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Why-Questions

> As a result of my assiduous concern with this problem I arrived by a kind of internal necessity at a reflection of astounding import: there must be invented, I reflected, a kind of alphabet of human thoughts, and through the connection of its letters and the analysis of words which are composed out of them, everything else can be discovered and judged. This inspiration gave me then a very rare joy which was, of course, quite premature, for I did not yet then grasp the true significance of the matter.
>
> —Leibniz
> *Towards a Universal Characteristic* (1677)

IN THIS PAPER we seek to pin down the conditions that define correct answers to why-questions. The problem can be stated more precisely. We will mean by a *why-question* a question that can be put in English in the form of an interrogative sentence of which the following is true: (1) the sentence begins with the word *why;* (2) the remainder of the sentence has the (surface) structure of an interrogative sentence designed to ask a whether-question—i.e., a question whose right answer in English, if any, must be either "yes" or "no"; (3) the sentence contains no parenthetical verbs, in Urmson's sense.[1] A why-question put as an English sentence that satisfies (1), (2), and (3) will be said to be in *normal form.* By the *inner question* of a why-question we will mean the question alluded to in (2) above—i.e., the question reached by putting the why-question in normal form, then deleting the initial "why" and uttering the remaining string as a question. By the *presupposition* of a why-question we will mean that which one would be saying is the case if, upon being asked the inner question of the why-question through an affirmative interrogative

sentence, one were to reply "yes," or what one would be saying is the case if, upon being asked the inner question through a negative sentence, one were to reply "no." Thus, "Why does copper turn green when exposed to air?" is a why-question in normal form; its inner question is "Does copper turn green when exposed to air?"; and its presupposition is that copper turns green when exposed to air. The presupposition of "Why doesn't iron turn green when exposed to air?" is that iron does not turn green when exposed to air.[2]

We will not be concerned with every sort of why-question. We will ignore why-questions whose normal forms are not in the indicative. We will ignore why-questions whose presupposition refers to human acts or intentions or mental states. Finally, we will ignore why-questions whose correct answer cannot be put in the form "because p," where *p* indicates a position reserved for declarative sentences. Notice that this last stipulation affects not only why-questions whose correct answer must be put in some such form as "in order to . . ." or "to . . . ,"[3] but also why-questions that one might wish to say have no correct answer, and in particular why-questions with false presupposition and why-questions whose inner question itself has no answer—e.g., "Why doesn't iron form any compounds with oxygen?" and "Why does phlogiston combine with calx?" More may be ruled out, and we shall have to come back to this point.[4]

To simplify matters, we will disregard the fact that correct answers to the why-questions that do concern us can often be put in some other form than "because p" with a declarative sentence at the *p*. Furthermore, we will reserve the term *answer* to refer to what is conveyed by the sentence at *p* abstracted from the "because . . ." environment. Thus, if "Because the temperature is rising" is the correct answer to some why-question we will speak of "the temperature is rising" as the answer.

We can now put our problem very simply. Let *a* and *b* be any two true propositions; what necessary and sufficient conditions must they jointly satisfy if *b* is to be a correct answer to a why-question whose presupposition is *a*?[5]

II

So far we have relied on a characterization of why-questions in which features peculiar to the English lexicon and to English grammar play an essential role. We have carefully avoided identifying why-questions as a class of English interrogative sentences, but we have nevertheless defined them as questions that must be expressible in a certain way in English.

This may seem to detract from the interest of the problem. Philosophers of science in particular may feel wary of a typology of questions that rests squarely on the availability of certain forms in a specific natural language. There are good grounds for such suspicion. After all, scientific questions are for the most part only accidentally expressible in English. They can also be put in French, German, Russian, Japanese, etc., not to mention artificial languages. Furthermore, some of these questions may not be expressible in English at all, especially so if by "English" we mean contemporary, "ordinary" English. "Why is the emf induced in a coiled conductor a function of the rate of change of magnetic flux through it and of the resistance of the coil?" could probably not have been asked in seventeenth-century English, and a similar situation may hold for questions that have not yet arisen.

One could try to meet such reservations by providing at the outset a language-independent definition of why-questions, or rather of *Why*-questions, a class of questions that would include all why-questions but that would not be limited to questions expressible in English. However, it is not clear how one is to be guided in setting up such a definition. We propose to deal with the matter somewhat differently. We will set as one condition on the solution of our problem that it abstract completely from the peculiarities of English—i.e., that it be stated in terms that transcend linguistic idiosyncracies and are applicable to expressions in any relevantly rich language. Having done this we should be able to give a definition of Why-questions that preserves whatever warrants an interest in the nature of why-questions on the part of philosophers of science.[6]

III

What we have just said commits us to two hypotheses. The first of these hypotheses is that the relation between presupposition and (correct) answer to a why-question can be analyzed in language-independent terms. This hypothesis may be false, in which case we will not be able to solve our problem within the restrictions that we have adopted. However, it should be clear that the hypothesis cannot prevent us from accepting as relevant intuitions about the presence or absence of the relation in specific cases available to us as speakers of English. When we say that the relation is language independent, we do *not* mean that it hinges only on extra-linguistic facts. We mean that insofar as it hinges on linguistic features it hinges only on syntactic and semantic properties that expressions from every language share. Thus, the properties of being true and of being mutually implied are properties that expressions may have

whether they belong to English or Chinese or Beulemans. The property of being the result of a do-transformation (the transformation that inserts "do" in, e.g., "He did not eat" or in "Didn't he eat?" but not in "He will not eat" or in "Hasn't he eaten?") is a property shared only by English expressions. Our hypothesis is therefore compatible with the tenet that any speaker of English has the faculty to perceive whether the semantic and syntactic properties of two given English sentences meet (or fail to meet) the conditions that would make one of these sentences express the answer of a why-question whose presupposition is expressed by the other. He must, of course, understand the sentences, and he must also have certain relevant beliefs. On the other hand, to say that he has the faculty to perceive whether this sort of condition is satisfied in specific instances is not to say that he can describe them or analyze them. Nor is it to say that he will never or ought never to hesitate before pronouncing something to be a correct answer to a why-question. Hesitation is to be expected where the case at hand is complex and demands slow and careful scrutiny. It is also to be expected when the truth of the sentences or of the relevant beliefs are themselves objects of hesitation. But there are clear-cut cases and these constitute a corpus for which, as speakers of English, we must account.

IV

The second hypothesis is that there are issues in the philosophy of science that warrant an interest in the nature of why-questions. The most obvious of these issues are whether science (or some branch of science or some specific scientific doctrine or some approach) ought to, can, or does provide answers to why-questions, and if so, to which ones. In other words, when appraising critically the state of scientific knowledge (or of some branch of science or some doctrine or some approach), how much weight should we give to unanswered why-questions? Should we consider that some why-questions are beyond the reach of scientific methodology or rules of evidence? Should we refrain from accepting as final any doctrine that raises why-questions to which no answers are forthcoming? We will have little to say about these very complex issues here, but since they provide much of the motivation for our inquiry, a few words of caution are called for.

These issues are usually discussed in English with the word "explanation" used instead of "why-question" or "answer to why-question." Analogous substitutions occur in other languages. This way of putting things can be innocuous and is possibly justified by the awkwardness of

using the more contrived locutions. But it is ambiguous and may be a source of confusion. To become aware of this we need but notice that "explanation" may refer to the answers of a huge variety of questions besides why-questions, the only requirement being that their *oratio obliqua* form fit as grammatical object of the verb "to explain" and its nominalization "explanation of," e.g., how-questions, what-is-the-cause-of-questions, what-corresponds-at-the-microscopic-level-questions, etc. Yet, the issues raised by these other types call for considerations peculiar to each type and different from those called for in the case of why-questions. Confusion is therefore likely to ensue and is apt to be further compounded if we allow ourselves to forget that "explanation" may also refer to things not readily specified as answers to a specific class of questions. To remain aware of the range of issues covered by a given analysis we must therefore keep sharp the differences among questions about (1) truth-conditions of sentences generated from "A explains B" and from "A is the explanation of B" by substituting any grammatically appropriate phrase for *B*, (2) truth-conditions of sentences obtained by substituting for *B* only *oratio obliqua* forms of grammatically appropriate questions, (3) truth-conditions of sentences obtained by substituting for *B* the *oratio obliqua* form of some more narrowly defined class of questions (e.g., why-questions, how-questions, what-corresponds-at-the-microscopic-level-questions, etc.), (4) conditions that are satisfied by answers and presupposition of all questions whose *oratio obliqua* form can be substituted for *B*, (5) conditions that are satisfied by answers and presupposition of some narrower class of questions whose *oratio obliqua* form can be substituted for *B*.[7] It should be clear that we will limit ourselves to a special case of (5) in this paper, the case of why-questions. In fact, our limits are even narrower since we have eliminated from consideration certain types of why-questions.

Offhand, it may seem that the above (1) to (5) enumeration is redundant and that we might have stopped after (3). Actually, subtle but important distinctions underlie the difference between "Explanation of Q" and "Answer to Q." We have discussed these at some length elsewhere [8] and will say just a few words about them here to suggest the sort of further problems involved.

Let us describe someone as in a *p-predicament* (*p* can be thought of as standing for "puzzled" or "perplexed" but for *mnemonic* purposes only) with regard to some question *Q*, if and only if on that person's views, the question *Q* admits of a right answer, yet the person can think of no answer, can make up no answer, can generate from his mental repertoire

no answer to which, given that person's views, there are no decisive objections. For instance, a physicist committed to classical physics but aware of the photoelectric effect would be in a *p*-predicament with regard to the question "Why does a photoelectric current appear without delay as soon as light of frequency above the threshold frequency impinges on the target, and this no matter how low the frequency of the impinging light?" Let us also describe someone as in a *b-predicament* with regard to a question *Q* if and only if the question admits of a right answer, no matter what the views of the person, but that answer is beyond what that person can think of, can state, can generate from his mental repertoire. Thus, someone unacquainted with the kinetic-molecular theory of matter would be in a *b*-predicament with regard to the question "What is the mechanism by which water evaporates from uncovered dishes left in the open?" Let us say furthermore that a question *Q* is *unanswerable relative to a certain set of propositions and concepts C* if and only if anyone who subscribes to these propositions and limits himself to these concepts must be in either a *p*-predicament or *b*-predicament with regard to the question *Q*. The search for and discovery of scientific *explanations*, we think, is essentially the search for and discovery of answers to questions that are unanswerable relative to prevailing beliefs and concepts. It is not, therefore, merely a quest for evidence to settle which available answer is correct, it is a quest for the unthought-of.

The difference between "explanation" and "answer" just sketched transcends the distinction between why-questions and other questions. It should nevertheless be kept in mind when we deal with the issues described at the beginning of this section. These need not be resolved in the same way for why-questions that are unanswerable relative to the set under consideration and for those that are merely unanswered.

V

According to a very familiar theory, explaining a fact (an event, a phenomenon, a natural law) consists in deducing a statement describing the fact from the statement of a true law and additional true premises. Thus, according to this theory, the explanation of a fact is a valid and sound (i.e., all the premises are true) deduction, none of whose premises are superfluous, some of whose premises are empirical laws, and whose conclusion is a description of the fact explained. The premises of such a deduction are called the *explanans* and the conclusion, the *explanandum*. We will refer to such deductions as *deductive nomological explanations*

and to the theory itself, whose most famous and competent exponent has been Carl Hempel, as the *Hempelian doctrine*.[9]

As a general characterization of the notion of explanation, i.e., as a description of the truth-conditions of statements of the form "A explains B" or "A is a correct explanation of B," or their non-English equivalents, the Hempelian doctrine obviously will not do, a fact that its proponents have always recognized. The evidence for this also shows that the doctrine does not describe necessary and sufficient conditions on the answers to all the sound questions whose *oratio obliqua* form may be substituted for *B*. Answers to, or explanations of, how cloud chambers work, of what the nature of light is, of what occurs at the molecular level when water freezes, etc. need not be explanans (nor even a pragmatically selected component of explanans). On the other hand, the doctrine no doubt does describe necessary and sufficient conditions on answers to *some* questions whose *oratio obliqua* form can be substituted for *B*. Thus, every deductive nomological explanation is an explanation or at least a sound answer to questions of the form "How could anyone knowing that . . . (here put the conjunction of all the premises in a deductive nomological explanans) . . . but not that . . . (here put the corresponding explanandum) . . . have predicted that . . . (here repeat the explanandum) . . . ?" and obviously the conjunction of the premises also constitutes a correct answer to questions of the form "From what laws and antecedent conditions can the fact that . . . (here put the explanandum) . . . be deduced?" But does the Hempelian doctrine tell us what we want to know about why-questions? Is a proposition p the correct answer of a why-question whose presupposition is q if and only if p is the conjunction of premises (or of some pragmatically selected subset of premises) of a deductive nomological explanation whose conclusion is q? The following counterexamples (and they are easily multiplied) strike us as settling the matter and this quite apart from some technical difficulties connected with the relevant notions of deducibility and law.

1. There is a point on Fifth Avenue, M feet away from the base of the Empire State Building, at which a ray of light coming from the tip of the building makes an angle of θ degrees with a line to the base of the building. From the laws of geometric optics, together with the "antecedent" condition that the distance is M feet, the angle θ degrees, it is possible to deduce that the Empire State Building has a height of H feet. Any high-school student could set up the deduction given actual numerical values. By doing so, he would not, however, have *explained* why the Empire State Building has a height of H feet, nor would he have

answered the question "Why does the Empire State Building have a height of H feet?" nor would an exposition of the deduction be the explanation of or answer to (either implicitly or explicitly) why the Empire State Building has a height of H feet.

2. From the Leavitt-Shapley Law, the inverse square law for light, the periods of Cepheid type variable stars in the Andromedan Galaxy, their apparent range of brightness, one can deduce that the Andromedan Galaxy is 1.5×10^6 light years away from the earth. The premises of the deduction, however, do not tell why or explain why the Andromedan Galaxy is 1.5×10^6 light years away from the earth.

3. Whenever the pointer of the water meter points to 5, and only the bathtub faucet is open, water flows at a rate of five gallons per minute into the bathtub. The pointer has been on 5 for the last three minutes, and no faucet except the bathtub one is open. Therefore, fifteen gallons of water must have flowed into the bathtub. The deduction does not explain or tell or reveal *why* fifteen gallons of water flowed into the bathtub during the last three minutes.

4. All of Cassandra's predictions always come true. (Cassandra is a computer.) Yesterday Cassandra predicted that it would rain today. But obviously that is not why it is raining today.

5. Only men who are more than six-feet tall leave footprints longer than fourteen inches. The footprints left by Gargantua on the beach are more than fourteen inches long. Therefore Gargantua is more than six-feet tall.

Again the reasoning fails to mention *why* Gargantua is more than six-feet tall.

These counterexamples are compatible with the thesis that answers and presuppositions of why-questions *must* be premises and conclusions of deductive nomological explanations. They do show, however, that this cannot be *sufficient*.

It has been suggested that these counterexamples and others like them are not really binding on philosophers of science, that they ultimately involve an appeal to ordinary usage and that such appeals are not appropriate when we deal with inquiries that are far removed from ordinary concerns. These objections can be construed in a number of ways.

1. They may mean that our refusal to call the explanans examples of *explanations*, or to look upon them as telling *why* something is the case, merely reflects allegiance to unscientific intellectual practices that scientists qua scientists have or should have abandoned. But this is hardly

plausible. In 1885, Balmer devised a formula from which the frequencies represented in the spectrum of a sample of excited hydrogen could be deduced. But any scientist worthy of the name would have refused to accept such a deduction as the answer to why these particular frequencies were represented. The case is far from unique, and we owe the birth of quantum mechanics and of modern astronomy to that sort of refusal.

2. They may mean that the verb "to explain" and its cognates have a technical meaning in scientific contexts, a status similar to that of "work," "action," "model," etc. But this is false. "To explain" does not belong to any technical jargon (except perhaps that of some philosophers), and anyhow the crucial words in our inquiry are "why" and "because."

3. They may mean that although we do not say of these inferences that they explain or tell why something is the case, we could, and that only an unscientific tradition prevents us from doing so. This would make sense if "ordinary use" merely demanded that we *refrain* from saying of the premises of the above inferences that they tell why something is the case, but words meaning what they do, we must also *deny* it. The deduction about Gargantua does *not* tell why Gargantua is more than six feet tall; "because the footprints he left on the beach were more than fourteen inches long" is *not* the answer to "why was Gargantua more than six feet tall?" My typewriter is neither blind nor not blind. That is a state of affairs for which "ordinary language" is partly responsible and a case might be made for extending the meaning of "blind" so that my typewriter can be said to be blind. That horses are warm-blooded, however, is a fact about horses, not language. It would remain true even if "warm-blooded" meant "member of the Ku Klux Klan," although we would then have to put the matter differently. That the premises of the inference about Gargantua do not make up a correct answer to why Gargantua was so big is a fact about these premises. It would remain a fact even if "why" were to become a request-marker for premises of deductive nomological explanations, although we would then have to put the matter differently.

4. The relation between the explanans and the explanandum of a deductive nomological explanation—let us call it the *H*-relation—can be defined in language-independent terms, i.e., in terms applicable to the expressions of any language rich enough for science. On the basis of such a definition it is also possible to define, in *language-independent* terms, a class of questions very much like why-questions, whose answer and presupposition need only be *H*-related. Let us call them *H*-why-questions. Their definition is a little complicated and we leave it for a footnote,[10] but anyone familiar with Hempel's doctrine will sense this possibility and will recognize it as one of the virtues of the doctrine. Those who reject the above counterexamples may simply doubt that why-questions can also be defined in language-independent terms and may believe that *H*-why-questions are the nearest possible language-independent approximation. Accepting the counterexamples as binding would then mean giving up the principle that scientific questions are essentially language independent. However, such qualms are premature if, as we believe, why-questions *can* be defined in language-independent terms.

5. The objection may finally mean that by insisting on the relevance of these examples we must not only be insisting on the importance of why-questions (which have their own interrogative in English), but must be denying the importance of *H*-why-questions (which do not have an interrogative in English). We do not.

VI

What is essential is not always easy to distinguish from what is accidental in the relation between why-questions and their answers. For instance, it is often assumed that besides being true, presuppositions of why-questions that have answers must also be something surprising, something that conflicts with what had been expected, or at least something unusual. Stated a little more precisely, the view amounts to this: We ask questions for all sorts of reasons and with many different purposes in mind—e.g., to test someone's knowledge, to offer someone the opportunity to show his erudition, to kill time, to attract attention; but questions have one basic function, the asking for information not already in our possession. On the view now considered, why-questions can fulfill that basic function only when asked by someone who finds the truth of the presupposition surprising and unexpected.

Why-questions no doubt are often asked by people to whom the presupposition comes as a surprise and the fact that they ask them is often related to their surprise. Furthermore, some why-questions whose presupposition is not surprising or unexpected seem to have no answer. Why does the earth have only one satellite? Why does every gram-molecular weight of matter contain 6×10^{23} molecules? Why can anything not move with a velocity greater than that of light? Why do bodies attract one another with a force that is directly proportional to their mass and inversely proportional to the square of their distance?

Why is *chien* the French word for dog? Why has there never been a President of the United States whose first name was Clovis? Why does anything exist at all? Anyone will feel about at least one of these questions that he cannot provide a "because . . ." answer, although not because he does not know or has forgotten but simply because there is no answer. The view is even compatible with the use of "why-should" questions that challenge one to show that a given why-question has an answer—e.g., "Why should there have been a President with the first name Clovis?" "Why shouldn't every gram-molecular weight contain 6×10^{23} molecules?"

If it were true that presuppositions of why-questions must be surprising, we would now have to seek out the relevant criteria for being surprising. Fortunately, it is not true. There is nothing unsound about the question "Why is the train late today?" asked by the harassed New Haven commuter who would be more surprised if the train were on time; nor is there anything unsound about why-questions raised by scientists about very familiar everyday phenomena. The same sort of considerations show that presuppositions need not be departures from regularities.

The view that we have just described is close to another view that is equally tempting and equally false. According to this second view, why-questions have answers only when there exists a plausible argument in behalf of a contrary of their presupposition. This could account for all the things accounted for by the previous view and for further things as well. If true, it would require us to analyze the relevant notion of plausible argument. But it is not true. There is no such plausible argument forthcoming in the case of "Why has there never been any President of the United States with the first name Clovis?" and yet the question is sound and has an answer: "Because no one by that name has ever been elected to the office or been the Vice-President when a President died in office." The example is deliberately chosen from the list of questions cited previously as seeming to have no answer. It suggests that one's attitude toward the presupposition and other "pragmatic" considerations play no crucial role.

VII

The solution that we are about to propose requires a few preliminary definitions. These definitions are stated with the help of predicate logic notation. The use of this notation introduces a number of theoretical problems that we will simply ignore. The problem of lawlikeness is but one of them. There are others that anyone familiar with the discussions of Hempelian doctrine will immediately detect.[11] We use the notation

because it strikes us as providing the simplest way of exhibiting at present certain purely formal matters and we hope that our illustrations will bring out the intentions behind the schematisms. All these definitions must eventually be replaced by ones that make use of better representations. We think, however, that the heart of the analysis is essentially sound and that it may therefore be of some interest even in this temporary form. Each definition will be preceded by paradigms. This should make the formulae easier to read; it should, in fact, enable one to skip them altogether.

First Definition: General rule.

Paradigms: The level of a liquid in a cylindrical container on which a melting object is floating always rises. All French nouns form their plural by adding *s*. The velocity of an object never changes.

A general rule is a *lawlike* statement of the form

$$(x)(F_1x \cdot F_2x \ldots F_jx :\supset: S_1x \cdot S_2x \ldots S_kx) \qquad (j \geqslant 1, k \geqslant 1)$$

Note that the definition does *not* require that a general rule be true or even plausible.

Second Definition: General abnormic law.

Paradigms: 1. The level of liquid in a cylindrical container on which a melting object is floating at room temperature will rise unless the object is made of a substance whose density in liquid form is the same or is greater than that of the original liquid at room temperature. If the density is the same, the level will remain the same; if the density is greater, the level will go down.

2. The level of liquid in a cylindrical container on which a melting object is floating at room temperature will rise unless upon melting completely the floating object undergoes a decrease in volume equal to or greater than the volume originally above the surface of the water. In the former case, the level remains the same; in the latter case, the level goes down.

3. All French nouns form their plural by adding *s* unless they end in *al* (except *bal, cal, carnaval,* etc.) or in *eu,* or in *au,* or in *ou* (except *chou, genou,* etc.) or *x,* or *z,* or *s*. If and only if they end in *al* (except *bal,* etc.) they form the plural by dropping the last syllable and replacing it with *aux;* if and only if they end in *eu* or *ou* or *au* (except *chou,* etc.) they form their plural by adding *x;* if and only if they end in *x* or *z* or *s* they form their plural by adding nothing.

These are examples only if we are willing to assume that they are true as they stand.

A general abnormic law is a *true, lawlike* statement of the form

$$(x)\ (F_1x \cdot F_2x \ldots F_jx :\supset :. -Ex \equiv .\ A_1x \vee A_2x \ldots \vee A_nx \vee B_1x \ldots \vee B_mx \ldots \vee R_ex$$
$$: A_1x \vee A_2x \ldots A_nx . \equiv S_Ax$$
$$: B_1x \vee B_2x \ldots B_mx . \equiv S_Bx$$
$$: \ldots\ldots\ldots\ldots\ldots$$
$$: R_1x \vee R_2x \ldots R_ex . \equiv S_Rx)$$
$$(n \geqslant 1, j \geqslant 1)$$

of which the corresponding following statements are also true:

(a) $(x)\ (F_1x \cdot F_2x \ldots F_jx :\supset . Ex \vee S_Ax \vee S_Bx \ldots S_Rx)$ $\quad (R \geqslant 1)$

(b) $(x)(A_1x \supset : -A_2x \cdot -A_3x \ldots -A_nx \cdot -B_1x \ldots -B_mx \ldots -R_ex$
$:.\ A_2x \supset : -A_1x \cdot -A_3x \ldots -A_nx \cdot -B_1x \ldots -B_mx \ldots -R_ex$
$:. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$
$:.\ R_ex \supset : -A_1x \cdot -A_2x \ldots -R_{e-1}x)$

(c) It does not remain a true, lawlike statement when one or more disjuncts in any of the internal biconditionals is dropped or when one or more of the conjuncts in the initial antecedent is dropped. (These three conditions are redundant, but we are obviously not after elegance in this sketch.)

(d) The closure of the main antecedent is not a logical truth or contradiction.

(e) The closure of none of the internal disjunctions is a logical truth or contradiction.

(We construe the "unless" in the paradigms as the exclusive disjunction.)

Third Definition: Special abnormic law.

Paradigms: 4. The velocity of an object does not change unless the net force on it is not equal to zero.

5. No sample of gas expands unless its temperature is kept constant but its pressure decreases, or its pressure is kept constant but its temperature increases, or its absolute temperature increases by a larger factor than its pressure, or its pressure decreases by a larger factor than its absolute temperature.

Again we must assume that these are true.

A special abnormic law is a true, lawlike statement of the form

$$(x)(F_1x \cdot F_2x \ldots F_jx :\supset :. -Ex \equiv .\ A_1x \vee A_2x \vee \ldots \vee A_nx)$$
$$(n \geqslant 1, j \geqslant 1)$$

that satisfies conditions (a) to (e) on general abnormic laws. (It is easy to show that every general abnormic law is equivalent to a conjunction of special abnormic laws but we will not make use of this fact.)[12]

Fourth Definition: Antonymic predicates of an abnormic law.

Paradigms: The antonymic predicates of (3) above are "Forms the plural by adding *s*," "Forms the plural by dropping the last syllable and replacing it with *aux*," "Forms the plural by adding *x*," "Forms the plural by adding nothing." Those of (4) are "Has a velocity that is changing," "Does not have a changing velocity."

The antonymic predicates of a general abnormic law are the predicates that appear in the consequent of (a). Those of a special abnormic law are the predicate substituted for E in the statement of that law, and the negation of that predicate.

Fifth Definition: The completion of a general rule by an abnormic law.

Paradigms: (1) and (2) are each a completion of the first paradigm of a general rule. (3) and (4) are the completion of the next two paradigms of a general rule.

An abnormic law is the completion of a general rule if and only if the general rule is false and is obtainable by dropping the "unless" qualifications—i.e., by closing the statement before the first exclusive disjunction. (With our representation of the exclusive disjunction this requires negating the predicate substituted for E—or dropping the negation if it is already negated—deleting the biconditional connective, and making the obvious bracketing adjustments.)

We can now describe what we believe to be the relation between presuppositions and answers to why-questions. Before doing so, we will briefly present an example that points out the relevant features. The example and those to follow will only involve monadic predicates and will therefore fit the formulae in the definitions given above. But the predicates of presuppositions and answers of why-questions will not always be monadic and these definitions are thus too narrow as they stand. The shortcoming is readily remedied. We can either replace the references to the various formulae by references to the closure of the formulae obtainable by substitution from those given, or we can replace the formulae by more abstract schemata that allow for polyadic and for "zero-adic" predicates.[13] We shall assume that some such correction has in fact been adopted without actually carrying it out. Doing so would not solve the deeper problems alluded to in the introductory paragraph of this section, and the apparent gain in rigor would only be deceptive.

Why is the plural of the French noun *cheval chevaux*, i.e. formed by

dropping the last syllable and replacing it with *aux*? Answer: (Because) *cheval* ends in *al*.

The answer together with abnormic law (3) and the further premise that *cheval* is a French noun form an explanans whose conclusion is the presupposition. The further premise that is not part of the answer together with the general rule completed by the abnormic law constitute a valid (but not sound) deduction whose conclusion is a *contrary* of the presupposition.

Here then is the relation: *b* is the correct answer to the why-question whose presupposition is *a* if and only if (1) there is an abnormic law *L* (general or special) and *a* is an instantiation of one of *L*'s antonymic predicates; (2) *b* is a member of a set of premises that together with *L* constitute a deductive nomological explanation whose conclusion is *a;* (3) the remaining premises together with the general rule completed by *L* constitute a deduction in every respect like a deductive nomological explanation except for a false lawlike premise and false conclusion, whose conclusion is a contrary of *a;* (4) the general rule completed by *L* has the property that if one of the conjuncts in the antecedent is dropped the new general rule cannot be completed by an abnormic law.[14]

More examples may loosen up this jargon.

Why has there never been a President of the United States with the first name Clovis? We get the answer in the following way.

General rule: Every name is the name of some President of the United States.

Abnormic law that completes this general rule: Every name is the name of some President of the United States unless no one by that name has ever been elected to the Presidency and no one by that name has ever been Vice-President when a President died in office.

Premises that together with the law form a deductive nomological explanation whose conclusion is the presupposition: Clovis is a name; no one with the name Clovis has ever been elected to the Presidency of the United States, and no one by that name has ever been Vice-President when a President died in office.

Premises that together with the general rule lead to a contrary of the presupposition: Clovis is a name.

Remaining premise: the answer.

Next is an illustration of a why-question that has more than one correct answer. The case is adapted from a paper by Hempel: "In a beaker filled to the brim with water at room temperature there floats a chunk of ice which partly extends above the surface. As the ice gradually melts, one might expect the water in the beaker to overflow. Actually, however, the water level remains unchanged. How is this to be explained?"[15] We construe the last question as simply meaning, "Why did the level of water not rise?" Two relevant abnormic laws, (1) and (2) are available and both are completions of the same general rule—i.e., that given as our first example. The propositions that the contents of the beaker are a liquid on which a melting object is floating, that the liquid is water, that the object is ice, that ice upon melting becomes water—i.e., has the same density in liquid form as water, together with (1) form a deduction whose conclusion is the presupposition. The answer to the question: (Because) ice upon melting has the same density as water. The other premises together with the general rule lead to a contrary of the presupposition. We leave it to the reader to show that (2) leads in the same way to the answer: (Because) the ice undergoes a decrease in volume equal to the volume originally above the surface of the water.

It is instructive to read what Hempel wrote about this example:

> The key to an answer is provided by Archimedes's principle, according to which a solid body floating in a liquid displaces a volume of liquid which is the same weight as the body itself. Hence the chunk of ice has the same weight as the volume of water its submerged portion displaces. Now since melting does not affect the weights involved, the water into which the ice turns has the same weight as the ice itself, and hence, the same weight as the water initially displaced by the submerged portion of ice. Having the same weight, it also has the same volume as the displaced water; hence the melting ice yields a volume of water that suffices exactly to fill the space initially occupied by the submerged part of the ice. Therefore the water level remains unchanged.

Insofar as there is an answer conveyed in all this, it seems to be roughly equivalent to our second one.

Hempel was undoubtedly right in holding that the key to the explanation is provided by Archimedes' principle. However, if we look upon the question as a why-question, the principle is no more crucial than the principle that melting does not affect weight. It is the key in the sense that it provides a clue, also in the sense that anyone in a *p*-predicament or *b*-predicament with regard to the why-question must in all likelihood be told or be reminded of the principle; it is also an essential piece of knowledge for establishing that the answers are true, but it is not essential to establish that the answers, granted that they are true, are also correct answers to the why-question.

Our last illustration was a why-question that has more than one correct answer. Most why-questions are probably like that—i.e., true presuppositions seldom if ever determine unique answers. According to our analysis,

this is to be expected since more than one abnormic law is usually available from which a given presupposition can be derived. Our analysis, then, does not segregate good answers from poor ones, only correct ones from incorrect ones. We could, therefore, expect it even to account for the degenerate cases made famous by Molière: "Why does opium put people to sleep? Because it has dormitive power." One might as well have said, "Because it puts people to sleep." These cases almost go through because of the availability of such abnormic laws as "No substance puts people to sleep unless it puts people to sleep." Instances of the valid "$(x)(Fx \supset .-Ex \vee Ex)$" and of other schemata obtainable from "$p \supset .q \equiv q$" by substitution and generalization are always available. However, these cases do not quite go through insofar as (2) on page 100 together with the definition of "deductive nomological explanation" require that the abnormic law be *empirical*. Thus, we see why, on the one hand, one can assimilate such answers with correct answers and why, on the other hand, one knows that they ought to be rejected.

VIII

Our analysis accounts for some familiar facts about why-questions. In general, a question arises whenever there is reason to believe that it has an answer, although the answer is not known. This will happen in the case of why-questions when one believes that the presupposition is true, views it as a departure from a general rule, and thinks that the conditions under which departures from the general rule occur can be generalized by an abnormic law. One may be mistaken about this. One may, for instance, be mistaken in thinking that the presupposition is true. In that case, no answer (as we have defined the term, i.e., correct reply in the form of "because . . .") will be forthcoming. There will be, of course, appropriate replies. A statement to the effect that the presupposition is false will provide the relevant information.

One may, on the other hand, be mistaken in thinking that the presupposition represents a departure from a general rule. In that case, again, there will be no answer, although there will be other appropriate replies. "Why does this live oak keep its leaves during the winter?" "All live oaks do!" (Not however, "Because all live oaks do.") This sort of reply, like the previous one, has the force of a correction and entails that the question does not really arise.

One may, finally, be mistaken in thinking that the conditions under which departures from the general rule occur can be generalized. Here

once more, no answer will be forthcoming: "Why is Johnny immune to poison ivy?" "Some people are and some people are not." However, an "answer" built from a degenerate abnormic law will also do, e.g., "No one is immune to poison ivy unless he is," and from that, "Because he is."

These everyday situations should not be taken too lightly by philosophers of science. Why-questions must sometimes be countered with a general rule rather than with an answer. This corresponds to the fact that scientific investigations of why something is the case often end not with the discovery of a "because . . ." answer, but with the establishment of a new general rule. And this poses a problem: When is such a substitution merely a *begging* of the why-question? When does our ignorance demand that we not trade a why-question for a *H*-why-question but find the limits of a general rule? Why-questions even in science must sometimes be dealt with by denying that a departure from a general rule can be nontrivially generalized, which also raises problems: What sort of evidence warrants such denials? Can any fact ever be *shown* to be ultimate and unexplainable?

We mentioned in section VI the view that why-questions can fulfill their basic function only if the presupposition is something surprising or if there is at least a plausible argument forthcoming in behalf of one of its contraries. It is easy to see how such a view might come to be accepted: many instances support it. This is no accident. One often guides one's expectations by general rules, rules that are sometimes explicitly and sometimes only implicitly acknowledged. Reliance on such rules entails belief that they work in most cases. But it also leads one to view certain facts as departures from general rules, a prerequisite for a why-question to arise. This prerequisite then is often satisfied under circumstances that surprise or that at least provide the grounds for a plausible argument for a contrary of a presupposition (the argument whose lawlike premise is the false general rule). As counterexamples show, such circumstances, although frequent, are not essential, and they do not provide the key to the nature of why-questions. Here too, an interesting problem for philosophers of science comes up. A clear mark of scientific genius is the ability to see certain well-known facts as departures from general rules that may have no actual instances, but that *could* have had some, and the germane ability to ask why-questions that occur to no one else. This way of looking at things can sometimes yield important insights, but it is also sometimes simply foolish. Is the difference analyzable in logical categories, or is it fundamentally a matter of psychology or perhaps theology?

Another view frequently held about why-questions—particularly about

why-questions with negative presuppositions—is that the answer must describe the absence of a necessary condition for the contrary of the presupposition. This is not far from the truth for many cases to which these notions are easily applied, but it is an oversimplification, even for those cases. In the typical cases, the answer must describe the absence of (or at least something incompatible with) not merely *any* necessary condition for the contrary of the presupposition, but of a necessary condition belonging to a set (1) only one of whose members can be false, (2) each of whose members is necessary, and (3) all of whose members are jointly sufficient for that contrary. This follows from the definition of abnormic law. This is easily seen by looking at the propositional structure of instantiated special abnormic laws. A typical structure is

$$Ya \supset : Xa \equiv . Aa \vee Ba \vee Ca \qquad (1)$$

where "$Ya \supset - Xa$" is the propositional structure of the instantiated general rule, "Xa" is the presupposition, and the answer must be one of the disjuncts to the right of the biconditional. Typically, when (1) is true, so is

$$Xa \equiv . Aa \vee Ba \vee Ca \qquad (2)$$

("Ya" being the premise that together with the general rule leads to a contrary of the presupposition) and so then is

$$-Xa \equiv : -Aa \cdot -Ba \cdot -Ca \qquad (3)$$

This shows that the answer ("Aa" or "Ba" or "Ca") describes the absence of a necessary condition("$-Aa$" or "$-Ba$" or "$-Ca$") for the contrary of the presupposition. (Throughout we follow the practice of using "contrary" to mean "contrary or contradictory.")

Condition (b) in the definition of an abnormic law requires that the disjuncts in (1) be mutually exclusive—i.e., that if one of the conjuncts in (3) is false, the others must be true. (3) by itself requires that these conjuncts be jointly sufficient for "$-Xa$."

We can test this consequence against an idealized, concrete instance. Two switches, A and B, are in series in a circuit so that current flows if and only if both switches are closed. Current is not flowing and both switches are open. Why is the current not flowing? Because both A and B are open. It would be misleading to say "Because A is open," although it is true and although it mentions the absence of a necessary condition for the contrary of the presupposition, and similarly for "Because B is open." Either of these replies *in this context* would imply that the other switch is closed. The possible answers, then, are: *A is open although B is closed; B is open although A is closed; A and B are both open.* These are mutually exclusive. The negations are: *either A is closed or B is open; either B is closed or A is open; either A or B is closed.* But this is a set of conditions for the contrary of the presupposition (1) only one of whose members can be false, (2) each of whose members is necessary, (3) all of whose members are jointly sufficient.

We can now understand the function and form of the why-should questions mentioned in section VI. "Why is the current flowing?" "Why shouldn't it be flowing?" They are designed not only to bring out grounds for believing that the original why-question has an answer, but also to narrow down the area within which the answer is expected. They do this by asking what necessary conditions for the contrary of the presupposition *are satisfied,* what necessary conditions belong to a set of jointly sufficient conditions only one of which is presumably false.[16] The answer wanted for the original why-question is thereby defined since it must negate the one remaining condition. Why-should questions take on the force of a challenge when there is reason to doubt that only one condition is missing. On the other hand why-should questions need not have an answer when a necessary and sufficient condition for the presupposition of the why-question is expected—i.e., in cases where (1) has only one disjunct or (3) has only one conjunct.

We must now turn to the examples cited in section V against the Hempelian doctrine. How do they fail as answers to why-questions? Let us look at a simple but typical member of the family. The telephone post at the corner of Elm Street is forty-feet high. Its top is connected by a taut wire to a point thirty feet from its foot. The length of the wire is fifty feet. Why is the pole forty-feet high? According to one interpretation of the Hempelian doctrine, an answer should be available that is made up of the facts about the wire, since the height can be deduced from these facts and laws of physical geometry. There would be an answer made up that way according to our analysis if it were an abnormic law that no pole is forty-feet high unless a taut fifty-foot-long wire connects its top to a point thirty feet from its foot. But there is no such law. Fifty-foot-high poles may have no wires attached to them, and they may also have wires attached to them that are of a different length and connect to a different point on the ground. If we extend the clause after "unless" with disjunctions that include the cases with other wires and with no wires, we will still not end up with an abnormic law; some of the disjuncts will not be mutually exclusive and, furthermore, the law will remain a law if all the disjuncts except that pertaining to the case of no wires are dropped.

There would also be an answer made up of the facts about the wire according to our analysis if it were a law that no pole is forty-feet high unless, if there is a taut wire connecting the top to a point on the ground and the wire is fifty-feet long, then the point on the ground is thirty feet from the foot. But there is no such law. If there were, it would entail that every pole to which no wire is attached must be forty-feet high!

However, the following is a law: No pole whose top is connected to a point on the ground by a wire that is fifty-feet long is itself forty-feet high unless that point on the ground is thirty feet from the foot of the pole. Still, it does not meet the requirements of the analysis. According to (4) on p. 94, in the description of the relation, the general rule completed by the abnormic law must not be such that by dropping one or more of the conjuncts in the antecedent a new general rule is obtained that can also be completed by an abnormic law. But the above abnormic law violates that condition. We know enough about poles to be confident that there is an abnormic law of the form "No pole is forty-feet high unless. . . ."

All the cases cited against the Hempelian doctrine will fail for similar reasons. Just as we are confident that there are laws according to which poles will be forty-feet high regardless of whether wires are attached to them, so there must be laws according to which the Empire State Building will have the height it has even in total darkness, the distance to the Andromedan Galaxy would be what it is even if no light traveled to us from it, the rate of flow of water into the bathtub would be what it is whether or not measured, Gargantua would be more than six feet tall even if he had not gone to the beach.[17]

The very same sorts of considerations, it may be worth noting, will account for certain asymmetries that have puzzled some philosophers. From the laws of the simple pendulum and the length of a piece of string at the end of which a bob is hanging and local free-fall acceleration, one can deduce the period with which that bob is oscillating. From the same law and data about local free-fall acceleration and the period with which the bob is oscillating, one can deduce its length. Yet a statement of the length is an answer to "Why does the bob oscillate with such and such a period?" whereas a statement of the period of oscillation is not an answer to "Why is the length of the string at the end of which the bob *is* hanging so many inches long?" The asymmetry is traceable, in a manner exactly similar to the previous reasoning, to the fact that whereas the period would not have been what it is if the length had not been what it is, the length would have been what it is whether the bob had been oscillating or not.

Condition (4) may seem at first blush somewhat arbitrary. A little reflection will bring out, however, that it corresponds to a generally acknowledged and reasonable norm. It demands on the one hand that the answer be a consequence of the most general abnormic law[18] available, and it demands on the other hand that questions of the form "Why is this A a C?" not be given answers that are really designed for "Why is this AB a C?"

It may seem odd that abnormic laws should be associated with a special interrogative. But they are, after all, the form in which many common-sense generalizations that have been qualified through the ages are put. They are also a form of law appropriate to stages of exploratory theoretical developments when general rules are tried, then amended, until finally completely replaced. We are always at such a stage.

NOTES

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1. J. O. Urmson, "Parenthetical Verbs," reprinted in *Essays in Conceptual Analysis*, ed. A. Flew (London, 1956), p. 192. (3) eliminates from our discussion questions designed to ask for an opinion rather than a fact. Thus, it eliminates, e.g., "Why do you think that nail biting is a symptom of anxiety neurosis?" in the sense of "Why, in your opinion, is nail biting a symptom of anxiety neurosis?" although not in the sense of "Why do you hold the belief that nail biting *is* a symptom of anxiety neurosis?"
2. A little care is needed in using the notions introduced here. A given why-question can often be put in more than one normal form, some of which will be ambiguous. This is particularly true of those that may be put in interrogative sentences with token reflexive expressions (e.g., "Why is your temperature above normal?" as put to Henry and "Why is Henry's temperature above normal?" as put to his doctor). Whenever this is the case, the inner question can also be ambiguous. We must therefore always think of the inner question as put under circumstances that give ambiguous expressions the same disambiguation given to them in the mother question.

   We could have introduced the notion of presupposition by availing ourselves of some grammatical devices, e.g., the presupposition is what one would be saying is the case by asserting the sentence whose underlying structure preceded by a Why morpheme yields the why-question (or at least the interrogative

sentence) when subjected to the Question Transformation. But we wish to avoid complicating the exposition beyond necessity or involving ourselves in grammatical issues that are still in flux. See in this connection particularly section 4.2.4 of Jerrold J. Katz and Paul M. Postal, *An Integrated Theory of Linguistic Descriptions* (Cambridge: The Massachusetts Institute of Technology Press, 1964). Note that what we call the presupposition of a why-question does not turn out to be what they call the presupposition of a why-question.

3. It is not clear whether there are such questions—i.e., whether, for example, answers of the form "in order to . . ." cannot always be replaced without loss of meaning by answers of the form "because (subject) wished to . . . ," and similarly for the other types of answer. The issues involved here are extremely interesting but not central for this paper.
4. *Cf.* sec. VIII.
5. As should be clear by now, "correct answer" must be understood in a narrow sense. "Correct answer to Q" (where *Q* is a question) covers a possible reply to *Q* if and only if a statement of the form "A told B W" (where *W* indicates a position occupied by the *oratio obliqua* form of *Q*, and *A* and *B* indicate positions occupied by expressions through which persons are mentioned) would be true of any episode in which that reply had been given by *A* to *B* in response to *Q*. "Correct answer," therefore, does not cover such possibly warranted replies as "I don't know" or "The question involves a false presupposition."
6. See Note 14 below.
7. The literature abounds with discussions that are weakened by a failure to see all these possibilities. A classical example will be found in Pt. I of Pierre Duhem, *La Theorie Physique* (Paris, 1914) in which it is argued that the object of a physical theory is not to explain a set of empirical laws. However, "explain" is construed in effect to mean giving the answers to questions of the form "What fundamental entities involved in what processes and governed by what laws underlie . . . ?" As a consequence, Duhem did not examine a number of other types of explanations that one might plausibly assign to theoretical physics.

   The notion of presupposition used in this section is broader than that defined in section I, since it also pertains to questions that are not why-questions. No analysis of this broader notion is needed for this paper. Note 14 may suggest the line that such an analysis might follow since it provides an instance of the schematisms to be generalized. It should be obvious to anyone who bothers to seek out the suggestion that it would be premature to attempt the analysis given the present state of our understanding of other types of questions. In this connection see again J. J. Katz and P. M. Postal, op. cit.
8. Some of the ideas in this section have been discussed in greater detail but at too great a length in my "An Approach to Explanation," in *Analytical Philosophy*, 2d Ser., ed. R. J. Butler (Oxford: Basil Blackwell, 1965) and in my "A Theory About the Theory of Theory and About the Theory of Theories" in *Philosophy of Science: The Delaware Seminar*, II, ed. Bernard Baumrin (New York: Interscience Publishers, 1963).
9. A complete bibliography on the subject probably appears in Carl G. Hempel, *Aspects of Scientific Explanation* (New York: The Free Press, 1965), which I have unfortunately not yet seen as this essay is being written. Otherwise, consult, e.g., the bibliography at the end of Hempel's magnificent "Deductive-Nomological vs. Statistical Explanation" in *Minnesota Studies in the Philosophy of Science*, III, eds. H. Feigl and G. Maxwell (Minneapolis: U. of Minnesota Press, 1962); Pt. I of Israel Scheffler, *The Anatomy of Inquiry* (New York: Knopf, 1963); Chap. 9 of Adolf Grünbaum, *Philosophical Problems of Space and Time* (New York: Knopf, 1963); and *Philosophy of Science: The Delaware Seminar*, I, Pt. II; II, Pt. I.

10. See Note 14 below.
11. See particularly R. Eberle, D. Kaplan, and P. Montague, "Hempel and Oppenheim on Explanation," *Philosophy of Science*, 28 (1961), 418–28; D. Kaplan, "Explanation Revisited," *Philosophy of Science*, 28, 429–36; and J. Kim, "Discussion on the Logical Conditions of Deductive Explanation," *Philosophy of Science*, 30 (1963), 286–91.
12. Since every special abnormic law is also a general abnormic law, we could have dispensed with one of these two notions but not without complicating the exposition.
13. A "zero-adic" predicate will occur if, for instance, a position indicated in one of our schemata by a predicate letter and variable bound to an initial quantifier is replaced by a sentence with no free variables—i.e., with no variable bound to the initial quantifier. Abnormic laws with occurrences of such internal closed sentences are required for why-questions whose presupposition or answer are expressed by closed sentences, as is the case when they are laws.
14. We asked that this relation abstract from the peculiarities of English and be capable of serving as the basis of a definition of the notion of Why-questions, a type of question in every respect like why-questions except that they need not be expressed in English. To satisfy ourselves that it meets these demands we will sketch a more formal analysis that clearly uses only the vocabulary of predicate-cum-identity logic and language-independent predicates, and we will then use the relation to define the notion of Why-questions within the same limits. The analysis will be somewhat crude, its only function being to exhibit language independence. It will suffer in at least the following respects. (1) The second half of condition (1) and condition (4) are not incorporated on the ground that it seems obvious that their incorporation can be accomplished without introducing language-dependent concepts but would complicate matters beyond the point of diminishing returns. (2) We assume without argument that any language rich enough for the purposes of science includes sentences with the logical structure of abnormic laws. This, we believe, involves no more than the assumption that such a language must possess the equivalent of truth-functional connectives, quantifiers, and lawlikeness. (3) We assume without argument that if a set of sentences implies some conclusion in one language, then any set of sentences that expresses the same thing in another language must imply any sentence that expresses the same conclusion in that language—i.e., that although logic may be reflected by syntax, it is nevertheless independent of it. (4) We assume without argument—although not without qualms—that interrogative sentences of different languages may express the same question, that declarative sentences of different languages may express the same proposition, and that one may use a relational term to speak of a sentence and of what it expresses. It seems, however, that ontologically sounder rephrasings cannot introduce language-dependent elements. (5) We assume without argument that any language rich enough for the purposes of science will contain interrogative as well as declarative sentences; that it will also have methods for transforming declarative sentences into interrogative ones; that furthermore all the answers to all the questions generated by some of these methods must stand in a characteristic relation to the transformed sentence.

    We will list a lexicon of language-independent predicates and will then define others in terms of these. Two things ought to be noted. First, we do not assume that being abnormic is a property of laws but assume rather that it is a

property of certain sentences that express laws. Thus, certain laws may be expressible as abnormic lawlike statements in some languages but not in other languages, depending on the lexicon of each. Second, let us call the relation between presupposition and answer described above the *W*-relation. We do not assume that *any* question whose presupposition and correct answer, if any, stand in the *W*-relation is a why-question. Instead, we make allowance for the fact that the *W*-relation need not exclude relations characteristic of other questions (see particularly the definition of "TW" below in this connection).

To simplify the reading, we use numerals as free variables.

Initial lexicon:

L_1	1 is an empirical law.
F_1	1 is a fact.
E_{123}	1 expresses 2 in 3 and 3 is a language.
A_{12}	1 is an abnormic lawlike sentence of 2 and 2 is a language.
G_{12}	1 is a lawlike general rule in 2 and 2 is a language.
C_{123}	1 is a completion of 2, both being sentences in 3 and 3 is a language.
H_{1234}	1 is a deduction whose conclusion is 3 and one of whose premises is 2, all of whose premises are necessary for the conclusion, 2 is a lawlike sentence, all the premises and conclusion being in 4, 4 is a language.
P_{12}	1 is an argument and 2 is a premise of 1.
T_{1234}	1 is a method of generating (transformation) 2 from 3 in 4 and 2 is an interrogative sentence and 3 is a declarative sentence, 2 and 3 being sentences in 4 and 4 is a language.
R_{123}	1 is an interrogative sentence, 2 expresses a correct answer in 3 to the question expressed in 3 by 1 and 3 is a language.
N_{123}	1 expresses in 3 a contrary of what is expressed by 2 in 3 and 3 is a language.

Defined terms:

"LA_{123}" = "$L_1.A_{23}.E_{213}$"
(1 is an empirical law expressed as an abnormic law by 2 in 3)
"GE_{123}" = "$-F_1.G_{23}.E_{213}$"
(2 is a false general rule expressing 1 in 3)
"FA_{123}" = "$F_1.E_{213}$"
(1 is a fact expressed by 2 in 3)
"W_{123}" = "$(\exists s)(\exists t)(\exists u)(\exists v)(\exists w)(\exists x)(\exists y)$
$[LAst_3.GEuv_3.Ctv_3.Hwvx_3.Nx_{13}.Hyt_{13}.(p)(\exists z)(Pwp.$
$p \neq y : \supset : Pyp.Fzp_3).(q)(Pyq. -Pwq.q \neq t : \equiv . q = 2)]$"
(1 and 2 stand in 3 in the relation in which the presupposition and the answer of a why-question stand in English, i.e., the *W*-relation).
"TW_{12}" = "$(x)(y)\ [(\exists z)(T_{1zx_2}.Ryz) \equiv Wxy_2]$"
(1 is a method in 2—2 being a language—of generating questions whose presupposition and answers are *W*-related.)
"VY_{123}" = "$(\exists m)(TWm_3.Tm_{123})$"
(1 has been generated out of 2 by a method of generating Why-questions in 3—i.e., 1 expresses a Why-question in 3 whose presupposition is expressed by 2 in 3.)
"WY_{12}" = "$(x)(y)(z)(Ey_{1x}.Ez_{2x} :\equiv VYyzx)$"
(1 is a Why-question whose presupposition is 2)
"WHY_1" = "$(\ x)WY_{1x}$"
(1 is a Why-question)

We can follow the same procedure to define *H*-Why-Questions—i.e., questions calling for deductive nomological explanations.
"HW_{123}" = "$(\exists x)(z)(\supset y)(Gx_3.H_{2x_{13}}:P_{2z} \supset FAyz_3)$"
(1 and 2 stand in the *H*-*W*-relation)
"THW_{12}" = "$(x)(y)\ [(\exists z)(T_{1zx_2}.Ryz) \equiv HWxy_2]$"
"HVY_{123}" = "$(\exists m)(THWm_3.Tm_{123})$"
"HWY_{12}" = "$(x)(y)(z)(Ey_{1x}.Ez_{2x}:\equiv HVYyzx)$"
"$HWHY_1$" = "$(\exists x)\ HWY_{1x}$"
(1 calls for a Hempelian explanation.)

15. Carl G. Hempel, "The Logic of Functional Analysis," *Symposium on Sociological Theory*, ed. Llewellyn Gross (Evanston, Ill.: Peterson, 1959), p. 272.
16. Such a request obviously need not be met with an actual listing of conditions. The set can be indicated in many other ways—e.g., by pointing to other cases that seem in all relevant respects like those of the presupposition, but of which the predicate of the presupposition is not true.
17. We can cope with these cases in a different way. Instead of individuating why-questions by their presupposition, as we have done so far, we individuate them by an ordered pair consisting of their presupposition and a false general rule. Thus distinct why-questions can now share the same presupposition. We restate the characteristic relation of why-questions as follows: *b* is the correct answer to a why-question whose presupposition is *a* and whose general rule is *g* if and only if (1) there is an abnormic law *L* that is a completion of *g*, and *a* is an instantiation of one of *L's* antonymic predicates; (2) *b* is a member of a set of premises that together with *L* constitute a deductive nomological explanation whose conclusion is *a;* (3) the remaining premises together with *g* constitute a deduction in every respect like a deductive nomological explanation except for a false lawlike premise and false conclusion, whose conclusion is a contrary of *a*. We eliminate (4) on p. 100. Instead of appealing to it in analyzing the failure of the counter-examples to the Hempelian doctrine (when these examples are reconstructed to include true abnormic laws), we construe the failure as that of not containing the answer to the why-question most reasonably inferred from context and general background. This is compatible with the possibility that the examples contain the answer to *some* why-question with the given presupposition. The failure is nevertheless fatal. Note that this approach still allows for why-questions—even under this new individuation—that have more than one correct answer.

    There is much to be said for this approach. It conforms to many of our practices. It does justice to our intuition that why-questions are governed not only by presuppositions but also by presumptions. It avoids certain difficulties with the argument in the text. However, it introduces certain pragmatic issues that we prefer to delay as long as possible.
18. For a discussion of a similar demand in connection with something the author calls "scientific understanding" (a notion whose relevance to the topic of why-questions, we confess, is not clear to us), *cf.* p. 310 of A. Grünbaum's *Philosophical Problems of Space and Time* or p. 93 of *Philosophy of Science: The Delaware Seminar*, I.