Tachyons, Time Travel, and Divine Omniscience

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SUMMARY

For philosophers in either field, philosophy of science and philosophy of religion are too often viewed as mutually irrelevant disciplines. As a result, insights acquired in each field may not be appropriated by philosophers working in the other field. This is unfortunate, because sometimes the problems can be quite parallel and a consistent resolution is required. One especially intriguing case in point concerns, in philosophy of science, the possibility of tachyons and time travel and, in philosophy of religion, the relationship between divine foreknowledge and human freedom. It is rarely appreciated by discussants of these respective issues that the problems are quite parallel and that insights garnered in the resolution of the difficulty in one discipline may have provocative implications for the solution of the parallel problem in the other field.

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I. Theological Fatalism

To begin, then, with philosophy of religion: Greek fatalism, embodied in Aristotle's argument of *De interpretatione* 9, posed a special threat to Christian theology. Committed to the biblical doctrine of divine foreknowledge as well as to human freedom, Christian thinkers had to explain how it is either that God knows future contingents without future contingent propositions' being antecedently true or false or that God's knowing the truth value of such propositions does not after all entail fatalism. The problem of theological fatalism seemed especially acute since God's foreknowledge of some future event is itself a fact of past history and therefore temporally necessary; that is to

say, it no longer has any potential to be otherwise. Therefore, what God foreknew must necessarily come to pass, since it is impossible that God's knowledge be mistaken. In our own day, philosophers such as A. N. Prior, Richard Taylor, Steven Cahn, Nelson Pike, and Paul Helm have argued that from the temporal necessity of

1. God foreknew *p.*

and the logical necessity of

2. If God foreknows *p*, then *p*.

it follows, for any future-tense proposition *p*, that necessarily *p*. The majority of contemporary philosophers have, however, disputed the cogency of such reasoning. From the fact that God foreknows that I shall do *x*, it follows, not that I *cannot* do otherwise, but only that I *shall* not do otherwise. It remains within my power not to do *x*, but, given God's foreknowledge, we know that I shall not in fact exercise that power. *Were* I to do otherwise, then God *would have* known different future-tense propositions than He in fact knows. [1] As for so-called "temporal necessity," this notion is notoriously difficult, and, if this is a legitimate kind of modality, it is not at all evident that God's foreknowledge of some future event is characterized by such necessity. [2] This does not mean that it is within one's power to change the past. Rather it is to assert the truth of the counterfactuals:

3. If I were to do *x*, God would have foreknown that I would do *x*.

and

4. If I were not to do *x*, God would have foreknown that I would not do *x*.

From the fact that God foreknows that I shall do *x*, we may therefore infallibly infer that I shall do *x*, but it would be fallacious to infer that it is not within my power to refrain from doing *x*.

II. Tachyons

This rejoinder to theological fatalism, which seems to me altogether correct, has some disturbing consequences when we turn to philosophy of science to investigate the possibility of tachyons and of time travel. When Albert Einstein proposed his Special Theory of Relativity in 1905, he conceived of the speed of light c as a limiting velocity such that transmission of energy from point to point in space-time at superluminal velocities is impossible: "velocities greater that that of light," he concludes, "have no possibility of existence." [3] This is because the mass of a particle would become infinitely large as its velocity approaches c. The speed of light was therefore conceived to

be an inviolable barrier for particle velocities. In the second half of the century, however, physicists such as Olexa-Myron Bilaniuk, V. K. Deshpande, E. C. George Sudarshan, and Gerald Feinberg realized that Einstein's conclusion was overdrawn. [4] Although his equations prohibited the *acceleration* of particles traveling at subluminal velocities to or beyond *c*, they did not preclude the existence of particles whose velocities are always greater than or equal to *c*. After all, photons and neutrinos both travel with a velocity equal to *c* without ever having been accelerated from a subluminal speed to luminal velocity. So why could there not exist particles that travel at superluminal velocities without ever having been accelerated from speeds less than or equal to *c*? In this case the speed of light remains an inviolable barrier, but that does not preclude the existence of particles on the other side of the barrier. Feinberg dubbed such particles tachyons, from *taciV* (swift), and the experimental search for these exotic entities was on.

And, indeed, if tachyons do exist, they are exotic. Apart from other oddities, the equations for energy and momentum for such particles reveal that tachyons would accelerate as they *lose* energy. Conversely, whenever energy was imparted to a tachyon, it would *decelerate*. This leads to one of the most peculiar characteristics of tachyons: their *prima facie* possession of negative energy. Let an observer at rest in a reference frame *S* observe a tachyon traveling with a velocity *v* relative to him. This same particle will travel with a different velocity *u* relative to another observer in a reference frame *S1* which is moving with respect to *S* with a velocity *w*. When the product *vw* exceeds *c2*, the tachyon will possess negative energy relative to S1. More peculiar still, such particles will seem to travel backward in time. To the observer in *S1* the negative-energy particle would appear to be absorbed first and emitted later.

The implications of such behavior were noticed by Richard Tolman as early as 1917 in what has come to be known as *Tolman's Paradox*, namely, that communication with the past is possible. [5] Let an observer *O* in a reference frame *S* send out a burst of infinitely fast tachyons at *t*1 to an observer *O1* in a reference frame *S1* which is receding from *S* at the uniform velocity *w*. The reception of the tachyon signal in *S1* triggers a similar burst of tachyons back to *O* which travel with an infinite velocity relative to *S1*. The relativity equations dictate that the second signal arrives in *S* at a time *t0* before the burst of tachyons is sent at *t1*. But, since the signal from *O1* to *S* was triggered by the signal from *O* to *S1*, it follows that the effect (*O*'s reception of *O1*'s signal) precedes the cause (*O*'s sending his signal to *O1*) in *S*, or, in other words, tachyons furnish the mechanism for backward causation.

This implication alone was enough to warrant the rejection of the possibility of tachyons in the minds of many physicists. [6] Proponents of tachyons felt at first constrained to explain away Tolman's paradox with its attendant backward causation by means of a "reinterpretation principle." "It is precisely by putting together the two quizzical concepts of 'negative- energy' particles

traveling *backward in time* that the resolution of the difficulty is found," stated Bilaniuk and Sudarshan; "A 'negative- energy' particle that has been absorbed first and emitted later is nothing else but a positive-energy particle emitted first and absorbed later, a perfectly normal situation." [7] By interpreting any negative-energy particle moving backward in time as a positive-energy particle moving forward in time, one may thereby eliminate the occurrence of an effect before its cause. In our previous case, for example, $O1$ will naturally regard the tachyon beam received from S as actually a signal that he is himself sending to $S1$. $O1$ and O will regard these beams as spontaneous emissions from their own tachyon transmitters rather than as receptions from another reference frame.

Now, at face value, the reinterpretation principle sounds merely like the endorsement of what can only be characterized as a fantastic delusion. If O's tachyon signal really does trigger $O1$'s transmitter to send a return signal, then it is simply irrelevant whether O or $O1$ *believes* that no backward causation has occurred. Perhaps the best face to put on Bilaniuk and Sudarshan's remarks is to interpret them as claiming that the causal relation is itself relative to reference frames; that is to say, there is no absolute causal directionality in the same way that there is no absolute simultaneity according to Special Relativity. The world-line of the tachyon burst simply *exists* (tenselessly) between space-time points in S and $S1$, and whether the tachyons are moving from S to $S1$ or vice versa is observer-dependent, as is also which event is conceived to be the cause and which the effect. Unfortunately, it has been shown that, even on this understanding, backward causation cannot be precluded. [8] More to the point, however, the notion that causal directionality is relative to reference frames seems clearly untenable. In their engaging discussion of a tachyonic antitelephone, Benford, Book, and Newcomb point out that causal directionality is independent of temporal considerations and is therefore not susceptible to arbitrary reinterpretation:

For example, let A be William Shakespeare and B Francis Bacon, and let $V1$ [the outgoing tachyonic velocity] be negative. If Shakespeare types out *Hamlet* on his tachyon transmitter, Bacon receives the transmission at some earlier time. But no amount of reinterpretation will make Bacon the author of *Hamlet*. It is Shakespeare, not Bacon, who exercises control over the content of the message (265). [9]

Thus, "the direction of information transfer is necessarily a relativistic invariant. An author's signature, for example, would always constitute an invariant indication of the source" (loc. cit.). The reinterpretation principle is thus seen to be essentially an exercise in self-delusion: causal directionality is invariant across reference frames, and to interpret events as related otherwise than as they are is only self-deception.

In light of these facts, proponents of tachyons began to reassess whether backward causation was after all so objectionable or paradoxical. [10] Some writers argued that the problem entailed by permitting tachyonic backward causation is fatalism. Feinberg, for example, called this the "most serious qualitative objection" to tachyons; the transmission of signals into the past of a single observer "is in apparent conflict with the natural view that one is free to decide whether or not to carry out an experiment up until the time that one actually does so." [11] The objection seems to be that one could, for example, call oneself in the past on a tachyonic antitelephone and then, after receiving the call, decide not to place it after all. Our discussion of theological fatalism, however, makes the flaw in the reasoning clear: the fact that one has received a call from oneself entails not that one is not free to refrain from placing the call, but only that one will not in fact refrain from placing it. [12] If one were to refrain from placing the call, then one would not have received it in the first place. Thus, no fatalistic paradox is generated by the existence of negative-energy tachyons.

But, although objections to tachyons based on fatalism are unimpressive, a more substantive objection appears to arise when one considers cases in which tachyonic backward causation would entail the existence of what Paul Fitzgerald has called a "logically pernicious self-inhibitor" ("Retrocausality," 534/5). Benford, Book, and Newcomb invite us, for example, to envisage a situation in which observers *A* and *B* enter into the following agreement : *A* will send at 3:00 a tachyonic message to reach *B* at 2:00 if and only if he does not receive a message from *B* at 1:00. *B* will send at 2:00 a message to reach *A* at 1:00 if and only if he receives a message from *A* at 2:00. Therefore, the exchange of messages takes place if and only if it does not take place. They conclude that "Unless some truly radical solution is found to this paradox, we must conclude that tachyon experiments [such as those being currently carried out] can only yield negative results" (265). John Earman points out that such paradoxes do not depend on human agency, but may be constructed solely with machines. Thus, the reinterpretation principle is irrelevant. *A contradiction is generated by asking whether a certain event occurs; we find that it occurs if and only if it does not occur. [13]* Although the tachyon event might be interpreted differently by different observers, this difference is totally irrelevant to the contradictory nature of the conclusion.

Now, it is not the existence of tachyons as such, admits Earman, that entails the possibility of a logically pernicious self-inhibitor; rather it is the whole situation which is impossible, and this includes assumptions concerning the possibility of controlling tachyon beams, of detecting them, and so forth. By giving up one or some of these other assumptions, one may impose consistency conditions on hypothetical cases so that the paradox cannot arise. Thus, Fitzgerald maintains that we must conclude only that tachyons cannot be controlled in all ways required for the self-inhibitor to function. [14] When asked why such machines fail, he responds that it may be either for

empirical reasons involving constructibility or controllability or owing to a fortuitous set of accidents each time one tries to experiment. The difficulty with the attempt to impose consistency conditions based on considerations of constructibility and controllability, however, Earman explains, is that we have good reason to believe that such devices are possible. The assertion that such experiments cannot be carried out is, therefore, "brazen," since the experiments involve "only operations which we know to be possible in our world." [15] Since such devices as are required for these experiments are apparently nomologically possible, it follows that tachyons are nomologically impossible and therefore do not exist. The threat of fortuitous accidents' preventing such experimentation seems utterly implausible, Fitzgerald himself confesses, for we should then have to posit a lawlike regularity of accidents to prevent the functioning of a machine which should be constructible if tachyons exist ("Tachyons," 428). Hence, the conclusion of the foregoing analysis would seem to be that, given the nomological possibility of tachyon emitters and detectors, one cannot avoid the paradoxes by denying assumptions concerning such devices, but is led instead to denying the possibility of the existence of tachyons. Although this reasoning has, to my knowledge, gone unchallenged in the tachyon literature, there is, within the body of literature on the possibility of time travel, a significant challenge to the modal validity of inferring that tachyons are impossible from the nomological possibility of such devices, a challenge akin to the argument against theological fatalism. Let us therefore turn to that discussion.

III. Time Travel

Long the darling of science-fiction enthusiasts, time travel has come under serious scrutiny in this century. Scientists and philosophers agree that the sort of time machine envisioned by H. G. Wells in his popular novel is in fact an impossibility. Since Wells's machine was conceived to move only through time but not through space, it would, so to speak, "run into itself" as it traveled both forward and backward in time. [16] Moreover, it seemed to involve the contradiction of traversing, say, one hundred years of time in five minutes of time, since it was sitting in the same place. With the development of relativity theory, however, which posited the traveler's relative motion in space as well as time, time travel re- emerged as a new possibility. In 1949 Kurt Gödel drafted a model universe using Einstein's field equations which was similar to Einstein's in that it was both static and spatially homogenous, but which differed from Einstein's universe in that Gödel assigned a negative value to the cosmological constant (which Einstein had introduced into the equations to prevent the model universe from expanding) and posited an absolute, cosmic rotation of matter, so that isotropy was precluded. [17] On Gödel's model, it was not possible to define a cosmic time because the local times of observers which are associated with the mean motion of matter cannot be fitted together into one world time. The most incredible feature of this model was that it permitted the existence of closed, timelike loops, so that by making a round trip on a rocket ship in

a sufficiently wide curve, it would be possible for some observer to travel into any region of the past or future and to return. Although the world-line of every fundamental particle was open, so that no temporal period could recur in the experience of an observer connected with the particle, other closed, timelike lines could exist such that, if P and O are any two points on the world-line of a fundamental particle and P precedes O, then a timelike line exists connecting P and O on which O precedes P. By following these loops an observer could fulfill Wells's dream of time travel.

The question is whether Gödel's model constitutes a mere mathematical curiosity or represents a possible description of the real universe. Unfortunately for time-travel buffs, it seems pretty clear that Gödel's universe fails as an actually descriptive account of the universe, and so time travel is not a possibility for us. That is to say, Gödel's universe, even if nomologically possible, is not physically possible. As G. J. Whitrow observes, the empirical evidence for world isotropy undercuts the postulate of cosmic rotation and furnishes instead evidence for the existence of cosmic time. The microwave background radiation is remarkable precisely for its isotropy, which varies by only about one part in a thousand. "Consequently, we have strong evidence that the universe as a whole is predominantly homogeneous and isotropic and this conclusion . . . is a strong argument for the existence of cosmic time." [18] Since these facts are incompatible with Gödel's model, it follows that time travel, at least along his lines, is physically impossible.

But the issue remains whether time travel is not possible in a broader sense. Here the proponents of time travel have argued persuasively that the stock objections to the possibility of time travel are unsound. For example, Gödel himself was disturbed because he believed that his models make it possible that someone might travel into the past and find a person who would be himself at some earlier period of his life. "Now he could do something to this person which, by his memory, he knows has not happened to him" (561). This objection, however, is once again infected by the fallacious reasoning of fatalism. For from the fact that someone did not do something, it does not follow that he could not have done it. Hence, Gödel was unnecessarily concerned about my doing something to myself which I could not remember: all that follows from his objection is either that I did not perform the action or that I forgot it. [19]

But at this point a more formidable objection to time travel may be lodged: time travel seems to entail the possibility of the existence of a logically pernicious self-inhibitor. The objection is a reminiscent of the argument against tachyons. Earman asks us to consider a rocket ship that at some space-time point x can fire a probe that will travel along a timelike loop into the past lobe of x's light cone. Suppose the rocket is programmed to fire the probe unless a safety switch is on and the safety switch is turned on if and only if the "return" of the probe is detected by a sensing device with which the rocket is equipped (230-232). Is the probe fired or not? The answer is that it is fired if and only if it is not fired, which is logically absurd. Again, this contradiction does not suffice to

show that time travel *per se* is impossible. Rather the whole situation is impossible, and this includes assumptions about the programming of the rocket, the safety switch, the sensing device, and so forth. But, although the contradiction could be avoided by giving up some of these assumptions, Earman suggests that we have good evidence that rockets can be so programmed. Earman concludes, "Thus, although we cannot exclude closed timelike lines on logical grounds, we do have empirical reasons for believing that they do not exist in our world" (232). His conclusion may be strengthened: it is not just the feasibility in our world of such rockets which generates the paradox; so long as such machines are nomologically possible, the contradiction could arise. Given the nomological possibility of such machines, then, timelike loops must be nomologically impossible if the contradiction is to be avoided. The conclusion would therefore appear to be similar to that in the tachyon case: that, although time travel is logically possible, there are no nomologically possible accessible worlds in which time travel can occur.

Paul Horwich has, however, disputed Earman's reasoning, claiming that he invalidly infers that, since the various assumptions are logically incompossible and since the rocket, safety switch, and so forth are physically possible, therefore timelike curves do not exist (440). [20] But there could exist timelike curves in the actual world or in any physically possible world in which the rocket, switch, and so forth do not exist. Letting p = "The rocket, probe, safety switch, and so forth exist and function properly," q = "Timelike loops exist," and r = "The probe is fired," Horwich's argument appears to be that the following reasoning, which is Earman's, is invalid:

5. (i) $(p \cdot q) \supset (r \equiv \sim r)$ P
   (ii) $\Diamond p$ P
   (iii) q P
   (iv) $(\Diamond p) \cdot q$ ADJ (ii), (iii)
   (v) $(\Diamond p) \cdot q \supset \Diamond (r \equiv \sim r)$ (i)
   (vi) $\Diamond (r \equiv \sim r)$ MPP (iv), (v)
   (vii) $q \supset \Diamond (r \equiv \sim r)$ CP (iii–vi)
   (viii) $\sim q$ RAA

The problem is that (v) does not follow modally from (i). Although the conjunction of p and q implies an absurdity, the conjunction of q with <> p implies neither a contradiction nor even the possibility of a contradiction. In other words, timelike loops can exist in any world in which such rockets, switches, and so forth are possible but never in fact exist or function correctly; similarly for tachyons and the tachyonic antitelephone.

The opponent of time travel (and tachyons) has thus apparently committed precisely the same fallacy as the theological fatalist, and the response to them has the same form. The opponent of fatalism asserts that from God's foreknowledge of a future contingent proposition it follows, not that

the future event *cannot* occur but only that it *will* not occur; the proponent of time travel maintains that from the fact that timelike loops exist it follows, not that such rockets *cannot* exist or function properly, but only that they *do* not exist or function properly. Further, the opponent of fatalism maintains that, if the contingent event *were* not to occur, then different propositions *would* have been true and God's foreknowledge *would* have been otherwise; the proponent of time travel contends that, if such rockets *were* to be built and function properly, then the timelike loops *would* not exist. Thus, the two situations seem quite parallel.

IV. Tachyons, Time Travel, and Theological Fatalism

Now I must confess that, whereas the argument of the opponent of theological fatalism seems entirely plausible, the same argument in the hands of the proponent of time travel (and, implicitly, of tachyons) runs strongly counter to my intuitions. One might imagine a world, for example, in which all the technology and even the blueprints for the rocket, probe, and so forth exist and in which timelike loops exist. It seems bizarre to claim that, while the rocket could be built, so long as no one in fact builds it, the loops can exist without the possibility of a contradiction's arising. Moreover, it seems very strange to claim that, were the rocket and so forth to be built, then the timelike loops would not exist. Suppose a team of rocket scientists took out the blueprints of the devices and decided, "Let's build them!" What is going to stop them? Horwich's response that to ask such a question is simply to ask why a contradiction does not come true might fail to assuage one's suspicions that something is amiss here. *Something* must prevent the rocket's being built or a contradiction will arise; if the rocket and so forth are constructible, a contradiction would seem to be generable, which is absurd. Or again, we might imagine a world in which the rocket, probe, and so forth do exist and in which time travel occurs regularly. But each attempt to generate the self-inhibiting situation is frustrated by a series of accidents, which prevent the devices from functioning properly. But why do they always go wrong? Or worse, why do things not go wrong whenever the probe travels the same loop when no safety switch is used, but go awry whenever the switch is employed? Horwich confesses that he does not know the answer, but he believes that there is no reason to think an answer is impossible. This confidence might strike one as a somewhat unwarranted optimism. Finally, we might imagine a world in which time travel along timelike loops is a regular affair and in which the rocket, switch, and so forth not only exist, but would function properly if they were used. But in fact nobody uses them. Indeed, the commander of every time vessel may instruct his new recruits, "Do not activate the probe and the safety switch with the sensing device; otherwise the timelike loops along which we travel would not exist." Obeying his command, the new recruits like the rest of the crew are careful not to activate the devices, lest the loops should not exist. But does the very structure of space and time thus depend on the obedience of callow, young recruits to their commanding officer?

Nevertheless, it must be admitted that I have been somewhat unfair to the proponent of time travel in my illustrations. When we consider a world, we take into account not merely the history of that world up to some time t_n but rather its whole history. In any world containing timelike loops, the envisioned rockets never exist or function properly. It is not as though at t_{n+1} someone might build the devices and so cause the loops that had existed to fail to exist. Nor is it being claimed that the structure of space-time is dependent upon human decisions. Rather the point is that, since p and q are logically incompossible, their corresponding states of affairs never both obtain in any world. If one obtains, the other does not. If the other did obtain, then the one would not. To ask why is, as Horwich says, merely to ask why contradictions are not true. To think that in this case a contradiction is possible seems incorrectly to presuppose that time travel involves changing the past, an error analogous to the assumption, frequently made by theological fatalists, that one's freely choosing to do other than one does would involve changing God's foreknowledge. If the probe is seen to be returning though the safety switch is on, the space travelers know that the switch is going to be turned off or malfunction is some way so as to permit the launching of the probe. If the switch is off, they know it or the probe is malfunctioning. Should they decide not to launch the probe after all, for some reason or other (malfunction, change of mind, disobedience to the commander) the probe will be sent anyway (and they no doubt realize this). Otherwise it would not be seen to be returning. For one cannot change the past.

I think that the sense of discomfort which the time travel case (like the tachyon case) evokes but which the case of divine foreknowledge does not elicit is due to the absence in the former case of a lack of a relation of conditionship (in Roger Wertheimer's sense [21]) between the existence of the time loops and the construction and functioning of the rocket. What is at issue here is a piece of counterfactual reasoning on the part of the proponent of time travel:

6. $p \mathbin{\square\!\!\rightarrow} \sim q$

7. $p.\sim q \mathbin{\square\!\!\rightarrow} r \equiv r$

8. $p \mathbin{\square\!\!\rightarrow} r \equiv r$

The reasoning is valid and purports to show that, if the rocket and so forth were to exist and function properly, then the probe would be fired iff it were fired, since no timelike loops would exist in such a world. The truth of (6) appears to depend at any time upon a special resolution of vagueness which permits backtracking counterfactuals, that is, counterfactuals in which the truth of the antecedent implies some adjustment of the past. In such a case the closest possible worlds to the actual world are not those in which the past is preserved inviolate, but in which some feature of the past is other than in the actual world in order that some overriding feature of the actual world

might be preserved as much as possible. It is highly a disputed question as to when a special resolution of vagueness between worlds is warranted. It seems to me, however, that a special resolution is permissible when a relation of conditionship obtains between the state of affairs described in the antecedent of the counterfactual and that described in the consequent. Where this is lacking, the burden of proof would seems to lie on him who maintains that a special resolution is to be employed rather than the standard resolution of vagueness. Hence, for example, it seems true that

9. If it were the case that Lincoln was assassinated and I can possibly eat ice cream, then were I to do so, it would be the case that Lincoln was assassinated and I eat ice cream.

Here Lincoln's death and my eating ice cream are totally unrelated, and so whether or not I eat does not affect Lincoln's death. Analogously, the construction and proper functioning of the rocket have no effect upon the structure of space-time. Hence, if the timelike loops exist and the rocket and so forth are possible, then it seems that it would be true that, if the rocket were to exist, both the loops and the rocket would exist, which results in a self-inhibiting situation. But, since it is impossible that, were the rocket to exist and function properly, then both it and the time loops would exist, it follows that it must be impossible for the time loops to exist and the rocket to be possible. Since the rocket is possible, necessarily the time loops do not exist.

The crucial difference between these two cases, however, is that, although both lack a relation of conditionship between the earlier and later states of affairs, the time-travel case involves contradictory states of affairs, which the other does not. A backtracking counterfactual is therefore required in the time-travel case, not because the time loops are conditioned by later events, but because the envisaged situation does not obtain in any possible world; that is, there simply is no world in which both states obtain. The closest worlds to the actual world in which the rocket exists and functions properly must be worlds in which time loops do not exist. Therefore, a backtracking counterfactual is here in order, even under the standard resolution of vagueness and in the absence of any relation of conditionship between antecedent and consequent, despite the feeling of disquiet with which one is left.

This inquietude can, however, be considerably diminished by an analysis of one of the logical properties of "within one's power." Is the notion "within one's power" closed under entailment? That is to say, is

10. If (i) p entails q, and (ii) S has the power to make p true at t, then S has the power to make q true at t.

true? Joshua Hoffman and Gary Rosenkrantz have argued convincingly that it is

not. [22] For example, although it may be within my power to bring it about that

11. Some rocket ship is red.

is true, and (11) entails

12. Some rocket ship exists.

it may not be within my power to make (12) true. Therefore, power is not closed under entailment. Alfred Freddoso hopes to rectify the deficiency revealed by this important insight by requiring that p and q be logically equivalent. That is to say, he defends

10'. If (i) p is logically equivalent to q and (ii) S has the power to make p true at t, then S has the power to make q true at t.

Although he provides no justification for 10', he considers it "impeccable." [24]

But it seems to me that 10' may not be so flawless after all. For consider a situation such as that envisioned in Newcomb's paradox:24 a being guesses in advance whether I shall choose one of two boxes B1 or B2. My choice has absolutely no influence on his prediction, nor is his forecast the result of precognition: it is pure guesswork. Let us, however, suppose that the predictor is infallible, essentially inerrant. It follows that

13. I choose B1 ≡ The being predicts that I choose B1.

But, although it is within my power to choose B1, it is not within my power to bring about the being's prediction; for the problem conditions guarantee that the being's prediction is entirely outside my control. Therefore (10') is false. Now consider another scenario in which the notion of precognition is admitted. In this case the being cannot fail to predict my choices correctly because he has infallible precognition. So in this case, too, (13) is true. Here, however, it appears that it is within my power to bring about the being's prediction as well as my choice, since my choice determines his precognitions. But what about what lies within the being's power? It is within his power to predict that I choose B1, but it is not with his power to bring it about that I choose B1. So, once again, (10') is false. No doubt these cases are exotic, but then again power over the past is an exotic subject, and the cases have obvious relevance to the question at hand.

The above cases suggest that what is missing from (10') is some mention of the relation of conditionship between p and q. Only if p is a condition of q in Wertheimer's sense can one be guaranteed that, by having it within one's power to bring it about that p, one also has it within one's power to bring it about that q. Accordingly, I should replace 10' with

10*. If (i) *p* is logically equivalent to *q*, and (ii) *S* has the power to make *p* true at *t*, and (iii) *q* is a consequence of *p*, then *S* has the power to make *q* true at *t*.

Hence, even though it is true that

14. The rocket, probe, safety switch, etc., function properly ≡ Time loops do not exist.

and, even if space cadet Jones has it in his power to bring it about that the first half of this equivalence is true, it does not follow that he has it within his power to determine the structure of space and time. All that follows is that Jones exercises his above power in worlds in which there are no time loops and that in worlds in which time loops exist Jones never exercises his power. There is a sort of logical parallelism here without any relation of conditionship, and so rejection of the self-inhibitor argument does not imply embracing counterintuitive notions of power.

V. Conclusion

In conclusion, I think it is clear that the problems that confront the philosopher of science and the philosopher of religion respectively can turn out to be very similar and that interaction between the two can lead to some helpful insights for both. In the present case, the argument of the opponent of theological fatalism bears striking resemblance to the argument of the proponent of tachyons and time travel. They agree that past states of affairs may obtain which are logically incompatible with some envisioned action and yet insist that such an action is still possible because, if it were to be taken, the past states of affairs would not have obtained. This is initially disquieting, since in the one context the argument seems quite plausible whereas in the other the results seem counterintuitive. This inquietude can, however, be alleviated, I have argued, by positing the presence of a relation of conditionship in the case of divine foreknowledge, which makes it reasonable to ascribe to a free agent the power to determine partially what God foreknows, a relation which is absent in the cases of tachyons and time travel, so that in these cases one has no power over the past.

Footnotes

[1]

For the clearest statement of this position, see Alvin Plantinga, *God, Freedom, and Evil* (New York: Harper & Row, 1974), pp. 69-72; for an assessment of this solution, see Philip Quinn, "Plantinga on Foreknowledge and Freedom," in James Tomberlin and Peter Van Inwagen, ed., *Alvin Plantinga*, Profiles 5 (Boston: Reidel, 1985), pp. 271-287.

[2]

For the best analysis, see Alfred J. Freddoso, "Accidental Necessity and Logical Determinism," this *Journal*, LXXX, 5 (May 1983): 257-278; cf. Joshua Hoffman and Gary Rosenkranz, "Hard and Soft Facts," *Philosophical Review*, XC (1984): 419-434; Alvin Plantinga, "Ockham's Way Out," *Faith and Philosophy*, II (1986): 235-269. On none of these theories of temporal necessity does God's foreknowledge turn out to be temporally necessary. For an assessment of these theories, see my "Temporal Necessity; Hard Facts/Soft Facts," *International Journal for Philosophy of Religion*, XX (1986): 65-91.

[3]

"Elektrodynamik bewegter Körper," *Annalen der Physik*, XVII (1905): 891-921.

[4]

Bilaniuk, Deshpande, Sudarshan, "Meta Relativity," *American Journal of Physics*, XXX (1962): 718ff; Gerald Feinberg, "Possibility of Faster-than-light Particles," *Physical Review*, CLIX (1967): 1089-1105.

[5]

The Theory of Relativity of Motion (Berkeley: University of California Press, 1917), pp. 54/5. Actually Tolman's paradox results not only when infinite velocities are involved, but for all velocities greater than $c2/w$, where w is the relative velocity of two observers.

[6]

See Bilaniuk *et al.*, "More about Tachyons," *Physics Today* (December 1969), p. 49; David Bohm, *The Special Theory of Relativity* (New York: W. A. Benjamin, 1965), p. 158; F. A. E. Pirani, "Noncausal Behavior of Classical Tachyons," *Physical Review*, D 1 (1970): 3224.

[7]

Bilaniuk and Sudarshan, "Particles beyond the Light Barrier," *Physics Today* (May 1969): 47; Gerald Feinberg, *op. cit.*, p. 1091.

[8]

See Bilaniuk *et al.*, "More about Tachyons," pp. 48-50; G. A. Benford, D. L. Book, and W. A. Newcomb, "The Tachyonic Antitelephone," *Physical Review*, D 2 (1970): 263-265 [this is the same Newcomb of the famous Newcomb's paradox]; Pirani, *op. cit.*, p. 3224; Paul Fitzgerald, "Tachyons, Backwards Causation, and Freedom," in *PSA, 1970*, Roger C. Buck and Robert S. Cohen eds.

Boston Studies in the Philosophy of Science, VIII (Boston: Reidel, 1971), pp. 421-423; T. Chapman, *Time: a Philosophical Analysis*, Synthese Library (Boston: Reidel, 1982), pp. 23-25.

[9]

Cf. Fitzgerald, "Tachyons," pp. 421-423.

[10]

Roger G. Newton, "Causality Effects of Particles that Travel Faster Than Light," *Physical Review*, CLII (1967): 1274. Interestingly, Newton acknowledges his debt to Michael Scriven on the score of causal directionality and time and appeals to tachyons to show the possibility of precognition experiments. See also Paul L. Csonka, "Advanced Effects in Particle Physics, I," *Physical Review*, CLXXX (1969): 1266-1281; Bilaniuk *et al.*, "More about Tachyons," p. 52.

[11]

Op. cit., p. 1092. Cf. Chapman, *Time*, p. 23, who asserts that, after receiving a return signal which he will trigger, the observer may decide not to send his signal after all; in this case the standard objection to backward causation applies.

[12]

Cf. Fitzgerald, "Tachyons, Backwards Causation, and Freedom," pp. 428-434; and, "On Retrocausality," *Philosophia*, IV (1974): 543. Suppose, he says, I receive a tachyon message from the future that a man I am about to shoot will be at a banquet two days hence. Is it therefore not within my power to kill him? Not at all, responds Fitzgerald; I have both the ability and opportunity to do so, so that I could kill him; but were I to do so, I would not have this reliable message from the future that he is alive. The point is that ignorance is not a necessary condition of an action's being within one's power. Fitzgerald's analysis is flawed, however, when he proceeds to argue that, in the case in which one does not try to perform the action precisely because one believes the tachyon message, then one's freedom is limited by the message from the future. For anything, he claims, which prevents a person's doing what he wants is to a limit on his freedom. Fitzgerald fails to see, however, that in this case what one wants to do is changed by the message; it does not therefore prevent one from doing what one wants to do. It merely changes one's motivation. As Fitzgerald goes on to observe, this can arise without messages from the future at all. Suppose before I pull the trigger someone rushes up and informs me that my intended victim is my beloved, long-lost uncle. Suddenly, my motivation is changed, and I no longer want to kill him, but would we say that my informer has limited my freedom in conveying his report to me?

[13]

"Implications of Causal Propagation outside the Null Cone," *Australasian Journal of Philosophy*, I, (1972): 254. Thus, the escape route suggested by DeWitt, that information sent into the past is wiped from the observer's memory, is unavailing (Bikaniuk, *et al.*, "Tachyons," p. 50).

[14]

"Tachyons," p. 427; and "Retrocausality," p. 435.

[15]

Earman, "Causal Progagation," pp. 234/5. Assuming that the apparatus will work as it is supposed to, a typical experiment will involve the following elements: (1) a tachyon source that can be amplitude modulated, (2) a tachyon detector, (3) a velocity filter giving a monoenergetic beam. Proposed devices for each of these are used in tachyon research. (Benford *et al.*, "Antitelephone," p. 263; cf. Bilanuik and Sudarshan, "Particles," pp. 50/1; *et al.*, "Tachyons," p.52.)

[16]

See Monte Cook, "Tips for Time Travel," in Nicholas D. Smith, ed. *Philosophers Look at Science Fiction* (Chicago: Nelson-Hall, 1982), pp. 47-55. See also Donald C. Williams, "Myth of Passage," this *Journal.*, XLVIII, 15 (July 19, 1951): 457-472, p. 463.

[17]

"A remark about the Relationship between Relativity Theory and Idealistic Philosophy," in *Albert Einstein: Philosopher-Scientist*, 2 vols., ed. Paul Arthur Schlipp (rep. ed.: New York; Harper, 1959), pp. 557-562. Gödel also announced discovery of expansion models and models with any value for ✕ for which there exists no cosmic time because of the presence of cosmic rotation.

[18]

The Natural Philosophy of Time, 2nd ed. (New York: Oxford, 1980), p. 307.

[19]

See Paul Horwich, "On Some Alleged Paradoxes of Time Travel," this *Journal*, LXXII, 14 (Aug. 14, 1975): 432-444, p. 435.

[20]

I am indebted to William Hasker for many interesting discussions of this issue.

[21]

See his "Conditions," this *Journal*, LXV, 12 (June 12, 1968): 355-364.

[22]

Joshua Hoffman and Gary Rosenkrantz, "On Divine Foreknowledge and Human Freedom," *Philosophical Studies*, XXXVII (1980): 289-296.

[23]

"Accidental Necessity and Power over the Past," *Pacific Philosophical Quarterly*, LXII (1982): 64.

[24]

Robert Nozick, "Newcomb's Problem and Two Principles of Choice," in N. Rescher, ed., *Essays in Honor of Carl G. Hempel* (Boston: Reidel, 1969), p. 132.