THE SEMANTICS OF QUESTIONS AND THE THEORY OF INQUIRY*

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I

The view that questions are imperatives of a certain kind seems to be generally accepted. One of the first philosophers who held this view was Charles S. Peirce. In his discussion of what he calls the "immediate" interpretant (or meaning) of a sign, Peirce notes that interrogative signs are included among the imperative ones. ([1]) This view is also the basis of many semantical theories of questions developed in recent years. Questions are requests for information, and requests are imperatives of a special kind.

But what exactly is requested by means of a question? According to the account given by the Swedish philosopher Lennart Aqvist in his book *A New Approach to the Logical Theory of Interrogatives* and a number of other publications, ([2]) questions are *epistemic requests*: thus, accord-

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([1]) See *The Collected Papers of Charles Sanders Peirce*, Vol. 8, ed. by Arthur W. Burks, Harvard University Press, Cambridge, Mass. 1958, Paragraph 8.369. In the sequel I shall refer to this work in the usual way by paragraph numbers, as above, and use the abbreviation '*CP*'.

([2]) Lennart ÅQVIST, *A New Approach to the Logical Theory of Interrogatives, Part I: Analysis*, Filosofiska föreningen i Uppsala, Uppsala 1965; 'On the Analysis and Logic of Questions', in *Contemporary Philosophy in Scandinavia*, ed. by R. E. Olson and A. Paul, The Johns Hopkins Press, Baltimore and London 1972, pp. 27-39.

ing to Åqvist's imperative-epistemic analysis of questions, a simple yes-no question "Is it raining?" can be analysed as follows:

(1) Let it be the case that I know that it is raining or I know that it is not raining. ([3])

To make this analysis more explicit and transparent, let us assume that a question is presented by a questioner a to an addressee b. The question is a request directed to b; if such a request is expressed briefly by 'I_b' and a's knowing that p is expressed by '$K_a p$', (1) can be expressed as follows:

(2) $I_b(K_a p \vee K_a \sim p)$,

where 'p' is short for "It is raining" and '$\sim$' is the negation sign. According to this analysis, what is requested by means of a question is not merely a certain information, but rather that a certain information be known to the questioner. Jaakko Hintikka has presented an essentially similar account of the semantics of questions, and I shall therefore call it below "the Åqvist-Hintikka semantics". ([4]) This analysis can be articulated further: a request directed to an addressee is necessarily a request that the addressee *do* something; thus the imperative (2) cannot simply require that the questioner knows something, but rather that the addressee b should make p or $\sim p$ known to a, or that the addressee should bring it about that the questioner knows that p. The directive operator 'I_b' in (2) can thus be analysed by means of an impersonal imperative operator 'I' and an action operator 'D_b' as follows:

(3) $ID_b(K_a p \vee K_a \sim p)$,

where 'I' is simply an expression for the imperative mood and 'D_b' may be read 'b brings it about that' or 'b sees to it that'. ([5]) The proposition

([3]) See Lennart ÅQVIST, 'On the Analysis and Logic of Questions', p. 27.

([4]) See Jaakko HINTIKKA, 'Questions about Questions', in *Semantics and Philosophy*, ed. by M. K. Munitz and P. K. Unger, New York University Press, New York 1974, pp. 103-158; *The Semantics of Questions and the Questions of Semantics*. Acta Philosophica Fennica 28:4, North-Holland, Amsterdam 1976; 'Answers to Questions', in *Questions*, ed. by Henry Hiz, D. Reidel, Dordrecht 1975, pp. 279-300; 'New Foundations for a Theory of Questions and Answers', in *Questions and Answers*, D. Reidel, Dordrecht 1983, pp. 159-190.

([5]) The logic of the action operator 'D_b' has been discussed by Risto HILPINEN in 'On the Semantics of Personal Directives', *Semantics and Communication*, ed. by C. H. Heidrich, North-Holland, Amsterdam 1974, pp. 162-179, and by Ingmar Pörn, *Action Theory and Social Science: Some Formal Models*, D. Reidel, Dordrecht 1977, Ch. 1.

in the scope of the action operator may be called the *desideratum* of the question: it is a description of the state which the questioner wishes to achieve by means of the question. (6) (Lennart Åqvist calls the desideratum the "core" of the question; below I shall use the former expression. (7) The deletion of (all occurrences of) the epistemic K-operator from the desideratum gives us what is called the *presupposition* of the question: it is possible to give a satisfactory answer to a question, that is, bring about the required state of knowledge, only if its presupposition is true. (8) (This follows from the fact that the concept of knowledge has "success grammar", that is, it is possible to know only what is the case.) The presupposition of (3) is a tautology, but (for example) a simple wh-question

(4) Who killed Julius Caesar?

has a nontautological presupposition, "Someone killed Julius Caesar". (9)

As some critics have pointed out, this analysis requires refinement and qualification. For example, it can be shown to lead to paradoxical results unless special assumptions are made about the interpretation of the imperative operator and the action operator in (3). Thus Jaakko Hintikka has observed that the force of these operators should be regarded as relative to the presupposition of the question, viz. 'ID_b' should be read as "Assuming that the presupposition of the question is satisfied, bring it about that...". Moreover, the action requested by (3) is of a special kind: it should change the epistemic state of the questioner, but not the world (or part of reality) the question pertains to. (10) I shall not discuss these qualifications in detail in this paper. On the other hand, the Åqvist-Hintikka analysis has also been criticized on the ground that it is inapplicable to some questioning situations: it has been argued that questions cannot always be regarded as epistemic requests in the sense of the

(6) See Jaakko HINTIKKA, 'Questions about Questions', p. 104; *The Semantics of Questions and the Questions of Semantics*, p. 22.

(7) Lennart ÅQVIST, *A New Approach to the Logical Theory of Interrogatives, Part I: Analysis*, p. 61.

(8) Jaakko HINTIKKA, *The Semantics of Questions and the Questions of Semantics*, p. 27.

(9) For wh-questions, see Jaakko HINTIKKA *The Semantics of Questions of Semantics*, Ch. 4.

(10) Jaakko HINTIKKA, 'New Foundations for a Theory of Questions and Answers', p. 175.

Åqvist-Hintikka semantics. For example, the purpose of an *examination question* is to find out whether the addressee knows something, not to make the information known to the questioner. (The questioner should already know the correct answer.) Thus (3) is not a correct analysis of an examination situation. Åqvist has suggested that (3) can be modified to cover examination questions by taking the *desideratum* of such questions to be([11])

$$(5) \qquad K_a K_b p \vee K_a \sim K_b p$$

instead of the simple '$K_a p \vee K_a \sim p$'. This seems plausible, but David and Stephanie Lewis have pointed out that this suggestion is not helpful in the case of certain interrogation situations in which both the questioner and the addressee already know that p, and both know that the other knows that p, and so on, and the sole purpose of the interrogation is to make the addressee confess something, that is, *assert* that p *(or* $\sim p$), rather than to bring about any change in the questioner's state of knowledge.([12]) David and Stephanie Lewis have also suggested that sometimes an addressee can give what seems a perfectly satisfactory answer to a question without bringing about the state required by (5) simply because the questioner is a very skeptical and suspicious person.([13]) Lewis and Lewis agree with Åqvist that questions are requests or imperatives, but what is requested is that the addressee should *tell something truly* to the questioner (give the questioner truthful information); whether this is accompanied by any change in the questioner's state of knowledge is a contingent matter.([14]) Lewis and Lewis take questions to be *linguistic* rather that epistemic requests. A similar view of questions has been put forward earlier by Nuel Belnap.([15]) According to this *imperative-assertoric* analysis of questions, a yes-no question whether p may be formulated as follows:

([11]) Lennart ÅQVIST, 'Scattered Topics in Interrogative Logic', in *Philosophical Logic*, ed. by J. W. Davis *et. al.*, D. Reidel, Dordrecht 1969, pp. 114-121, cf. p. 120.

([12]) David LEWIS and Stephanie LEWIS, Review of *Contemporary Philosophy in Scandinavia*, *Theoria* 41 (1975), pp. 39-60; see pp. 48-51.

([13]) *Ibid.*, p. 51.

([14]) *Ibid.*, p. 49.

([15]) Nuel BELNAP, 'An Analysis of Questions: Preliminary Report', Technical Memorandum 7 1287 1000/00, Systems Development Corp., Santa Monica, Ca. 1983.

(6) Let it be the case that either p and you tell me that p, or not-p and you tell me that not-p, ([16])

in other words, if 'As_b' is an assertion operator,

$$(6') \quad I_b((p \,\&\, As_b p) \vee (\sim p \,\&\, As_b \sim p)),$$

which is easily seen to be equivalent to

$$(6'') \quad I_b((p \rightarrow As_b) \,\&\, (\sim p \rightarrow As_b \sim p)),$$

where 'I_b' stands for an imperative directed to b. (6′′) says that if p is true, b should assert that p, and if p is false, b should assert that not-p. This analysis is subject to similar qualifications as the Åqvist-Hintikka analysis; for example, the imperative operator 'I_b' concerns only b's possible assertion, not the state of affairs p. Moreover, b is allowed to assert only either p or $\sim p$, but not both.

The Åqvist-Hintikka semantics does not seem to be applicable to all questioning situations, but mainly to cases in which the questioner's objective is to obtain new information from the addressee, that is, to genuine information-seeking questions. ([17]) *Research questions* provide a good example of genuine information-seeking questions. According to the common-sense view of science, the principal aim of inquiry is to remove ignorance and provide satisfactory answers to the questions in which the investigators are interested. It is obvious that research questions are not merely linguistic requests, but epistemic requests: a satisfactory answer to a research question should be known to be true or at least something which can be reasonably believed to be the case. In this context the epistemic operators of the Åqvist-Hintikka theory are indispensable.

Charles Peirce notes that the distinction between a question and an assertion is parallel to that between *doubt* and *belief*. ([18]) Thus Peirce's well-known distinction between "paper doubt" and genuine or "living

([16]) LEWIS and LEWIS, *op. cit.*, p. 50.

([17]) Jaakko HINTIKKA has argued, however, that the definition of a *conclusive* (or complete) answer involves epistemic conditions in other contexts as well, and the applicability of the imperative-epistemic semantics is therefore not restricted to genuine research questions (or information-seeking questions). See Jaakko Hintikka, 'New Foundations for a Theory of Questions and Answers', pp. 183-187.

([18]) *The Collected Papers of Charles Sanders Peirce*, Vol. 7, ed. by Arthur W. Burks, Harvard University Press, Cambridge, Mass. 1958; 7.313.

doubt" entails a similar distinction between spurious and genuine questions. ([19]) According to Peirce, a genuine or serious interrogation (a research question) involves ([20])

> first, a sense that we do not know something; second, a desire to know it; and third, an effort – implying a willingness to labor – for the sake of seeing how the truth may really be.

Manfred Moritz refers to a distinction between genuine questions and spurious questions in his paper 'Zur Logik der Frage', published in 1940 ("unechte und echte Fragen"), and notes that both examination questions and rhetorical questions can be regarded as spurious questions, because in these cases the questioner already knows the correct answer. ([21]) According to this traditional view, the Åqvist-Hintikka analysis is an account of genuine or real questions, but it need not be applicable without qualification to situations in which the questioner feigns ignorance about various matters, and requests information which is already in his possession.

This analysis provides a good general framework for the theory of inquiry, and several philosophers – especially Jaakko Hintikka himself – have recently done interesting work in this area. ([22]) Below I shall discuss

([19]) *The Collected Papers of Charles Sanders Peirce*, Vol. 5, ed. by C. Hartshorne and P. Weiss, Harvard University Press, Cambridge, Mass. 1934, 5.416.

([20]) *CP*, 5.584.

([21]) *Theoria* 6 (1940), pp. 123-149, see p. 125. This was a common view in the semantical discussions on questions at the turn of the century; a question was usually regarded as an expression of a wish to know something ("Wissensbegehren"). Cf. Alexius Meinong, 'Über emotionale Präsentation', in *Alexius Meinong Gesamtausgabe*, Vol. 3, ed. by R. Haller and R. Kindinger, p. 98. Lennart Åqvist expresses the distinction between genuine and spurious questions by speaking about "primary" and "secondary" (or "parasitical") *uses* of the interrogative mood; he mentions that the expression "parasitical use" is due to Ingemar Hedenius. See *A New Approach to the Logical Theory of Interrogatives*, Ch. II, Sect. 7 (p. 46). The distinction between primary and secondary questions made in the present paper (see Sections III and IV below) is completely different from Åqvist's distinction.

([22]) See Jaakko HINTIKKA, 'On the Logic of an Interrogative Model of Scientific Inquiry', *Synthese* 47 (1981), pp. 69-83, and other papers published in the same issue of *Synthese*. See also Jaakko Hintikka, 'The Logic of Science as Model-Oriented Logic', in *PSA 1984*, ed. by Peter Asquith and Phillip Kitcher, Philosophy of Science Association, East Lansing, Mi, 1984, pp. 177-185; 'Sherlock Holmes Formalized', in *The Sign of Three*, ed. by Umberto Eco and Thomas Sebeok, Indiana University Press, Bloomington 1983, pp. 170-178, and Stephen Gale, 'A Prolegomenon to an Interrogative Theory of Scientific Inquiry', in *Questions*, ed. by Henry Hiz, pp. 319-345, and the references given in the last-mentioned paper.

the relevance of the Åqvist-Hintikka semantics to the theory of inquiry, in particular, the interpretation of the epistemic K-operator in this context.

II

In this paper I take an inquiry to be a process by which a belief system (a system of accepted propositions) which is in some respect unsatisfactory is modified and transformed into a new system. If the inquiry is successful, the resulting system is less unsatisfactory than the originel system.

How does one evaluate a belief system: what does it mean to say that a system is "satisfactory" or "unsatisfactory"? This depends of course on the objectives which belief systems should serve. Many philosophers have assumed that apart from the various practical objectives of belief formation, belief systems are subject to two principal cognitive requirements, viz.

(i) the requirement of informational completeness, and
(ii) the requirement of error avoidance.

These two objectives were described by William James in his well-known essay 'The Will to Believe' as follows: ([23])

> We must know the truth; and we must avoid error, – these are the first and great commandments as would-be knowers, but they are not two ways of stating an identical commandment; they are two separable laws.

Many philosophers have spoken in this context about "epistemic utilities" or "epistemic values". ([24]) The first objective, informational completeness, reflects the epistemic or cognitive value of information; the second objective, error avoidance, that of truth. ([25])

([23]) William JAMES, 'The Will to Believe', in *The Will to Believe and Other Essays*, Longmans Green and Co., London 1897, p. 17.

([24]) The expression "epistemic utility" seems to be due to Carl G. HEMPEL; see his 'Inductive Inconsistencies', *Synthese* 12 (1960), pp. 439-469; reprinted in *Aspects of Scientific Explanation*, Collier-Macmillan Ltd., London 1965.

([25]) For a discussion of truth and information as epistemic utilities, see Risto HILPINEN, 'Decision-Theoretic Approaches to Rules of Acceptance', in *Contemporary Philosophy in Scandinavia*, ed. by R. Olson and A. Paul, pp. 147-168; and Isaac Levi, *The Enterprise of Knowledge*, MIT Press, Cambridge, Mass. and London 1980, Ch. 2.

The evaluation of a belief system in these respects is relative to the questions or problems in which an investigator is interested. This is obvious in the case of informational completeness: all potential belief systems are logically speaking incomplete, and the evaluation of their informativeness depends on the cognitive interests of the investigator – on the problems which interest him. Nicholas Rescher has spoken in this context about question-answering completeness or *erotetic completeness* (*Q*-completeness): according to Rescher, a belief system B_a (a set of propositions accepted by *a*) is *Q*-complete (erotetically complete) if and only if it contains complete answers to all the questions which can be asked on the basis of B_a, that is, whose presuppositions are satisfied in B_a. ([26]) (The concept of a *complete answer to a question* is here taken as given; I shall not try to analyse it here.) The concept of *Q*-completeness can be relativised to a set of questions *QS* as follows: A belief system B_a is complete with respect to a set of questions *QS* if and only if it contains an answer to every question *Q* in *QS* whose presuppositions are satisfied in B_a.

The truthfulness or error-freedom of a belief system can be relativised to a set of questions in an analogous way. Inconsistency is the main indication of error in a belief system. Because of the general fallibility of our beliefs, it seems reasonable to assume that even the most rational belief system may contain some false beliefs. But if we include in a given belief system a proposition to the effect that some beliefs in the system are false, the system becomes inconsistent, and this kind of inconsistency and error in the system is not likely to be removed by any process of inquiry. Thus even the most reasonable (human) belief systems may be inconsistent, and therefore unsatisfactory from the standpoint of absolute error avoidance. ([27]) (I am assuming here that belief systems are not generally logically closed.)

But this kind of inconsistency need not affect the ability of the system to provide consistent and seemingly error-free answers to the questions in which an investigator is interested. The concept of *apparent error-freedom relative to a set of questions* can be defined as follows:

([26]) Nicholas RESCHER, *The Limits of Science*, University of California Press, Berkeley 1984, pp. 31-32.

([27]) Cf. Frank P. RAMSEY, 'Knowledge', in F. P. Ramsey, *The Foundations of Mathematics and Other Logical Essays*, ed. by R. B.Braithwaite, Routledge and Kegan Paul, London 1931, pp. 258-259. This "paradox" is analogous to the "Preface Paradox" discussed by David Makinson in 'The Paradox of the Preface', *Analysis* 25 (1964), pp. 205-207.

(7) A system B_a is apparently error-free with respect to a set of questions $QS = \{Q_1,...,Q_n\}$ if and only if B_a does not give inconsistent answers to any question Q_i in QS.

The well-known lottery paradox can serve as an example of this possibility. Consider a fair lottery with 1000 lottery tickets numbered 000,...,999, in which one of the tickets will win, and let q_i be the proposition that ticket No. i will win. For each ticket i, it seems reasonable to accept the proposition that ticket No. i will *not* win, that is, accept each $\sim q_i$ (i = 000,...,999), but it is also reasonable to accept the proposition that one of the tickets will win, that is, accept the disjunction $q_{000} \vee ... \vee q_{999}$. The belief system obtained in this way is logically inconsistent, but apparently error-free with respect to the set of questions QS = {..., Does ticket No. i win?,..., Does one of the tickets win?}. ([28])

The error-freedom of a system of beliefs is relative to questions in another way as well. Above error-freedom was treated as an absolute concept, but in many cases it seems possible to speak about the *degree of error* (or degree of falsity) of a proposition or a set of propositions, and make comparisons between different propositions in this respect. In special cases it may even be possible to measure the *distance* of a proposition from the truth. ([29]) This concept of "degree of falsity" is an important ingredient in Popper's concept of truthlikeness (verisimilitude), but David Miller has shown that if the verisimilitude of a theory is measured by the accuracy of the predictions derived from it, no false theory can have a higher degree of verisimilitude than another false theory. ([30]) Miller's result is essentially dependent on the assumption that all conceivable predictions derived from a theory are equally relevant to its evaluation. The result is avoided if the concept of verisimilitude – or degree of error – is relativised to a set of questions or problems. Thus Miller's result shows that if the "degree of error" of a system of beliefs is interpreted

([28]) For an early discussion of the lottery paradox, see Henry E. KYBURG, Jr., *Probability and the Logic of Rational Belief*, Wesleyan University Press, Middletown, Conn. 1961; see also the papers in Marshall Swain (ed.), *Induction, Acceptance, and Rational Belief*, D. Reidel, Dordrecht 1970. The lottery paradox is of course formally analogous to the Paradox of the Preface and to the example given by Ramsey; see note 27.

([29]) For a general discussion of this issue, see Risto HILPINEN, 'Approximate Truth and Truthlikeness', in *Formal Methods in the Methodology of Empirical Sciences*, ed. by R. Wójcicki *et. al.*, D. Reidel, Dordrecht and Ossolineum, Wrocław 1976, pp. 19-42.

([30]) David MILLER, 'On the Accuracy of Predictions', *Synthese* 30 (1975), pp. 159-191.

in terms of the *accuracy* of the beliefs, the assessment of the truthlikeness (or error-freedom) of the system must be relativised to a set of questions. ([31])

III

Let us call the questions which determine the "goodness" of a belief system the investigator's *primary questions*. I assume here that the main function of a person's belief system is to provide error-free answers to the primary questions in which he is interested. We might say that a primary question is a question addressed by an investigator to himself (or to his belief system) – thus a primary question places an investigator under an "imperative obligation" to use his belief system as a cognitive resource for finding a satisfactory answer to the question.

According to the Åqvist-Hintikka semantics, a primary question is not merely a linguistic request, but an epistemic request, a request for knowledge. Åqvist and Hintikka assume that the K-operator used here has "success grammar": they assume that the concept of knowledge has (at least) the strength of true opinion; otherwise the character of this central concept is left largely open. ([32])

Here I propose to understand the concept of knowledge in the classical sense, that is, as justified true belief, and discuss the relevance of this interpretation of the K-operator to the theory of inquiry. Recent work in epistemology has shown that the justified true belief analysis of knowledge is somewhat oversimplified and requires supplementation. ([33]) Here I shall simply assume that (in addition to the condition of truthfulness) some requirement of "conclusive" justification is *a necessary* condition of knowledge, but the discussion below does not exclude additional epistemic requirements (concerning the indefeasibility and reliability of knowledge claims, for example).

([31]) Cf. the comments on Miller's result by Roger Rosenkrantz, 'Truth-likeness: Comment on David Miller', *Synthese* 30 (1975), pp. 193-197.

([32]) See Lennart ÅQVIST, 'Analysis and Logic of Questions', p. 32 (especially footnote 7), and Jaakko HINTIKKA, 'New Foundations for a Theory of Questions and Answers', p. 177.

([33]) There exists a huge philosophical literature on the additional conditions of knowledge; Robert K. Shope, *The Analysis of Knowing: A Decade of Research*, Princeton University Press, Princeton, N. J. 1983, is a good general survey of this discussion.

According to Isaac Levi's interpretation of belief systems, "there is no relevant distinction between what X fully believes and what he knows at [time] t". All beliefs are equally "justified": Levi says that ([34])

> from X's point of view at t, all his beliefs at t are true, infallibly true (in the sense that they could not possibly be false in any respect to be taken seriously) and certainly true. Under the circumstances, from X's point of view, his beliefs possess all the qualifications they need to be accorded the honorific status of knowledge.

I adopt here a different intepretation of belief systems: I assume that such a system consists of a set of propositions (or beliefs) together with a system of evidential relationships among these propositions. Whether a certain proposition p is justified within B_a depends on the evidential relationships between p and other members of B_a; thus I do not assume that every proposition which belongs to B_a is also automatically justified within it. It is easy to see that according to the present interpretation of the semantics of questions, the two cognitive requirements mentioned above (informational completeness and error avoidance) follow from the requirement that the principal function of a belief system is to give satisfactory answers to the investigator's primary questions.

Since a primary question is a request for knowledge and not for mere information, the request need not be automatically satisfied if the questioner's belief system contains a proposition which is a direct and complete answer to the question. The answer must also be known, and therefore (according to the classical view of knowledge) well-justified within the questioner's belief system. Note that if the only requirement on belief systems were that they should contain true beliefs, and give truthful answers to certain questions, even a system which is *not* apparently error-free with respect to these questions would be perfectly satisfactory as long as it contains all the correct answers.

The concept of justification used here should be understood as non-demonstrative, *prima facie* conclusive justification, not as deductive justification. In general, non-deductive grounds for a proposition may be undermined or "defeated" by new evidence or new "counter-grounds".

([34]) Isaac LEVI, 'Truth, Fallibility and the Growth of Knowledge', in Levi, *Decisions and Revisions*, Cambridge University Press, Cambridge 1984, pp. 109-110.

We should require, however, that a proposition p is justified *within* a belief system B_a only if the grounds for p in B_a are not defeated by other propositions which also belong to B_a. Thus the concept of justification is subject to the following condition:

(8) A proposition p is justified within B_a only if the grounds which justify p in B_a are not defeated by any relevant counter-grounds in B_a.

Thus a proposition which is justified within a given system B_a need not be justified in every system which includes B_a. ([35])

According to (8), a proposition p cannot be justified within a belief system which also contains the negation of p, or a proposition which entails $\sim p$, because such information would necessarily defeat any putative justification for p. Thus a belief system can give a satisfactory answer to a certain question only if it is apparently error-free with respect to that question. ([36])

In his book *Progress and Its Problems* Laurens Laudans has regarded the problem-solving power of a theory as the main criterion of scientific progress. He has also argued that questions of truth, corroboration, and confirmation are in this context largely irrelevant. ([37]) According to Laudan, ([38])

> In appraising the merits of theories, it is more important to ask whether they constitute adequate solutions to significant problems

([35]) For the concept of defeasibility and defeasible justification, see Robert K. Shope, *The Analysis of Knowing: A Decade of Research*, Ch. 2. The defeasibility conditions are usually presented in a subjunctive form, in terms of what a person would believe (or would be justified in believing) if he were to acquire certain new beliefs. Condition (8) has a more restricted scope; it concerns the defeasibility of justification *within* a given belief system.

([36]) The apparent error-freedom of B_a with respect to certain questions is only a *necessary* condition of the satisfactoriness of the answers provided by B_a. The Preface Paradox, the Lottery Paradox and other similar examples are plausible examples of inconsistent belief-systems which can be apparently error-free with respect to certain questions – but whether *all* the answers provided by such systems can be *justified* in the strong sense required by the concept of knowledge is another matter. (I owe this point to Mark Kaplan.) This is a controversial issue; cf. the references given above in note 28.

([37]) Laurens LAUDAN, *Progress and Its Problems*, Routledge & Kegan Paul, London and Henley 1977, pp. 24-25.

([38]) LAUDAN, *op. cit.*, p. 14.

> than it is to ask whether they are "true," "corroborated," "well-confirmed" or otherwise justifiable within the framework of contemporary epistemology.

I assume that the reference to "the framework of contemporary epistemology" means here only that Laudan speaks about justification in the sense in which this concept has been studied in recent epistemology. According to the view of questions and answers taken in this paper, Laudan's view is almost incoherent, because questions of error-freedom (in particular, questions of consistency) and justification are an essential part of the evaluation of the adequacy of answers and solutions to problems. Laudan characterizes a solution as follows: ([39])

> Generally, any theory, *T*, can be regarded as having solved an empirical problem, if *T* functions (significantly) in any schema of inference whose conclusion is a statement of the problem.

This view seems seriously flawed, because it makes no reference to epistemic considerations. It resembles the "imperative-assertoric" view of questions and answers, rather than the "imperative-epistemic view" – except that Laudan wants to discount all considerations of truthfulness.

IV

If a belief system is not apparently error-free with respect to a question, it cannot give a well-justified answer to it, and is therefore unsatisfactory. But a system B_a can be unsatisfactory in other ways as well: (i) it may not give any answer at all to some primary question *Q*, and is thus incomplete with respect to *Q*, or (ii) it may give an answer *p* which is unjustified, not because the system contains conflicting information about the question, but because *p* is not supported by any relevant evidence within B_a. In both cases the question *Q* creates a need to *expand* the system. ([40]) I suggest that this is done by presenting questions to some ex-

([39]) *Ibid.*, p. 25.

([40]) According to Isaac LEVI, a belief system B_a' is an *expansion* of B_a if it is obtained by adding something to the latter; B_a' is called a *contraction* of B_a if it is obtained by deleting some proposition(s) from B_a. In the former case, $B_a \subset B_a'$; in the latter, $B_a' \subset B_a$. See Isaac Levi, *The Enterprise of Knowledge*, p. 25.

ternal source of information, and by adding the answers received to B_a. Questions of this kind may be termed *secondary questions*. The source of information used here may be the investigator's own senses, a measuring instrument, or any other source which is external to the investigator's own belief system. (For example, *experiments* may be regarded as secondary questions – in accordance with Kant's famous metaphor, they can be regarded as "questions presented to nature".)

The justification requirement explains why a belief system which is not error-free with respect to a certain question, that is, a system which contains two mutually incompatible answers to a certain question, cannot usually be revised simply by deleting one of the conflicting answers: the remaining answer must be well-justified to be satisfactory. For this reason it is often necessary to expand a belief system by means of secondary questions even when the system contains several incompatible answers to some question: the expansion is necessary for making a justified choice among the alternatives. Much of the recent work on rational belief revision has analysed the elimination of inconsistencies in terms of the *contraction* of belief systems. This is a plausible approach, because an inconsistency in a belief system can be said to be generated by an *excess* of information. ([41]) Nevertheless this approach is apt to give a misleading account of the process of inquiry, because a *justified* belief revision which also preserves the informativeness of the system with respect to the relevant primary questions often requires an expansion of the system by means of suitable secondary questions. ([42])

Like the primary questions, secondary questions are requests for knowledge or epistemic requests. A given source of information can give the investigator knowledge only about certain secondary questions (or kinds of secondary questions). For example, according to a well-known philosophical view, observational knowledge is restricted to propositions

([41]) See Nicholas RESCHER, *The Coherence Theory of Truth*, Oxford University Press, Oxford 1973, pp. 72-140; Carlos Alchourrón and David Makinson, 'On the Logic of Theory Change: Contraction Functions and their Associated Revision Functions', *Theoria* 48 (1982), pp. 14-37; David Makinson, 'How to Give It Up: Some Formal Aspects of the Logic of Theory Change', *Synthese* 62 (1985), pp. 347-363.

([42]) I have discussed this point in greater detail in 'Rescher's Theory of Cognitive Systematization', in *Praxis and Reason: Studies in the Philosophy of Nicholas Rescher*, ed. by Robert Almeder, University Press of America, Washington, D. C. 1982, pp. 28-53; cf. pp. 40-44.

involving special "observation predicates"; if this is the case, admissible experimental questions (secondary questions addressed to "nature") are subject to a similar restriction. It also seems plausible to assume that the potential answers to experimental questions should be expressible by *atomic* sentences. (In his recent work on the logic of experimental inquiry Jaakko Hintikka has criticized this "Atomistic Postulate" in an interesting way. ([43])) It is clear that all restrictions of this kind are motivated by epistemic considerations, i.e., on the basis of what it is possible to know "directly" on the basis of observation, or which belief expansion procedures are reliable enough to serve as a reasonable basis of inference and argument. Thus it is not normally possible to present primary questions directly to an external source: obtaining satisfactory answers to the primary questions requires demonstrative and nondemonstrative reasoning from the investigator's background beliefs and from the answers received to the secondary questions.

Furthermore, an answer received from an external source may fail to qualify as knowledge unless it coheres (or is supported by) the other beliefs in the questioner's belief system. An unexpected or unsupported experimental result is apt to give rise to new questions which are necessary for ascertaining the validity of the result. ([44])

In Jaakko Hintikka's interrogative model of inquiry, non-demonstrative reasoning appears to play only a minor role. Hintikka's model concerns a situation in which the investigator ("inquirer") attempts to derive a certain conclusion C (or not-C) (an answer to a certain "primary question" concerning a world M) from his background knowledge or "theory" T. ([45]) According to Hintikka, ([46])

> What the Inquirer is allowed to do is twofold: (i) the Inquirer is allowed to put questions to a source of information, here called "Nature", concerning M; (ii) the Inquirer may draw logical conclusions from

([43]) Jaakko HINTIKKA, 'The Logic of Science as a Model-Oriented Logic'; 'What Is the Logic of Experimental Inquiry?' (forthcoming).

([44]) For a good discussion of the justification of experimental results, see Allan Franklin, 'The Epistemology of Experiment', in Allan Franklin, *The Neglect of Experiment*, Cambridge University Press, Cambridge (forthcoming).

([45])See Jaakko HINTIKKA, 'The Logic of Science as a Model-Oriented Logic', pp. 177-178; 'Sherlock Holmes Formalized', p. 171.

([46])Jaakko HINTIKKA, 'The Logic of Science as a Model-Oriented Logic', p. 177.

> T plus the answers to questions (i). The Inquirer's aim is to prove logically either C or $\sim C$ by using as premises T plus the answers.

Thus Hintikka assumes from the very beginning that the process of inquiry does not involve any non-demonstrative reasoning or inference: the only "moves" available to the inquirer are the deductive moves and questions (in my terminology, secondary questions). This is not an essential feature of an interrogative account of inquiry.

In general, the function of secondary questions is either (i) to *justify* a certain answer to primary question ("the context of justification") or (ii) to *suggest* a new answer to a primary question ("the context of discovery"). ([47]) It seems highly implausible to require that the answers to primary questions should always be deductive consequences of the answers to secondary questions and the inquirer's background knowledge, especially in case (ii) (in the context of discovery). (In case (i), this requirement is analogous to the old view that "valid" inductive arguments can always be converted into valid deductions by adding "suppressed premises" to them.)

V

According to the view of questions taken here, a primary question is a request for knowledge directed by the investigator to himself; a command to the effect that the investigator should bring it about that he himself knows something. According to the classical analysis of knowledge, a self-directed yes-no-question amounts to the following:

> (9) Let a bring it about that if p is true, $B_a p$ & $E_a p$, and if p is false, $B_a \sim p$ & $E_a \sim p$,

where 'a' refers to the investigator, ([48]) and '$E_a p$' means that a is justified in believing that p. According to (9), a should bring it about that he (himself) believes and is justified in believing a certain proposition (if that

([47]) I assume that the interrogative model of inquiry can serve both as a model of discovery and as a model of justification.

([48]) Here I ignore the complication that if (9) is really a *self-directed* question: 'a' should be a special indexical expression for the inquirer, viz. an index used by the inquirer himself.

proposition is true). How can a person "bring it about" that he believes something? Many philosophers have argued that believing something (or coming to believe something) cannot be regarded as a voluntary action: a person cannot choose his beliefs in the way he can choose his actions. ([49]) Nevertheless we judge the rationality of people's beliefs and criticize beliefs in a way which seems to presuppose that they are, at least to some degree, subject to voluntary control. ([50])

The model outlined above provides a natural and plausible solution to this puzzle. In (9) the action operator 'bring it about' does not occur immediately in front of the belief operator, but in front of the desideratum of a question. The "active" part of belief formation consists in the investigator's presenting a certain secondary question to an external source of information; when the investigator receives an answer, he lets his beliefs be determined by the external source. If the answer received is not sufficient to determine a complete answer to the primary question (in this case, "whether p"), more secondary questions are needed. When the investigator registers the answers to the secondary questions, he does not "choose" his beliefs, but lets them be determined by something which is external to his belief system. Here the question-theoretic account of inquiry agrees with Peirce's characterization of scientific method as a method in which we let our beliefs be determined by something external to them. ([51])

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([49]) For example, David HUME in *A Treatise on Human Nature*, ed. by L. A. Selby-Bigge, Clarendon Press, Oxford 1965, pp. 623-625. But Descartes seems to have held the opposite view; cf. H. H. Price, *Belief*, George Allen & Unwin, London 1969, pp. 221-240. For a discussion of this issue from the historical perspective, see Seppo Sajama, *Idea, Judgment, and Will*, Reports from the Department of Theoretical Philosophy, No. 7, 1983, Part 2. See also Peter Geach, *Reason and Argument*, Basil Blackwell, Oxford 1976, pp. 2-4.

([50]) Cf. Peter GEACH, *Reason and Argument*, p. 3.

([51]) See C. S. PEIRCE, 'The Fixation of Belief', *CP*, 5.384.