(P^*) = p$. Mellor calls this the frequency condition (44). It can be shown that the frequency condition entails the evidence condition (45–48). In fact, these three conditions are necessarily true, ie holding of chance in all possible worlds (49).

Chance is the property of a fact such that these three conditions are met. There is nothing more to chance than that. In this sense chance is analogous to mass, which is defined purely in terms of the laws it figures in.

Chance is of course related to propensity. The strength of the propensity of a cause to bring about its effect is p if 'C⇒ch(E) = p'. Chances embody the propensity of actual finite reference classes to yield actual frequencies. The propensity of any chance to yield frequencies close to itself increases with the number of trials. Thus repetition of a chance setup causes the frequency to be close to the chance, so that the fact that frequencies are evidence for chances is an example of effects being evidence for their causes.

We turn now to Mellor's argument against causal determinism. As is commonplace, Mellor begins with a case from quantum physics. However, his actual argument is far from commonplace.

Suppose we have a radioactive atom of type E. Its laws give it a chance of decaying (Dx) in a given time interval

$$\text{ch}\ (\text{Dx}) = \lambda$$

Suppose that atom h does decay in the time interval (Dh). Then its law gives it a chance λ where $0<\lambda<1$. But the determinist could deny that Dh has any causes. However, suppose instead we bombard h (write this as 'Bh') with some subatomic particle which raises its chance of decaying, say, from the very small value 10^{-10} to the very large value $1–10^{-10}$, and that h does decay. Surely the bombarding caused the decay; i.e., 'Dh because Bh' is true. Then we have a cause which is neither necessary nor sufficient for its effect (53).

Besides denying the bombarding caused the decay the only avenue open to the causal determinist is to appeal to hidden variables. If h and i are E atoms and in identical circumstances h decayed and i did not then that must be because there is some property C which h has and i does not, such that $\text{ch}_{\text{Ch}}(\text{Dh}) = 1$ and $\text{ch}_{-\text{Ci}}(\text{Di}) = 0$.

According to Mellor $\text{ch}_{\text{Ch}}(\text{Dh}) = 1$ is consistent with the fact that $\text{ch}(\text{Dh}) = \lambda \neq 1$. But how can Dh have two chances at the same time? By those chances being the properties of different facts at that time (54). This I think presents Mellor with a serious difficulty. Since the chance that C gives E is dependent on the circumstances (24), C is part of the circumstances, so that ch(Dh) is not equal to λ but is 1. To this Mellor replies (in conversation) that it is not, the circumstances need include only enough to underpin a law. To me this seems to have a number of undesirable consequences. First, it makes chance epistemic, since its value depends on how much of the circumstances are accounted for. Second, it makes it possible to have two true incompatible

laws each depending on different parts of the circumstances, so that in this case according to one law ch(Dh) = λ and according to another ch(Dh) = 1. Therefore it seems to me unwise to allow relevant circumstances to be omitted from a statement of circumstances.

Nevertheless, to demonstrate that these chances are compatible Mellor tries to show that they both can meet the necessity, evidence and frequency conditions on chance. For example, the evidence condition is met if cr(Dh, ch(Dh) = p) = p. Evidence ch(Dh) = 1 justifies cr(Dh) = 1, and no other evidence can change that, and this must include the evidence that ch(Dh) = λ. This should be my credence if my evidence includes both chances. But if my evidence includes only ch(Dh) = λ, that justifies cr(Dh) = λ. The first part of this seems wrong to me. If my evidence includes both chances then I have two credences 1 and λ, from which it follows that credence is not an adequate interpretation of the probability calculus.

However, Mellor argues that the existence of such hidden variables is irrelevant to the question of causal determinism. The reason is that even if a deterministic hidden variable is postulated, that hidden factor C will itself have an indeterministic cause: i.e., that h has C is a matter of chance, with no deterministic cause. If we postulate hidden variables for that, then those factors will have indeterministic causes, etc. Therefore hidden variables are irrelevant to the issue of causal determinism.

Even so, the causal determinist can still insist that since causation is necessarily deterministic, none of these cases are causation. How then is this issue to be decided? Mellor's answer reveals broad features of his approach to metaphysics.

The reason these disagreements about determinism arise is that it may appear sometimes that our commonsense notion does entail determinism. Yet other times we recognize indeterministic causes as causes. But it matters not that the commonsense notion is inconsistent. Often commonsense requires some degree of revision. The way to decide the issue here is to compare other connotations of causation: if those connotations require determinism then let causation necessarily be deterministic. If they allow indeterminism, let causation be possibly indeterministic.

Mellor identifies five key connotations of causation:

1. Causes precede their effects
2. Causes and their effects are contiguous
3. Causes are evidence for their effects
4. Causes explain their effects. (60)
5. Causes are means to bringing about their effects as ends. (66)

It is clear, he says, that none of these entail determinism. But it is

also necessary to show why. This can be done non-controversially in the case of 3 and 4. For A to be evidence for B it is not required that B obtains. So where a cause is evidence for its effect it is not necessary that the cause is sufficient for its effect. So too for the case of explanation. The only account of explanation that might seem to say otherwise is Hempel's DN model (Hempel 1965), which says that an explanation entails what it explains. But causes rarely entail their effects: if the relevant law is contingent then not even the total cause entails its effect. So causes are not explanations on the DN model. What is an explanation is the total cause together with the law. Thus the (derivative) sense in which a cause can explain its effect is by entailing that there is a law making the cause sufficient for the effect.

This brings us to a key point in the book. Causation's connotations constrain the chances that causes give their effects. They require, argues Mellor, that every cause raise the chance of its effect: $ch_C(E) > ch_{\sim C}(E)$. Take the evidential connotation. To show that this entails that causes raise the chance of their effects Mellor uses an example of a cylinder firing, where the presence of gas G and the presence of oxygen O are causes of the explosion E, in addition to the firing of the spark C. Then $ch_C(E) = ch_G(E) = ch_O(E) = ch(E)$ since each of these chances are evaluated in the closest world which in each case happens to be the actual world, where C, O and G obtain. So $ch_C(E)$ does not measure C's contribution, but C's, O's and G's joint contribution. The spark's contribution is measured by the difference between $ch_C(E)$ and $ch_{\sim C}(E)$; where $ch_C(E)$ is greater C is evidence for E, where it is less C is evidence against E, where they are equal it is not evidence either way. Thus the evidential connotation entails that causes raise the chance of their effects. I worry that this begs the question. To say that *causes* are always evidence for their effects requires the assumption that causes always raise the chance of their effects. For in a genuine case of chance lowering causation the the cause in question would not be evidence of its effect. For example, if Sue's pulling her shot causes a hole in one, yet lowers the chance of that effect, then Sue's pulling the shot is not evidence for her getting a hole in one.

Mellor's case concerning explanation requires a particular account of the nature of explanation. According to Mellor the aim of explanation is to "reduce the gap" between what we know to be true (the explanandum in the absence of any explanation) and what we know to be necessary in the not-possibly-not sense. Full explanations will appeal to an explanans which makes the explanandum necessary in this sense. Partial explanations appeal to an explanans which reduces the range of possibility, i.e., raise the chance, of the explanandum. The less possible effect it is, the closer fact E becomes to being necessary.

Explanations raise chance rather than make probable for reasons parallel to those just discussed concerning evidence.

This account is supported by an argument to the best explanation, explaining why maths and logic don't often use explanation, whereas history and science do. Logic and maths give results which are already necessary, whereas science and history don't.

The means-end connotation is an essential connotation in Mellor's view: "causation is essentially the feature of the world that gives ends means" (79–80), a view once proposed by Gasking (1955), and defended recently by Price (1996). But for this to be much help we need to know what the means-ends relation amounts to, and it had better not be in terms of causation. Mellor invokes non-causal decision theory, which in turn yields the result that means raise the chances of their ends, thus constraining causes to raise the chances of their effects (Ch. 7).

It may be objected that there is another connotation which Mellor has omitted: that causes determine their effects (causal determinism). Mellor admits that this has been a widely accepted part of the concept. This makes the common concept inconsistent, and this requires revision. (The task of metaphysics by Mellor's lights is not simply to map the concept as it appears in common usage.) Something has to go, and determinism it is. However, Mellor feels that he is able to explain the appeal of causal determinism. This he does through the notion of the degrees of effectiveness of causes: since deterministic causes are the most effective, we naturally think of deterministic causation as the paradigm.

My main concern about this case is in the other direction: there are well-documented cases of chance-lowering causes. (Dowe 1993, Rosen 1978, Salmon 1984). Mellor defends the probabilistic theory against this type of counterexample by drawing a distinction between particular and factual causes (67–68). The particular event Don's fall is not the same thing as the fact that Don fell, although both may be causes. Mellor considers a standard chance-lowering example. Sue pulls her golf drive, but the ball hits a tree and bounces into the hole. "But the pulled drive causes her to hole out in one, even though she would have had a greater chance of doing so had she not pulled her drive."

But, says Mellor, we must distinguish the particular event Sue's drive, from the fact that she drives the ball. That she drives the ball (D) does raise the chance that she gets a hole in one (H), and is a cause. This fact entails that the particular event Sue's drive causes the particular event Sue's holing out. But it does not entail that the fact that Sue pulls her drive (P) causes the fact that Sue holes out. According to Mellor Sue holes out despite the fact that she pulled her drive.

But to say D causes H but P does not seems unsatisfactory. P expresses the way D in fact obtained, and P in fact led to H (incredibly).

That the drive was pulled did produce the hole in one (not just that she drove the ball).

Now proponents of the despite defense (Humphreys 1981, Papineau and Sober 1986, Papineau 1989) can dig in their heels and say that because P lowers the chance of H, H occurs despite P, (in the sense that it is a negative cause.)

Mellor himself says it comes down to intuitions and that we reach a familiar stand-off. That may be so, but note two things. First, the intuition Mellor draws on is really just the intuition that chance lowerers aren't causes. But second, ad hominem, note that Mellor by his own lights should admit that his intuitions about this case are wrong. The reason is that on Mellor's account it can be shown that P does raise the chance of H, and so, on Mellor's account, P is a cause of H. P and D both give H the same chance, according to equation 1a, since the closest world where D and the closest world where P are both the actual world; thus $ch_D(H) = ch_P(H) = ch(H)$.

What is that chance? Consider P', the fact that Sue pulls her drive is exactly the right way to make it likely that the ball will strike the tree in exactly the right spot so as to make it likely that the ball will rebound into the hole. This is exactly what obtains in our case—Sue does pull her drive in that manner. Then, by the same reasoning as above, $ch_D(H) = ch_P(H) = ch_{P'}(H) = ch(H)$. We can now see that the chance that D (or P or P′) gives H in the circumstances is quite large (1, in a deterministic world). So the chance D gives H depends on the fine details about the fact D, stated or otherwise. So also the chance P gives H depends on the fine details about the fact P.

So given there are finer details about the actual fact P, expressing the way she pulled the shot, it follows that $ch_P(H)$ is much larger that Mellor supposes when he asserts that $ch_P(H) < ch_{\sim P}(H)$. Providing there is sufficient fine detail of this sort, as there surely is, then $ch_P(H) > ch_{\sim P}(H)$ and P is the cause of H by Mellor's own account. So by his own lights, Mellor's intuitions about this case are not to be trusted.

But suppose there were no finer details about P, such as is the case with certain cases in quantum physics (see Dowe 1993, 1996; Salmon 1984). Then the fact D would raise H's chance, while P does not. But P would still be the way H arises, and so would be just as much the cause of H as it is in the previous scenario. So we have a chance-lowering cause. The only way to avoid this conclusion is to define away the possibility.

There is much in this book that this review cannot adequately cover, concerning the causal relation, properties, laws, and time. Briefly, what causal facta (the entities in our world whose existence make true statements true) there are depends on what properties there are, which in

turn depends on what laws there are. Concerning time, according to Mellor there are no causal loops and causally linked facts cannot coincide. Thus causation picks out a linear dimension of spacetime which, Mellor argues, must be time. Time is the dimension of causation, so causes must precede their effects (Ch. 17).

There is an increasing number of books being published on causation, but Mellor's book demands the attention of anyone with a serious interest in causation in metaphysics or philosophy of science. While it does engage with many issues of interest to contemporary philosophers, it does not explicitly engage current literature, yet it does stand on its own merits. It is difficult, challenging and in places ingenious. I found it hard but rewarding. *The Facts of Causation* certainly reaches the high standards that we have come to expect from Hugh Mellor.

REFERENCES

Dowe, P. (1993), "On the Reduction of Process Causality to Statistical Relations", *British Journal for the Philosophy of Science* 44: 325–327.

———. (1996), "Chance Lowering Causes: Old Problems for New Versions of the Probabilistic Theory of Causation", in D. Dowe, K. Korb, and J. Oliver (eds.), *Information, Statistics and Induction in Science*. Singapore: World Scientific Publishing Company, pp. 226–236.

———. (1997), "The Causal Conditional and the Chances of Effects", in P. Weingartner, G. Schurz, and G. Dorn (eds.), *The Role of Pragmatics in Contemporary Philosophy*. Vienna: Holder-Pichler-Tempsky.

Gasking, D. (1955), "Causation and Recipes", *Mind* 64: 479–487.

Hempel, C. (1965), *Aspects of Scientific Explanation*. New York: Free Press.

Humphreys, P. (1981), "Aleatory Explanations", *Synthese* 48: 225–232.

Lewis, D. (1986), *Philosophical Papers Volume II*. New York: Oxford University Press.

Papineau, D. (1989), "Pure, Mixed and Spurious Probabilities and Their Significance for a Reductionist Theory of Causation", in P. Kitcher and W. Salmon (eds.), *Minnesota Studies in the Philosophy of Science*. Minneapolis: University of Minnesota Press, pp. 410–505.

Papineau, D. and E. Sober (1986), "Causal Factors, Causal Inference, Causal Explanation", *Proceedings of the Aristotelian Society Supplementary* 60: 115–136.

Price, H. (1996), *Time's Arrow and Archimedes' Point*. Oxford: Oxford University Press.

Rosen, D. (1978), "Discussion: In Defense of a Probabilistic Theory of Causality", *Philosophy of Science* 45: 604–613.

Salmon, W. (1984), *Scientific Explanation and the Causal Structure of the World*. Princeton: Princeton University Press.