Laws and Counterfactuals

PETER VAN INWAGEN

SYRACUSE UNIVERSITY

Let us assume for the sake of argument four not wholly uncontroversial propositions:

(A) The phrase 'is a law (of nature)' does and should have a reasonably important place in our attempts to describe the world (unlike, say, 'was born under Sagittarius' or 'the luminiferous aether', according to most of us).

(B) This phrase is a real predicate: it is typically and properly used in ascribing a certain property to certain objects (unlike, say, 'exists', according to Kant, or 'is good', according to R. M. Hare).

(C) The objects that have this property are sentences or propositions (non-linguistic entities expressed by sentences) or whatever it is that are the bearers of truth-value: anything that is a law is *also* either true or false.

(D) Whether a proposition or sentence is a law is independent of what scientists or others happen to believe or happen to have discovered: a proposition, if it is a law, is unchangeably and objectively so, just as, on the prevailing view of mathematics, a proposition, if it is a theorem, is unchangeably and objectively so, whatever mathematicians or others happen to believe or happen to have proved.

I

Can one devise an extensionally adequate and non-trivial analysis of the concept of a law that is not in conflict with propositions (A)-(D)? That is, is it possible to devise a set of individually necessary and jointly sufficient conditions for a proposition's or sentence's being a law, such that none of these conditions involves any concept that depends for its intelligibility on a prior understanding of 'law', or is no better understood than 'law', and such that none of these conditions entails or presupposes that any of (A)-(D) is false? Many philosophers have offered lists of conditions that they think are necessary for lawhood. The following three conditions, or similar ones, appear, at least implicitly, on most lists,

(i) A law must be true[1]

(ii) A law must be contingent

(iii) A law must not entail the existence of any particular individuals,[2]

just as '*p* is true' and '*S* believes that *p*' turn up in most lists of conditions that are supposed to be necessary for the truth of statements of the form '*S* knows that *p*'.[3] And just as these two conditions are universally conceded to be insufficient for knowledge, the above three conditions are universally conceded to be insufficient for lawhood. For just as there may be cases of true belief that are not cases of knowledge, there may be "accidental truths" that are not laws. Consider, for example, 'Everyone exactly 1.782 meters tall is bald'. Suppose this sentence, or the proposition it expresses, is true. Then it satisfies (i)-(iii). But no one would want to call it a law. And this intuition can be supported by a simple argument: 'Consider Jones who is 1.783 meters tall and who has a full head of hair. The counterfactual

(c) If Jones had been one tenth of a centimeter shorter, he would have been bald

is surely false. Thus, the generalization we are considering depends for its truth upon the "accidental" circumstance that Jones is 1.783 rather than 1.782 meters tall. Therefore, this generalization is an "accidental truth"; that is, it is not a law.' Because of the role a counterfactual conditional plays in this argument, we may summarize the point it makes as follows: 'The generalization we are considering fails to be a law because it does not *support its counterfactuals*'. ('Counterfactuals' because there are many counterfactual statements other than

(c) that would have served equally well in such an argument.) And, indeed, 'supports its counterfactuals' is a fairly standard piece of terminology in discussions of the concept of a law.[4] (Other, more or less equivalent, locutions are 'is convertible to counterfactual form', 'warrants inference to subjunctive conditionals' and 'sustains its counterfactual instances'.)

Thus, it would seem, we must add a further condition to (i)-(iii):

(iv) A law must support its counterfactuals

if we are to have an analysis of law that has any chance of being extensionally adequate. Someone might object to (iv) on the ground that counterfactuals are no better understood than laws, or even on the ground that counterfactuals should be analyzed in terms of laws and not *vice versa*. There may be something to these objections. But let us again assume something for the sake of argument: that the notion of a counterfactual conditional, however obscure it may be, is a better understood notion than that of a law of nature, and, therefore, that an analysis of law in terms of counterfactuality would provide at least some clarification of the former concept.

Let us now raise the question, Given that (i)-(iv) are individually necessary for lawhood, are they jointly sufficient? Most philosophers who have tried to say something about lawhood or "nomic necessity," and who have pointed out that something like (iv) is a necessary component of these ideas, are noncommittal on this further question. Or, more precisely, they do not raise it at all. The following passage by von Wright is typical:

> The assumption (hypothesis) that the concomitance of p and q has a nomic character contains *more* than just the assumption that their togetherness is invariable. It also contains the *counterfactual assumption* that on occasions when p, in fact, was not the case q would have accompanied it, had p been the case. The fact that it is a ground for counterfactual conditionals is what *marks* the connection as nomic.[5]

I am unable to decide whether this passage is meant to entail that "being a ground for counterfactual conditionals," which I take to mean more or less the same as "supporting its counterfactuals," is *sufficient* for the invariable concomitance of p and q having a "nomic character," or merely necessary.

The purpose of the present paper is to raise explicitly the question whether (i)-(iv) are sufficient or merely necessary for lawhood. I shall show that these conditions are *not* sufficient for lawhood. Or, more exactly, I shall show that they are sufficient only if (iv) is interpreted in a special way that depends upon our having a prior understanding of the idea of a "physically possible but nonexistent object." And I shall show that this idea is such that, if we have it, then we may use it to define 'law of nature' "directly," without making any use of the idea of a counterfactual conditional. It follows that a solution to the "problem of counterfactual conditionals" would not provide an answer to the question, What is a law of nature? That is, an adequate analysis of the concept of law can be got, if at all, only by adding some further condition(s) to (i)-(iv), or else by *replacing* (iv) with some stronger condition. I have no idea what such further or stronger conditions might be. If no such conditions can be found, then we must be willing either to take "law of nature" as a *primitive* idea, or else to abandon it altogether, at least in so far as its (alleged) content is determined by our assumptions (A)-(D).

Before this can be demonstrated, however, it will be necessary to explain just what is meant by a sentence's or proposition's "supporting its counterfactuals." This idea is usually introduced by examples and is left at a more or less intuitive level. But a more exact definition will be necessary for our purposes. I shall devote the rest of Section I to an attempt to define 'supports its counterfactuals', and return to the question of the adequacy of conditions (i)-(iv) in Section II. As a first attempt at a definition, consider:

(d1) If F and G are predicates, then $\ulcorner\forall x(Fx \supset Gx)\urcorner$ *supports its counterfactuals* iff $\ulcorner\forall x(Fx > Gx)\urcorner$ is true.[6]

The first thing to note about (d1) is that it applies only to *sentences*, and, in fact, only to sentences of a certain logical form. Let us, however, shelve this problem (if it is a problem) for the time being, and look at an example. Does '$\forall x$(x is human $\supset$ x is a mammal)' support its counterfactuals? According to (d1), only if

(1) If Cleopatra's asp had been human, it would have been a mammal

is true. Is (1) true? It seems absolutely inconceivable that an asp should be or should have been a human being. And who can say *what* would have been the case if something absolutely inconceivable had happened? One *could* say, with David Lewis, that just anything would be the case if the inconceivable were to happen, and thus that (1) is true.[7] But some philosophers might not be satisfied with an account of counterfactual conditionals that confers truth upon 'If Cleopatra's asp had been human, it would have been immaterial'. And some philosophers might even argue that at least some instances of 'Cleopatra's asp is human $> p$' (or, worse, 'The number 5 is human $> p$') are *meaningless*. Perhaps it would be wisest simply to avoid these problems (if they are problems) by recasting (d1) in a form that prevents them from arising. We might do this as follows. If F and G are predicates, then let us say that F *admits* G if, necessarily, anything that belongs to the extension of F is such that it could conceivably belong to the extension of G. For example, 'is a lump of copper' admits 'is heated' since, necessarily, anything that is a lump of copper is such that it could conceivably be heated. We may now write:

(d2) If F, G, and H are predicates, and if F admits G, then $\ulcorner\forall x(Fx \supset (Gx \supset Hx))\urcorner$ *supports its counterfactuals* iff $\ulcorner\forall x(Fx \supset (Gx > Hx))\urcorner$ is true.[8]

For example, on (d2), '$\forall x$ (x is a lump of copper $\supset$ (x is heated $\supset$ x expands))' supports its counterfactuals.[9]

Let us now return to a problem that was raised about (d1) and which is equally a problem for (d2): this definition applies only to sentences, and, moreover, only to sentences of a certain logical form. (And, in fact, it applies only to *some* sentences of that form.) Can we extend (d2) in such a way that it applies to sentences in general, and to propositions?

Let us first consider the problem of extending (d2) to apply to sentences in general. We could, of course, simply stipulate that *only* sentences of the form '$\forall x(Fx \supset (Gx \supset Hx))$' support their counterfactuals. But this seems overly restrictive. Moreover, if this were done, then (i)-(iv) would yield the result that all law-sentences were of the above form. A more liberal extension of (d2) that avoids this difficulty is this: make (d2) the first clause of a two-clause recursive definition (call it 'R'), the second clause of which is

(Rb) If a sentence s_1 supports its counterfactuals, and if s_2 is equivalent to s_1, then s_2 supports its counterfactuals.

The term 'equivalent' is, of course, vague. In order to give it at least *some* content, let us state what surely ought to be at least a sufficient condition for "equivalence": Two sentences are equivalent if each is derivable from the other by the rules of formal logic, supplemented by a rule that allows replacement of any expression by a definitionally equivalent expression. Unfortunately, this modest sufficient condition for equivalence is strong enough to make R yield self-contradictory results, owing to the 'only if' in (Ra) [=(d2)]. For it is possible to find two sentences of the form '$\forall x(Fx \supset (Gx \supset Hx))$' that are equivalent in the above sense, though one, by (Ra), supports its counterfactuals, and the other, by (Ra), does not. Thus, R will yield the result that a certain sentence both does and does not support its counterfactuals: take the sentence that, by (Ra), does not support its counterfactuals; then, since, it is equivalent to a sentence that, by (Ra), supports its counterfactuals, by (Rb) it supports its counterfactuals.

To see that such a pair of sentences can be found, consider the following three predicates (abbreviated as indicated):

x is human [Hx]

x is deprived of vitamin C [Cx]

x develops scurvy [Sx],

and introduce two predicates by definition:

x is privey [Px] $=_{\text{df}}$ C$x \supset$ Sx

x is unprivey [Ux] $=_{\text{df}}$ $-($C$x \supset$ S$x)$.

The sentences

(2) $\forall x(\text{H}x \supset (\text{C}x \supset \text{S}x))$

(3) $\forall x(\text{H}x \supset (\text{U}x \supset \text{P}x))$

can easily be seen to be equivalent in our sense, and perhaps everyone will agree that, by (Ra), (2) supports its counterfactuals. But

(4) $\forall x(Hx \supset (Ux > Px))$

is not true and hence, owing to the 'only if' in (Ra), (3) does not support its counterfactuals. Sentence (4) is false because, if it were true, then, say, Julius Caesar (who is human) would satisfy '$Ux > Px$'; that is, '$-(Cc \supset Sc) > (Cc \supset Sc)$'—where 'c' abbreviates 'Caesar'—would be true. But on any acceptable semantics for counterfactuals, for any sentence p, $\ulcorner -(p) > p \urcorner$ is true only if p is a necessary truth. And '$Cc \supset Sc$' is a contingent truth.

Fortunately, this contradiction is easily enough avoided: We need only weaken the 'iff' in (Ra) to 'if'. This weakening will have the result that it does not follow from (Ra) [as emended—call the emended version '(Ra)*'] that it is not the case that (3) supports its counterfactuals. Let us say, therefore, that a sentence *supports its counterfactuals* if and only if it does so either in virtue of (Ra)* [that is, of (d2) above, with 'iff' weakened to 'if'] or of (Rb).[10]

Whatever the merits or demerits of this definition may be, I see no better. *One* of its demerits, of course, is that it contains the vague word 'equivalent'. I shall not try to define this term; the reader must be content with an invitation—which I hereby tender—to flesh it out as he will. A second demerit (in my eyes, at least) is that this definition, and hence our definition of law, apply only to sentences. But anyone who, like me, believes he grasps the notion of a proposition may extend the notion of law to *some* propositions as follows: if a proposition is such that it is expressed by some sentence, then that proposition is a law if and only if the sentences that express it are laws. (If someone were to demonstrate that some proposition is expressed by two sentences one of which is a law and the other not, then this definition would have to be modified or abandoned. Let us cross that bridge if we come to it.) This extension of the notion of law to propositions is only partial, since, presumably, some propositions cannot be expressed by any sentence, owing to the paucity of our linguistic resources. I shall not attempt to deal with this difficulty.

II

Let us return to sentence (2). This sentence certainly seems to satisfy conditions (i)-(iv), and seems therefore to be a "law of nature." But I think that we can suppose that (2) satisfies (i)-(iv) and consistently add to this supposition further suppositions that would lead me (at least) to want to say that (2) is not a law.

Let us suppose that (2) does satisfy (i)-(iv) and, in particular, that

(5) $\forall x(Hx \supset (Cx > Sx))$

is true. But suppose also that there is a certain group of biologists and bureaucrats who want to institute a program of selective breeding that is intended to produce a population of human beings who are able to get along without vitamin C. Let us further suppose that wiser counsel prevails, and these people are disuaded from this idiotic and immoral undertaking; but suppose that *if* they had been allowed to have their way, they (or their descendants) *would have* succeeded: eventually there *would have been* human beings who did not satisfy '$Cx > Sx$'. In that case, it seems to me, we should hardly want to say that (2) is a law of nature. If (2) were a *law of nature*, then it would simply not be within the power of any group of people, however clever and well-informed they were, and however perservering they might be, to produce an object that failed to satisfy '$Hx \supset (Cx > Sx))$'. It would seem to be a feature of laws of nature that they impose limits on our abilities. If I am a bureaucrat and I tell an engineer to build a device that will do X (suppose, for example, I tell him to build a spaceship capable of traveling faster than light), and if he tells me that it is a consequence of some law of nature that no device does X, I cannot tell him to go ahead and build one anyway. I might indeed express skepticism about whether there really is any such law of nature as he claims there is, but I cannot *admit* that there is such a law *and* tell him to go ahead with the project despite this obstacle.[11] So it would seem that (i)-(iv) do not constitute a set of jointly sufficient conditions for a proposition's being a law, since it is possible to imagine a case in which a certain proposition satisfies (i)-(iv) and yet is such that a certain exercise of human ingenuity and perseverance would suffice to produce a counterinstance to it.[12] In fact, in the case we imagined, the truth of (5) depended on the decisions of certain bureaucrats; hence (5) would seem to be itself an accidental truth, and thus to be an insufficiently firm basis for the claim that (2) is a law.

It is possible to produce a simpler case of the failure of (i)-(iv) that has nothing to do with human abilities or decisions. Imagine a possible world W that has the following two features:

(a) In W, the laws of nature are the same as those in the actual world

(b) In W, lead exists only in the form of fine dust particles.

(These features certainly seem to be consistent: there does not seem to be anything in the actual laws of nature that prevents its being the case that lead exists only in the form of fine dust.) But if (a) and (b) are true, then, surely, the following sentence is true in W:

(6) $\forall x$(x is a piece of lead $\supset$ (x is left unsupported in the air $>$ x drifts slowly about)).

And if (6) is true in W, then, by (i)-(iv), the sentence S got by replacing '$>$' in (6) with '$\supset$' is a law in W. But since, by hypothesis, the laws in W and in the actual world are the same, it follows that S is a law in the actual world, which, of course, it is not; S is not even *true* in the actual world.

Now one reply that might be made to this argument on behalf of the analysis (i)-(iv) is this: When, for some predicates F, G, and H, we test $\ulcorner \forall x(Fx \supset (Gx \supset Hx)) \urcorner$ for lawhood by seeing whether $\ulcorner \forall x(Fx \supset (Gx > Hx)) \urcorner$ is true, we should take the variable of the latter to range not only over *actual* objects but also over *merely possible* objects. For example, while it may be that all *actual* humans satisfy '$Cx > Sx$', perhaps there are merely possible humans—among them, the humans who would have been born if our imagined program of selective breeding had been carried out—such that if the range of the variable 'x' in the universal generalization (5) is taken to include them, then (5) is false, and (i)-(iv) do not yield the result that (2) is a law. A similar remark could be made with respect to (6), S, and pieces of lead that are, in W, possible but not actual.[13]

This defense of (i)-(iv) is tempting, but, I think, it comes to nothing. First of all, it is not at all clear what a "possible piece of lead" or a "possible human being" might be. I doubt whether these concepts can be made sense of in any very straightforward way.[14] But let us ignore this problem. Let us suppose we know what it is for an object to be "non-actual but possible." The question remains, In what sense *possible*? If we mean by 'possible object', '*logically* possible object', then, I think, *no* sentence will satisfy (i)-(iv). In order for a sentence P to satisfy (iv), P must, for some predicates F, G, and H, be equivalent to

(7) $\ulcorner \forall x(Fx \supset (Gx \supset Hx)) \urcorner$,

where

(8) $\ulcorner \forall x(Fx \supset (Gx > Hx)) \urcorner$

is true. But if the variable of (8) takes as its range all logically possible objects, then (8) is either a necessary truth or a necessary falsehood: if the concept of a merely (logically) possible object makes sense at all, it is hard to see how we can avoid concluding that *every* universal generalization on all logically possible objects is either necessarily true or necessarily false. To see this, consider the two sentences, 'Every (logically possible) object is red' and 'Every (logically possible) object is self-identical'. Every predicate is either like 'is self-identical' in applying, of necessity, to every logically possible object, or else like 'is red' in failing, of necessity, to apply to some logically possible object. Thus, any universal generalization in the domain of all logically possible objects on a predicate of the former sort will be a necessary truth; on a predicate of the latter sort, a necessary falsehood. So (8) is either necessarily false or necessarily true. If (8) is necessarily false, it is false *tout court*, and P fails to satisfy (iv) and is thus not a "law of nature." On the other hand, if (8) is necessarily true, then (7) is necessarily true, and P, being equivalent to (7) is necessarily true, and thus fails to satisfy (ii), and is thus not a "law of nature." Therefore, if the proposal we have been considering were adopted, *no* sentence would be a law. Therefore, if (i)-(iv) can be saved by some extension of our domain of quantification beyond the domain of actual objects, this extension must embrace only *some*, not *all*, logically possible objects.

Perhaps it is intuitively obvious that any workable extension of our domain of quantification must include none of those logically possible objects that are "physically impossible," that is, objects whose existence in reality would be in conflict with or violate the laws of nature. (E.g., objects capable of traveling faster than light, or objects made of copper that do not expand when heated.) For if our domain of quantification includes any "physically impossible objects," then *some* sentences that are laws of nature will fail to satisfy (i)-(iv). We have already looked at the limiting case of this: an extension of our domain of quantification to include all logically possible objects (and hence *all* impossible objects whose impossibility is merely physical). And we saw that, in that case, *all* sentences that are laws fail to satisfy (i)-(iv). But more modest incursions into the realm of physically impossible objects would have unfortunate results in proportion to the depth of the incursion.

Suppose, for example, that 'copper objects expand when heated' is a law of nature. And suppose we extend our domain of quantification to include some or all of those (of course, non-actual) objects that are copper but fail to expand when heated. Then 'copper objects expand when heated' will fail to support its counterfactuals, and will thus fail to be a law. An argument similar to this one, *mutatis mutandis*, can be constructed to show that if our domain of quantification is extended only so far as to include some but not all physically *possible* objects, then some sentences that are *not* laws will satisfy (i)-(iv). (An extreme case of this, which we have already in effect discussed, is the restriction of our domain of quantification to actual objects. The *limiting* case, the "mirror image" of extending the domain of quantification to include all logically possible objects, would be the restriction of quantification to the null domain—in which case, every universal generalization would satisfy (iv).)

Thus, if we try to save (i)-(iv) by extending our domain of quantification, we shall get the "right result" only if we extend it in just such a way as to include all those and only those objects that are physically possible. But how shall we, in the presentation of our analysis of 'law', specify this class of objects? Clearly it will not do to specify it as the class of possible objects whose actual existence would be compatible with the laws of nature, for then our analysis would be circular. Let us assume, therefore, that we have discovered a way of specifying the class of physically possible objects that does not involve the idea of a law of nature. (I doubt whether there is any way to do this, but suppose there is.) Then, I think, conditions (i)-(iv) will constitute an extensionally adequate and non-circular analysis of 'law of nature'. I cannot say for certain that this is the case, but I see no counterexamples. Of course, if we were to adopt the resulting analysis, we should still be faced with the problems of specifying what it is for two sentences to be equivalent, of explicating the notion of a non-actual object, and of extending our analysis to apply to inexpressible propositions. But we should have *something*.

What we should have, however, is something we could have got a good deal more easily. We have supposed ourselves somehow to have specified the class of physically possible objects in a way that does not depend on the notion of a law of nature. Let us then define a *physically possible world* as a possible world such that every object that exists in that world is physically possible.[15] And let us call a proposition a *law of nature* if it is a contingent proposition that is true in every physically possible world. This definition is, in the domain of expressible propositions, either extensionally equivalent to (i)-(iv), or else (i)-(iv) give the *wrong* extension to 'law of nature'. Moreover, this definition avoids one problem facing (i)-(iv): it applies to inexpressible propositions. And note, finally, that this definition does not involve the idea of a counterfactual conditional. Thus, the very concept that is needed in order for condition (iv) to "work"—the concept of a physically possible but non-actual object—is such that if we have it, then condition (iv) is otiose.

The alternatives with which this result leaves us were anticiptated in Section I: we may search for some further condition(s) to add to (i)-(iv); we may search for some condition stronger than (iv) with which to replace (iv); we may decide that lawhood is a primitive and indefinable idea; or we may abandon the idea of lawhood, at least in the form in which it is embodied in suppositions (A)-(D). I do not know which of these alternatives ought to be chosen.[16]

References

[1] T. L. Beauchamp (ed.), *Philosophical Problems of Causation* (Dickenson, 1974).

[2] H.-N. Castañeda, "Thinking and the Structure of the World," *Philosophia* 4(1974).

[3] R. M. Chisholm, "Law Statements and Counterfactual Inference," *Analysis* 15(1954-55).

[4] N. Goodman, "The Problem of Counterfactual Conditionals," *The Journal of Philosophy* XLIV(1947): 113-28.

[5] D. Lewis, *Counterfactuals* (Harvard, 1973).
[6] A. Morton, "If I Were a Dry, Well-Made Match," *Dialogue* 12(1973): 322-4.
[7] T. Parsons, "A Prolegomenon to Meinongian Semantics," *The Journal of Philosophy* LXXI, 16(1974).
[8] A. Plantinga, *The Nature of Necessity* (Oxford, 1974).
[9] N. Rescher, *Conceptual Idealism* (Blackwell, 1973).
[10] R. Stalnaker, "A Theory of Conditionals," in N. Rescher (ed.), *Studies in Logical Theory* (Blackwell, 1968).
[11] P. van Inwagen, "The Incompatibility of Free Will and Determinism," *Philosophical Studies* 27(1975).
[12] G. H. von Wright, *Explanation and Understanding* (Cornell, 1971).

NOTES

[1]I do not think that this condition is acceptable as it stands. If one builds truth into the notion of a law of nature, then the notion of a miracle, an action of a supernatural power that is contrary to the laws of nature, is self-contradictory. For example, if Christ did in fact rise from the dead, then this event was not contrary to any "laws of nature" in the sense under consideration: necessarily, no *actual* event is such that its occurrence is incompatible with any *true* proposition. Now it may for all I know be a truth, even a necessary truth, that all laws of nature are true, that is, that miracles never happen. But it does not seem to me to be a useful thing to do to treat the sentence 'Miracles never happen' as a *tautology*. In the sequel, I shall ignore this problem, since what I say will be compatible with any reasonable revision of (i) that is intended to resolve this difficulty.

[2]Except, of course, necessarily existing individuals, if such there be.

[3]Two other conditions one often sees on such lists, 'A law must be universal in form' and 'A law may not contain empty terms' are useless. For any sentence satisfying either of them (and they would seem to apply only to sentences; it is not clear what it would be for a *proposition*, a non-linguistic entity, to be universal in *form* or to *contain* terms), it is easy to find a logically, or at least, a semantically equivalent sentence that does not satisfy them. And, presumably, if a sentence is a law, then so is any sentence logically or semantically equivalent to it.

[4]This phrase, so far as I know, was first used by Nelson Goodman in [4].

[5]G. H. von Wright ([12]: 71). Many similar passages can be found in the essays that make up parts II and III of Tom L. Beauchamp ([1]). See also N. Rescher ([9]), Chap IV. R. M. Chisholm, in some places, has made a claim that looks very much like the claim that (i)-(iv) are sufficient for lawhood. For example, in [3], he says, ". . . there are two types of true synthetic universal statement: statements of the one type, in the context of our general knowledge, seem to warrant counterfactual inference and statements of the other type do not. I shall call statements of the first type 'law statements' and statements of the second type 'non-law statements'."

[6]Here '>' is the counterfactual- or subjunctive-conditional connective. '$Fx > Gx$' is pronounced, "if x were F, x would be G"; '$p > q$' is pronounced, "if it were the case that p, it would be the case that q." The symbol is Stalnaker's ([10]). In using Stalnaker's symbol, I do not, of course, commit myself to accepting his semantics for counterfactuals (see *n.*10, *infra*). Definition (d1) is suggested by a form of words used by Chisholm ([3]: 97).

[7]See Lewis ([5]), *passim*, and pp. 24-26 in particular.

[8]This definition will obviously lead to counterintuitive results if we allow F to be an empty predicate. To allow for empty predicates occupying the 'F'-position in laws, we could rewrite the portion of the definition following 'iff' as follows:

(a) if F is non-empty, then $\ulcorner\forall x(Fx \supset (Gx > Hx))\urcorner$ is true.

(b) if F is empty, then $\ulcorner\forall x(Fx \supset (Gx > Hx))\urcorner$ would be true (even) if F were not empty.

Since, in all cases considered in the text, the predicate occupying the 'F'-position will be non-empty, I shall mention this refinement of (d2) only in this footnote.

[9]I am grateful to the referee for calling my attention to a penetrating and concise paper by Adam Morton ([6]) in which a definition of counterfactual support essentially the same as (d1) is considered and rejected because of the "impossible antecedents" difficulty. After rejecting this definition, Morton goes on to propose a more elaborate definition that is somewhat similar to (d2). (An important dissimilarity: Morton's analogue of (d2) contains a symbol representing *causal* possibility.) Morton, by the way, explicitly endorses the view that counterfactual support is sufficient for lawhood (p. 324).

[10]If this definition is to be of any interest, we must presuppose a semantics for '$>$' that does not confer validity on '$p \,\&\, q. \supset .p > q$'. Suppose, for example, that it is an "accidental" truth that all humans are less than ten feet tall. Consider '$\forall x$(x is human $\supset$ (x is human $>$ x is less than ten feet tall))'. If we adopt a semantics for counterfactuals according to which '$p \,\&\, q. \supset .p > q$' is valid (and if we extend it in a natural way so as to give an account of the satisfaction-conditions for sentences containing both '$>$' and free variables), then this sentence will (given our factual supposition) be true, and the result of replacing '$>$' in it with '$\supset$' will be a law, as will the equivalent '$\forall x$(x is human $\supset$ x is less than ten feet tall)', *contra hyp*. One version of Lewis's semantics (with "weakened centering," [5]: 29) has the feature we require.

[11]For a more detailed argument concerning the relationship between human abilities and the laws of nature, see [11].

[12]Or suppose (2) is *not* a law, since there is, was, or will be exactly *one* human being who would not [have] develop[ed] scurvy if deprived of vitamin C. Given (i)-(iv), though (2) is not a law, it would have been if that person's parents happened never to have met.

[13]See, for example, Rescher, ([9]: 59-61), footnotes 3 and 5 in particular.

[14]My reasons for thinking this are essentially those presented by Alvin Plantinga in [8]. (An *un*straightforward way of making sense of this idea would be to find some sort of set-theoretical construction to go proxy for merely possible objects. For example, the set of properties {humanity, obesity, standing in the doorway} might, on someone's account of merely possible objects, go proxy for the merely possible fat man in the doorway. This device is "unstraightforward" because this set *has* none of the properties it contains and, like everything else, really does exist.) For recent able, but, in my opinion, unsuccessful attempts to make sense of the notion of a merely possible object, see Rescher, [9] Ch. 2; Lewis, [5], 4.1; Terence Parsons, [7] and H.-N. Castañeda, [2].

[15]That is, a world such that every object that exists in that world is physically possible *simpliciter* or, redundantly, physically possible in the actual world; *not* a world such that every object that exists in that world is physically possible in *it*. This latter condition, of course, is satisfied by every possible world.

The referee has questioned this definition of 'physically possible world'; he wonders whether there might not be worlds in which "the physical possibilia [are] arranged in a physically impossible way." The answer to this question seems to me to be No. (I say *seems* because, I admit, I have a very hard time getting a grip on the notion of a "mere possibile.") Let us look at a specific case. Consider a simple possible world that consists of a single planet, P, in a stable, closed orbit about a single star, S, together with any other entities whose existence may be necessitated by the existence of P and S. Can we suppose that P and S are physically possible objects *and* that (say) the orbit of P about S is a physically impossible one? (Let's suppose for the sake of simplicity that the *actual* laws of nature include Newton's laws of motion and the law of universal gravitation.) To be more specific, can we suppose that the orbit of P about S is not an ellipse but a closed curve of some other sort? How could that be? Is it that S does not "generate" a field of attractive force the strength of which at a point varies inversely as the square of the distance of the point from S? But then, surely, S is not a physically possible star. Is it that P does not respond to an impressed force in accordance with Newton's laws of motion? Then, surely, P is not a physically possible planet. But if P responds "normally" to an impressed force and if S generates a "normal" gravitational field and if there are no other massy bodies on the scene, then, of mathematical necessity (at least, given a few rather esoteric assumptions, which can be "built into" Newton's laws), the orbit of P about S is, if it is closed, an ellipse. Thus, our attempt to imagine that P and S are physically possible objects arranged in a physically impossible way collapses.

All this is rather tricky. The source of the trickiness, I think, is the unclear notion of a merely possible object. But at any rate, I find myself unable to describe, in any detail, anything I should be willing to call "a world in which physically possible objects are arranged in a physically impossible way." My difficulty might be described abstractly like this: I don't see how to make any hard and fast separation between the properties that belong to the objects within the world I am attempting to describe "in themselves," and the properties they have "only in virtue of the way they are arranged."

If these reflections are unconvincing, the referee has made a suggestion which is much more clear and which I, at least, find compelling: the arrangement of subordinate objects within a world—or, better, the subordinate objects so arranged—should itself be thought of as an object. Call it the *cosmos* of that world. Even if a world did consist of physically possible subordinate objects arranged in a physically impossible way, there would exist in that world at least one physically impossible object, a physically impossible cosmos. Consider our simple world containing P and S. The cosmos of this world is conterminous with its only solar system. Even if—*per impossibile*, on my view—this world can be thought of as containing a physically possible planet in a physically impossible orbit about a physically possible star—it will *nonetheless* contain a physically impossible object, to wit, a physically impossible solar system.

[16]I should like to thank Thomas McKay and Alexander Rosenberg for valuable conversations about some of the issues discussed in this paper.