of the main argument, and nowhere in these arguments do I assume that the conditional analysis is wrong.

Of course, any or all of my arguments in defence of the premisses of the main argument may contain some mistake. But unless the conditionalist could point to some such mistake, he would not accomplish much by showing that some statement he *claimed* was equivalent to one of its premisses was false.[13]

13. For an argument in some respects similar to what I have called the 'main argument', see Carl Ginet's admirable article, 'Might We Have No Choice?' in Lehrer, 87–104. Another argument similar to the main argument, which is (formally) much simpler than the main argument, but which is stated in language very different from that of traditional statements of the free-will problem, can be found in my 'A Formal Approach to the Problem of Free Will and Determinism', *Theoria*, 1974.

Chapter 53

Selection from *Freedom from Physics: Quantum Mechanics and Free Will*

Barry Loewer

If . . . the atoms of our bodies follow physical laws as immutable as the motion of the planets, why try? What difference can it make how great the effort if our actions are already predetermined by mechanical laws. . . .

—Arthur Holly Compton,
The Freedom of Man

Introduction

Robert Nozick describes the experience of making a free choice thus:

Making choices feels like this. There are various reasons for and against doing each of the alternative actions or courses of actions one is considering, and it seems and feels as if one could do any one of them. In considering the reasons, mulling them over, one arrives at a view of which reasons are more important, which ones have more weight. . . . What picture emerges if we take seriously the feeling that the (precise) weights to be assigned to reasons is "up to us"? It is causally undetermined (by prior factors) which of the acts we will decide to do.[1]

I will call a choice that *is*, not merely *feels*, as Nozick describes 'libertarian free' and philosophers who believe that our choices are sometimes libertarian free 'libertarians.'

We have cut section 2 of this paper, which gives a summary of two indeterministic interpretations of quantum mechanics: the orthodox or Copenhagen interpretation, and the non-orthodox GRWP interpretation (named after its founders Ghiradhi, Rimini, Weber, and Pearle). The third interpretation summarized is Bohm's deterministic 'hidden variable' interpretation. Loewer argues in this section that 'since Bohmian mechanics is as well supported by empirical evidence as indeterministic quantum theories we currently have as much reason, at least as far as physics is concerned, to believe that our world is one at which determinism is true'; and that 'if quantum theory is to provide any support at all for libertarian freedom it will be some indeterministic version like the orthodox account or GRWP'. It is not essential to understand the details of these interpretations in order to grasp the philosophical points made in the rest of Loewer's paper.

1. Robert Nozick, *Philosophical Explanations* (Cambridge, Mass.: Harvard University Press, 1981), 294.

Barry Loewer, 'Freedom from Physics: Quantum Mechanics and Free Will', from *Philosophical Topics*, 24 (1998), reprinted with permission of Philosophical Topics and the author.

On the libertarian conception of freedom, a choice is free only if, as Nozick says, the agent's choice or the weight she assigns to her reasons is *up to her*. The phrase 'up to the agent' is frequently invoked by libertarians to express the idea that the choice *originates* in the will of the agent.[2] While factors prior to making the choice (including the agent's prior mental states) may limit possibilities or incline the agent one way or another, they don't causally determine which option she chooses. The choice originates in her. But exactly what does it mean for a decision to *originate* in the will of the agent? Robert Kane explains what it is for a decision to originate in an agent's will in terms of her being *ultimately responsible* for her decision and explains this notion thus:

> (UR) An agent is ultimately responsible for E's occurring only if (R) the agent is personally responsible for E's occurring in a sense which entails that something the agent voluntarily did or omitted, and for which the agent could have done otherwise, either was, or causally contributed to, E's occurrence and made a difference to whether or not E occurred; and (U) for every X and Y if the agent is personally responsible for X and if Y is an *arche* (or sufficient ground or cause or explanation) for X then the agent must be personally responsible for Y.[3]

If a decision satisfies (UR), then there is some part of the causal history of the decision that involves the agent's making a choice when she could have chosen otherwise and there is no sufficient cause of that choice. (UR) doesn't require the agent to be responsible for every part of the cause of her choice. It is enough if there is some part of the cause that cannot be accounted for by factors external to the agent. I think that (UR) goes some distance toward clarifying libertarian freedom. Whether it provides a sufficient condition is a matter I will return to later.

Are there any choices (decisions or actions) that satisfy (UR)? Libertarians all agree that if there are libertarian free choices, then *determinism* is false. Determinism is the doctrine that the laws of nature are such that two possible worlds that agree on their states at time *t* and on the laws of nature agree on their states at all times. It is obvious that the existence of choices satisfying (UR) is incompatible with determinism. The reason is that if determinism is true, then for any choice *X* by an agent *A* there is a *Y* such that *Y* is a sufficient cause of *X* but *A* is not responsible for *Y*. For example, *Y* can be the conjunction of the deterministic laws and the state of the universe at a time prior to *A*'s birth.

Libertarian conceptions of freedom contrast with *compatibilist* conceptions. Compatibilists agree with libertarians that for a choice to be free it must be up to the agent, but they understand this notion quite differently. According to compatibilists,

2. According to Nozick, libertarian free choices possess 'originative value.' He says:

> A being with originative value, one whose acts have originative value, can make a difference. Due to his actions, different value consequences occur in the world than otherwise would; these were not in the cards already. . . . Puppets and marionettes lack originative value (except in fairy stories), and the way we resemble them, if causal determinism is true, is that we lack originative value too (Nozick, op. cit., 312).

3. Robert Kane, *The Significance of Free Will* (New York: Oxford University Press, 1996), p. 35.

a choice is up to an agent if it is causally and counterfactually sensitive to the agent's reasons—her beliefs, preferences, plans, etc.—in an appropriate fashion. Sophisticated compatibilist accounts further require that these reasons are themselves causally and counterfactually sensitive in an appropriate way to prior and higher-order reasons and so forth.[4] A precise characterization of 'appropriate' is elusive, but it involves the implementation of rational relations among the agent's beliefs, preferences, choices, etc. However 'appropriate' is spelled out, compatibilists think that the existence of free choice is compatible with those choices and the reasons for them being covered by deterministic laws; that is, it is compatible with there not being more than one choice that is genuinely possible prior to making the choice. Obviously, a decision that is *merely* compatibilist free may fail to satisfy Kane's (UR) condition, since it may have a sufficient cause that is entirely outside of the agent.

As long as it was thought that the fundamental physical laws of nature supported determinism—as Newtonian theory was generally thought to—it appeared that physics excluded libertarian freedom.[5] For philosophers who, like Kant, thought that morality and even rationality require libertarian freedom, this consequence is absurd and paradoxical. On the one hand, scientific rationality seemed to lead to determinism and, on the other hand, the exercise of that rationality apparently requires libertarian freedom. But with the overthrow of Newtonian physics and its replacement with quantum theory, some physicists and philosophers have thought that the physics of our world may be compatible with libertarian freedom after all.[6] Among the claims that have been made about quantum theory are that its laws are ineliminably indeterministic, that properties sometimes fail to possess determinate values, that physical laws are ineliminably incomplete, and that physics cannot be formulated without reference to consciousness. All this has given hope to proponents of libertarian freedom. If physical laws require reference to consciousness for their formulation, it has been thought, they cannot exclude the possibility of freedom.

The primary aim of this paper is to investigate the claim that quantum theory is hospitable to libertarian freedom. . . .

4. A classic development of a compatibilist account of freedom is Harry Frankfurt, 'Freedom of the Will and the Concept of a Person,' *The Journal of Philosophy* 18 (1971): 5–20. Frankfurt emphasizes the importance of second-order preferences directing first-order preferences. For accounts of libertarian and compatibilist conceptions of control, see also John Martin Fischer, *The Metaphysics of Free Will* (Cambridge, Mass.: Blackwell, 1994).

5. Dualism might be thought to allow for libertarian freedom even if determinism holds, say, in the physical world. But although it might allow for freedom in the realm of the mental, it seems like a freedom hardly worth having, since the mental would be epiphenomenal with respect to the physical.

6. This hope is expressed in Arthur H. Compton, *The Freedom of Man* (New Haven, Conn.: Yale University Press, 1935); Karl Popper, *Objective Knowledge* (Oxford: Clarendon Press, 1972); Peter van Inwagen, *An Essay on Free Will* (Oxford: Clarendon Press, 1983); Robert Kane, *Free Will and Values* (Albany, N.Y.: SUNY Press, 1985); and 'Two Kinds of Incompatibilism,' in Timothy O'Connor, ed., *Agents, Causes, and Events* (Oxford: Oxford University Press, 1995); and Nozick, op. cit.

Indeterminism and freedom

It has often been claimed (especially by compatibilists) that it is actually indeterminism (and not determinism) that is incompatible with freedom. For example, Ayer says:

> Either it is an accident that I chose to act as I do or it is not. If it is an accident, then it is merely a matter of chance that I did not choose otherwise; and if it is merely a matter of chance that I did not choose otherwise, it is surely irrational to hold me morally responsible for choosing as I did. But if it is not an accident that I choose to do one thing rather than another, then presumably there is some causal explanation of my choice; and in that case we are led back to determinism.[7]

Ayer seems to identify choices that are not determined by prior conditions and laws with 'accidental' choices and these latter choices with ones that are 'merely a matter of chance.' He claims that choices that are merely a matter of chance are not free, at least not in the sense relevant to moral responsibility. If Ayer were right, then libertarian freedom would require free choices both to be determined and not determined (given the laws) by prior events. Quantum mechanics could not rescue it. But Ayer's argument is too quick. First of all, an event's being nonaccidental and its being determined by prior events are quite different things. Otherwise, were the laws to be deterministic, there would be no accidents, and were the fundamental laws to be probabilistic, then every event with an objective chance less than 1 would be an accident. Second, Ayer seems to assume that every event must either be determined by prior events or have some chance different from 1 of occurring. But this is not obviously so. Recent philosophical accounts of laws and probabilities allow for the possibility of events that are not covered by any laws and that don't have probabilities.[8] Third, and most importantly, it is not obvious that if a choice is the outcome of a probabilistic process, it is irrational to hold a person morally responsible for it. As we will see, libertarians have developed models on which deliberation is an indeterministic quantum mechanical process. They claim that on these models choices may be caused by an agent's reasons in a way that underwrites their being up to the agent. If they are correct, then it is rational to hold a person morally responsible for such choices. So we need to examine indeterministic quantum mechanical models of libertarian freedom within quantum theory to see whether they provide adequate accounts of libertarian freedom.

7. A. J. Ayer, 'Freedom and Necessity,' in his *Philosophical Essays* (New York: St Martin's Press, 1954), p. 275.
8. The two most important recent accounts are to be found in David Lewis, *Philosophical Papers* (New York: Oxford University Press, 1983) and David M. Armstrong, *What Is a Law of Nature?* (Cambridge: Cambridge University Press, 1983). Lewis advocates a *Humean* account of laws and probabilities according to which the laws are the contingent generalizations, including probabilistic generalizations, entailed by the theory that best combines informativeness, fit, and simplicity. Armstrong's account is *non-Humean*, specifying that laws, including probabilistic laws, are facts composed of relations of contingent necessity and probilification between universals. Both these accounts allow for the possibility of events that are not covered by any laws and that fail to have objective probabilities.

The idea that quantum theory makes room for or supports libertarian freedom goes back to the origins of the theory.[9] Before discussing suggestions about how that might be accomplished, I want to address the frequently made claim that quantum mechanics is irrelevant to discussions of free will, since quantum indeterminacy only involves microevents, while human choices and actions are a macroscopic phenomena.[10] This claim is almost certainly mistaken. If an indeterministic version of quantum theory like GRWP is true, then it is very likely that many macroevents—including mental events and actions—evolve indeterministically. Quantum theory assigns probabilities to macroscopic events (assuming that these are constituted by or supervene on microscopic events) in all sorts of usual situations. For example, if a measurement of the x-spin of a y-spin particle is recorded in the position of a macroscopic pointer, then the post-measurement position of that pointer is assigned an objective probability by quantum theory. If GRWP is true, then all sorts of typical measurement-like interactions between macroscopic and microscopic systems (i.e., interactions in which macroscopic properties become correlated with microscopic properties) evolve indeterministically. Since ordinary chemical reactions involve the breaking and forming of chemical bonds and such interactions are indeterministic according to quantum theory, those interactions involving small numbers of molecules will also be indeterministic. These indeterminacies may with high probability cancel out at the macroscopic level if the relevant macroscopic property is an average of microscopic qualities. But that need not be the case. The microscopic indeterminacy may be amplified at the macroscopic level as it is in measurements. Of course, the quantum mechanical probabilities of choices and actions (and other mental events) are an empirical matter and are not known. But if GRWP is true, then it is very plausible that these probabilities are never exactly 1 or 0 and sometimes deviate appreciably from these extremes.

I now want to discuss some quantum mechanical models of libertarian freedom. Nozick makes the following suggestion:

> According to the currently orthodox quantum mechanical theory of measurement, as specified by John von Neumann, a quantum mechanical system is in a superposition

9. Compton, op. cit., was an early and enthusiastic advocate of the idea that quantum theory permitted the existence of freedom of the will.
10. Ted Honderich seems to follow this line of reasoning. He says that:

> if . . . micro-indeterminism does produce chance events in the ordinary world, what about the evidence for that? Why have we not noticed one of these chance events? Why has a spoon not levitated before now, when the random lurches of little events within it all happened to combine in the right way? The common answer made to this is that any levitations, for several reasons, are so totally improbable as in some sense or other to be out of the question. It does not quite satisfy me. If it *is* true that there is indeterminism in the real world, and finding it would get someone a Nobel Prize, I would have expected a little unquestioned progress by now. *Some* kind of unquestioned progress. (Ted Honderich, *How Free Are You?* [Oxford: Oxford University Press, 1993], 66).

> Honderich is looking in the wrong place (e.g., for spoons to levitate) for indeterministic macroscopic events. Every macroscopic measurement of a quantum mechanical observable on a system that is not in an eigenstate of that observable is indeterministic; e.g., the noise made by a Geiger counter detecting alpha particles.

of states, a probability mixture of states, which changes continuously in accordance with the quantum mechanical equations of motion, and which changes discontinuously via a measurement or observation. Such a measurement "collapses the wave packet," reducing the superposition to a particular state; which state the superposition will reduce to is not predictable. Analogously, a person before decision . . . is in a superposition of (precise) weights, perhaps within certain limits, or a mixed state (which need not be a superposition with fixed probabilities). The process of decision reduces the superposition to one state . . . but it is not predictable or determined to which state of the weights the decision (analogous to a measurement) will reduce the superposition.[11]

Nozick says that he is not literally proposing that the process of making a decision is a quantum mechanical measurement but that he intends the analogy to show that a certain model of choosing an action is coherent.[12] Despite his disclaimer it is worthwhile to examine the model, since if quantum theory is to provide space for libertarian freedom, there must be some quantum mechanical account of acting freely. On Nozick's model, prior to making the decision the agent is in a superposition of states corresponding to different evaluations of reasons that favor different actions. Making the decision involves measuring this observable. The measurement collapses this state into one of its components, i.e., a state in which the weight of reasons favors a particular action over its alternatives.[13]

There is a problem about the particular way Nozick employs quantum theory in his account that arises from the nature of quantum mechanical superpositions. Prior to coming to a decision we expect that a person will report that she has not yet made up her mind, that is, that she hasn't yet decided what action her reasons favor. But if an agent is in a superposition of states, each corresponding to having made up her mind but in different ways, it follows from the linearity of the Schrödinger equation that in this state she has definitely made up her mind.[14] If she sincerely reports the state of her mind, then in the state Nozick describes, she will report that she has made up her mind. But of course prior to deciding on a particular action a person has not

11. Nozick, op. cit., 298.
12. Popper, op. cit.; David Wiggins, 'Toward a Reasonable Libertarianism,' in Ted Honderich, ed., *Essays on Freedom of Action* (London: Routledge and Kegan Paul, 1973); Kane, *Free Will and Values*, 'Two Kinds of Incompatibilism,' and *The Significance of Free Will*; J. R. Lucas, *The Freedom of the Will* (Oxford: Clarendon Press, 1970); and practically every other contemporary supporter of libertarian freedom appeal to quantum mechanics to argue that libertarian freedom is possible.
13. On the GRWP theory, the superposition will be stable only if it involves an isolated system with very few degrees of freedom or is close to an eigenstate of position. The latter is more plausible since weighing reasons likely corresponds to a physical process involving many degrees of freedom. If so, then the observable being measured (the observable corresponding to the superposition of reasons) must involve some property other than position; e.g., the spins of many particles.
14. The state |decided to do A> + c*|decided to do B> is an eigenstate of the operator corresponding to the property of having made up one's mind. For a discussion of this elementary but still, to some, surprising result, see David Albert, *Quantum Mechanics and Experience* (Cambridge, Mass.: Harvard University Press 1992) and David Albert and Barry Loewer, 'Tails of Schrödinger's Cat' in J. S. Bell (ed.), *The Speakable and the Unspeakable in Quantum Mechanics* (Cambridge: Cambridge University Press 1987).

made up her mind and, if she is sincere, won't report that she has. This is a bit surprising since one might think that a superposition of mental states would be experienced as a feeling of uncertainty. But that is not so.

This particular defect in the proposal is not difficult to repair. Robert Kane has suggested a slightly different account of how quantum mechanics might ground libertarian free will that avoids the problem.[15] Kane's picture of the process of making a free choice is similar to Nozick's. But he adds that the process of deliberation involves making an *effort of will*. This is where Kane locates quantum indeterminateness. He says:

> Let us suppose that the effort of will (to resist temptation) in the moral and prudential choice situations . . . is (an) *indeterminate* (event or process), thereby making the choice that terminates it *undetermined*.[16]

On this account, at the outset of deliberation the agent is in a superposition of states corresponding to initiating various degrees of efforts of will. The deliberation process is the evolution of this state, which at a certain point collapses into a state corresponding to exerting a specific effort of will. And that state leads to making a particular choice. Presumably, the greater effort of will is required for the action that is supported by moral or prudential reasons than the action that is supported by current whims. In any case, Kane's account doesn't suffer from the defect in Nozick's, since prior to the collapse the agent hasn't made a decision and will so report and after the collapse the agent has made a decision and will so report.

Kane's model of free will appears to satisfy some of the features that libertarians think free will possesses. Prior to making a choice there are various alternative choices open to the agent and making the choice involves mental processes internal to the agent. Conditions outside of or external to the agent do not *determine* which choice she makes. Further, the choice she makes will be rational by her own lights, since she will have reasons for it.

On Kane's account, do free choices satisfy his condition (UR)? Recall that (UR) requires that an agent's choice X is libertarian free only if each Y that is a *sufficient* cause of X is such that the agent is responsible for Y. Since the choices that are free on Kane's model are ones that don't have *any* causally sufficient conditions it is clear that they satisfy (UR). And if the fundamental laws are indeterministic, choices may very well not have any causally sufficient conditions. In spite of this

15. See Kane, *Free Will and Values*; 'Two Kinds of Incompatibilism'; and *The Significance of Free Will*. As far as I know, Kane was unaware of this problem with Nozick's account. His own account has a similar, although not as troubling, consequence. Even though prior to the collapse the agent does not exert a particular degree of effort—the state is a superposition of various degrees—she will report that she is exerting a specific degree of effort. But this doesn't seem to be a defect.
16. Kane, *The Significance of Free Will*, 128. Kane makes a distinction between what he calls 'Epicurean worlds' in which the laws are indeterministic but properties are never indeterminate (that is, in which there are no superpositions) and quantum mechanical worlds in which properties can be indeterminate. He thinks that the latter is required for libertarian free will, but it is not clear to me exactly why this should be so.

and the other appealing features of Kane's account, I don't think that a libertarian should be satisfied with it. It will be tricky to argue for this claim, since it is open to a libertarian to claim that choices that fit Kane's model are exactly what he *means* by a choice being free. However, given a widely accepted principle concerning chancy causation, it will follow by reasoning parallel to the reasoning that the libertarian uses to show that determinism is incompatible with freedom that a complete indeterministic theory (like GRWP) is incompatible with freedom.

To set the stage for my argument we will need to discuss a few points concerning objective physical probabilities and causation. I will suppose that the laws of physics are complete and that they assign objective probabilities to every event. For example, in GRWP, the quantum state $|\$_t>$ of the universe at time t and the dynamical law both determine objective probabilities for every possible evolution of $|\$_t>$. I'll call the claim that the laws are like this 'objective indeterminism.' On objective indeterminism, the objective probability of an event is indexed to two times: the time at which the event occurs and a second time at which the objective probability is evaluated given the history up to that time.[17] How this works will be clearer with an example.[18] Suppose A enters a labyrinth at time t_0 planning to choose whether to turn left or right when she comes to a branch point by flipping a coin (the outcome of which I assume to be genuinely chancy). Suppose also that the possible outcomes of each flip—heads or tails—each have objective chances of 1/2. Call the event of A's reaching the center of the labyrinth at t_n $C(t_n)$. Suppose that at t_0 the chance of A's reaching the center at t_n is .7, i.e., $Pt_0(C(t_n)) = .7$. At the first branch point, A turns left, away from the most direct path to the center. Then at t_1 (the time she turns left) the chance of $C(t_n)$ drops to .4. At t_2, A turns right and thus raises her chances of reaching the center by t_n to .6. Had A turned left at that point, the chance of $C(t_n)$ would have dropped to .2. As A advances through the labyrinth, the chance of her reaching the center by t_n will generally vary until finally at t_n it is either 1 or 0.

Suppose that A does reach the center of the labyrinth by t_n. It is reasonable to say that among the causes of $C(t_n)$ is A's turning right at t_2, i.e., $R(t_2)$. This is a case of *probabilistic causation*. It is probabilistic in that at t_2 the state of the world doesn't determine whether or not A reaches the center by t_n. It is causation in that it raises the chance of A's reaching the center by t_n. That event would have been less likely had A turned to the left. There are various accounts of probabilistic causation that have been proposed. According to Lewis, c probabilistically causes e if c and e are distinct events that occur and c's occurrence raises the chance of e's occurrence.[19] Lewis's account and all other accounts I know of conform to the following principle:

(P) If e is a chancy event (i.e., at times prior to its occurrence there are objective chances of its occurring or not occurring), then if c causes e, it does so by altering the chance of e (at the time immediately after c) or by altering the chance of some event in a causal chain leading from c to e.

17. By the chance at t of an event occurring at t^* I mean the chance of a particular type of event occurring at that time. If the event does occur, then it can be named and we can talk about the chance at various times of that very event.
18. This example is adapted from Lewis, *op. cit.*
19. Lewis explains c's occurrence raising the chance of e's occurrence as follows: If t is the time immediately after c's occurrence, then (*i*) $P_t(Oe) = x$, (*ii*) $-O(c) > P_t((Oe)) = y$, and x is greater than y.

(P) expresses the idea that the only way to causally influence the occurrence of a chancy event is by influencing its chance. It seems to me to be obviously true. I will use (P) to argue that if every event (including choices) possesses an objective chance at all times (as on GRWP), then no choice is genuinely libertarian free. Put slightly differently, my argument is that anyone who thinks that determinism is incompatible with free will should also think that objective indeterminism is also incompatible with free will. If this is correct, then accounts of free choice, like Nozick's and Kane's, that attempt to characterize free choice in terms of objective probabilities are not *genuine* libertarian accounts and indeterministic quantum theories like GRWP are not compatible with libertarian freedom.

Kane's condition (UR) is intended to capture the idea that a genuinely free choice originates in the will of the agent in such a way that it is *the agent* and not anything else that is ultimately responsible for the choice. Clearly, it does express the idea that nothing external to the agent is completely responsible (i.e., is a sufficient cause) for the choice. But libertarians also think that the agent must be responsible for her choice. Now whatever this amounts to, it is clear that the agent thinks that such responsibility is incompatible with determinism. What I propose to do is to show that the very considerations that persuade the libertarian that free choice is incompatible with determinism are equally effective in showing that free choice is incompatible with objective indeterminism.

The incompatibility argument is this:[20]

1. No agent is free to influence the past.
2. No agent is free to influence the laws of nature.
3. The past and the laws logically imply the future.
4. If an agent is not free to influence Q and Q logically implies R, then that agent is not free to influence R.
5. No agent is free to influence the future.

The usual compatibilist response to this argument is to reject (4). While the libertarian notion of freedom may not be entirely clear, it is clear that libertarians think that it satisfies (4). I don't want to enter into the discussion of whether our ordinary notion of a 'free choice' does or doesn't support (4), but I do want to examine a parallel argument that apparently establishes the incompatibility of objective indeterminism and freedom.

The argument for the incompatibility of libertarian free will and objective indeterminism is straightforward. Given (P) the only way that A can influence what choices she makes at time t is to influence the chances of those choices at prior times. But the only way that A can influence *those* chances is by influencing prior

20. There are various versions of this argument, some of which employ conditions that are thought to be necessary for acting freely. See van Inwagen, *op. cit.*, and Fischer, *op. cit.*

states that determine (together with the laws) those chances. And the only way *A* can influence those further states is by influencing *their* chances; and so forth. Clearly, this will take us back to a time at which *A* cannot influence events because she hasn't yet been born. It will follow then that *A* cannot influence her choices; i.e., they are not *up to her* in the way that libertarianism requires. Here is another version of the same argument. For perspicuity's sake I will assume that time is discrete. Let t_0 be a time at which *A* has no control (in the libertarian sense) over anything occurring at that time (say, before *A*'s birth). At t_0, *A* has no control over the chances indexed to t_0. Since *A* has libertarian control over an event only if *A* can influence that event, it follows from (P) that *A* has no control over an event that occurs at t_1. The events that occur at t_1 determine the probabilities indexed to t_1 of events at t_2. But then it follows from (P) that *A* has no control over events at t_2, and so on. It follows that at no time does *A* have control over subsequent events, including her choices.

It is not surprising that objective indeterminism is incompatible with libertarian freedom, since determinism is the limit of objective indeterminism in which all the chances are 1 or 0.[21] A libertarian who, like Kane, thinks that objective indeterminism makes all the difference to whether freedom is possible would seem to be committed to the view that as soon as the chances depart from 1 and 0, however slightly, freedom becomes possible. It is difficult to see why such a slight difference in the physics should make such a vast difference in our wills (i.e., whether they are free or not). If the above argument is correct, then satisfaction of Kane's condition (UR), although it may be necessary, is not sufficient for a choice to be free. It captures the idea that nothing other than the agent is ultimately responsible for her choice. But it doesn't guarantee that *the agent* is responsible. Specifically, it allows that nothing is ultimately responsible for the choice, since it is a matter of chance.

Some libertarians have argued that freedom involves a sui generis relation of *agent causation*.[22] Agent causation is supposed to relate the agent directly to her choices and is not explainable in terms of causal relations—deterministic or probabilistic—between an agent's mental states and her choices. O'Connor characterizes agent causation this way:

> The decision I make is no mere vector sum of internal and external forces acting upon me during the process of deliberation. . . . Rather, *I* bring it about—directly, you might say—in response to the various considerations: I am the source of my own activity, not merely in a relative sense as the most proximate and salient locus of an unbroken chain of causal transactions leading up to the event, but fundamentally, in a way not prefigured by what has gone before.[23]

21. One might object that a chance of 0 doesn't mean impossibility, since, for example, it is usual to say that the chance of a spinner landing on any particular point is 0 although, of course, it is possible for the pointer to land at each point. The answer is, as Lewis points out (op. cit.), that the objection confuses infinitesimal chance with 0 chance.
22. See Roderick Chisholm, 'Freedom and Action,' in Keith Lehrer, ed., *Freedom and Determinism* (New York: Random House, 1966); O'Connor, 'Agent Causation,' in *Agents, Causes, and Events*, and 'Indeterminism and Free Agency: Three Recent Views,' *Philosophy and Phenomenological Research* 53 (1993): 499–526; and Randolph Clarke, 'Toward a Credible Agent-Causal Account of Free Will,' in *Agents, Causes, and Events*.

It is often complained that agent causation is mysterious and merely labels the puzzle of freedom rather than helps to solve it. However that may be, it is clear that agent causation is also incompatible with objective indeterminism, since advocates of agent causation accept the view that the agent has libertarian control over her choices.

Neither deterministic versions of quantum mechanics like Bohm's theory nor objective indeterministic theories like GRWP make room for libertarian freedom. It appears that if libertarian freedom is coherent at all, it must be that free choices (or events leading up to free choices) are outside of the nomological order. In fact, there is a way of thinking about quantum mechanical measurements—one that has been around for some time—according to which quantum mechanical measurements are initiated by 'anomalous' events of conscious observation. This view is sufficiently intriguing to see whether it can be used to ground libertarian freedom. Eugene Wigner proposed that a quantum mechanical measurement occurs when a sentient being makes a conscious 'observation.'[24] So, for example, when a person observes a pointer in the quantum mechanical state $|M>$ that act of observation causes the state to 'collapse' into a state in which the pointer has a determinate position. Wigner doesn't say anything about how this process takes place, but he does seem to assume that acts of consciousness are themselves not physical events at all and so exempt from quantum theoretical laws.[25] I will call this version of quantum theory 'Wignerian mechanics.' Wignerian mechanics seems best understood within a dualist framework. It claims that the laws of physics are not causally closed, since certain changes of physical states would have nonphysical causes (e.g., acts of consciously making measurements) and could not be accounted for in terms of prior physical states. Notice that the world described in this account has two sources of physical indeterminism. First, there is quantum mechanical indeterminism. Once a measurement is made on a system, the system evolves according to the collapse postulate. Second, there is the indeterminism that results from the fact that exactly how a system evolves depends on whether or not conscious acts occur.

If *agent causation* is coherent at all, then it seems that Wignerian mechanics describes the sort of possible world in which it can be implemented. I won't discuss whether *agent causation* is coherent, but I do want to explore a suggestion for how Wignerian quantum mechanics might accommodate it.[26] Suppose that when

23. O'Connor, 'Agent Causation,' 173.
24. See Eugene Wigner, *Symmetries and Reflections* (Bloomington: Indiana University Press 1967).
25. I am assuming that not only are acts of consciousness nonphysical but they don't supervene on physical states. So a complete characterization of the physical state of a system may leave it open whether an act of consciousness associated with that system occurs.
26. I haven't seen this proposal explicitly made in print but Wigner, *op. cit.*, suggests it and I have heard it made in conversation.

a person consciously deliberates about whether to do d or d^* that act of consciousness involves measuring a quantum mechanical observable. *Agent causation* consists in the agent's making this measurement (although, of course, that is not how the agent thinks of what she is doing). The measurement initiates a collapse of state in conformity with the collapse postulate, with the quantum mechanical chances either in a state corresponding to her deciding to do d or in a state corresponding to her deciding to do d^*. The process of conscious deliberation (i.e., the quantum mechanical measurement) is itself not subject to law. That is, there is no law connecting prior conditions (mental or physical) to making a choice (or to the chance of making a choice).

Notice that the indeterminism that is peculiar to quantum mechanical laws is not essential to this account of libertarian freedom.[27] The indeterminism that is supposed to make room for libertarian freedom is not the quantum mechanical indeterminism (i.e., the probabilities associated with the collapse of the quantum state) but rather the indeterminism that results from its not being determined by prior conditions whether or not a conscious measurement (an act of deliberation) will take place. This is what leaves room for the libertarian to say that it is *up to the agent* whether or not the measurement occurs.

Wignerian quantum mechanics is the only interpretation of quantum mechanics that is at all favorable to libertarian freedom. But it is a very implausible interpretation. All the evidence that has ever been obtained in laboratories and by observation supports the view that every physical event is governed by quantum mechanical laws; i.e., that the quantum mechanical laws are complete. And there is absolutely no evidence that acts of measurement fall outside these laws and of course no evidence that mental acts bring about collapses of states or that they are not covered by the laws of quantum theory. It might be replied to this that although there is no 'scientific' evidence that contravenes the completeness of quantum mechanics, still, it is just a conjecture that all events, including acts of decision, are covered by quantum mechanical—or any—laws. And if libertarian freedom requires there to be events outside of the nomological order, then since we have reason to think that we are libertarian free, we have reason to think that the laws of nature are incomplete.[28] But this is a very frail line of thought. Libertarians may be correct that it *feels* to us that our choices are up to us in a way that exempts them from natural law. But it is preposterous to think that we can draw reliable conclusions about physics on the

27. Neither the indeterminateness of some observables nor the indeterminism of the evolution of state that is characteristic of quantum mechanics are essential to this approach to making room for libertarian freedom. Suppose that the fundamental laws are Newtonian but *ceteris paribus*—the ceteris paribus condition being that no events of libertarian freedom associated with a system occur. Suppose that an event of libertarian freedom can alter the momentum (or some other classical quantity) of some particles in the brain in ways that violate the Newtonian laws and that these alterations result in various intentions and that events of libertarian freedom are not covered by deterministic or probabilistic laws.

28. O'Connor, 'Agent Causation,' and Clarke, op. cit., argue in this way.

basis of such feelings. It is more plausible to suppose that this feeling—to the extent we have it—is an illusion.[29]

Conclusion

The results of this paper can be summarized thus: Libertarian freedom requires that an agent's free choices originate in her will. Whatever that means, the libertarian is clear that freedom is incompatible with determinism. It is widely thought that quantum theory is incompatible with determinism. This has suggested that there may be no incompatibility between what physics tells us our world is like and our possessing libertarian freedom. But we have seen that quantum theory provides scant support to the libertarian. We considered three interpretations of quantum theory—Bohm's theory, GRWP, and Wignerian mechanics. The first is deterministic and the latter two are indeterministic. The first two are complete (i.e., cover all events), while the latter allows for events not covered by its laws. Since libertarian freedom is incompatible with determinism, it is incompatible with Bohm's theory. GRWP assigns objective probabilities to every physically possible event at every time. I argued that since events that have objective probabilities can be influenced only by influencing their probabilities, reasons for holding that freedom is incompatible with determinism are also reasons for holding that it is incompatible with objective indeterministic theories like GRWP. Wignerian mechanics posits the existence of events that neither are determined by prior events nor have objective probabilities. Perhaps, then, it allows for libertarian freedom. But there is little reason to believe Wignerian mechanics. I conclude that there is little prospect for gaining (libertarian) freedom from physics.[30]

29. Colin McGinn suggests that this illusion may arise because we in fact generally don't know the complete cause of our choices. (See Colin McGinn, *Problems in Philosophy: The Limits of Inquiry* [Oxford: Basil Blackwell, 1993].) One can speculate that the belief that it is 'up to the agent' which action is actualized—so that prior to making a choice various possibilities are open—although false, plays an important role in the causal history of the action. Perhaps we are such that if we didn't have this belief, rational action would be more difficult.

30. Thanks to David Albert, Michael Bradie, Noa Latham, Brian Loar, and Timothy O'Connor for comments on earlier versions of this paper.