Introduction

If Thomas Kuhn had not sworn to me a long time ago that he would never again use the p-word, I would have been tempted to introduce my viewpoint in this volume by saying that contemporary epistemology draws its inspiration from an incorrect paradigm that I am trying to overthrow. Or, since the individuation of paradigms is notoriously difficult, I might have said instead that our present-day theory of knowledge rests on a number of misguided and misguiding paradigms. One of them is in any case a defensive stance concerning the task of epistemology. This stance used to be expressed by speaking of contexts of discovery and contexts of justification. The former were thought of as being inaccessible to rational epistemological and logical analysis. For no rules can be given for genuine discoveries, it was alleged. Only contexts of justification can be subjects of epistemological theorizing. There cannot be any logic of discovery, as the sometime slogan epitomized this stance—or is it a paradigm? Admittedly, in the last few decades, sundry "friends of discovery" have cropped up in different parts of epistemology. (See, for example, Kleiner 1993.) However, the overwhelming bulk of serious systematic theorizing in epistemology pertains to the justification of the information we already have, not to the discovery of new knowledge. The recent theories of "belief revision"—that is, of how to modify our beliefs in view of new evidence—do not change this situation essentially, for they do not take into account how that new evidence has been obtained, nor do they tell us how still further evidence could be obtained.

The contrast between contexts of discovery and contexts of justification originated from the philosophy of science rather than from the traditional theory of knowledge. In the received epistemology, the same preoccupation with justification appears in the form of questions concerning the concept of knowledge, especially its definition, as well in the form of sundry theories of confirmation or other kinds of justification.

Furthermore, the same defensive, not to say insecure, attitude pervades the epistemology of the deductive sciences. It has even distorted the terminology

of contemporary logic. For instance, what does a so-called rule of inference have to do with the actual drawing of inferences? If you are given twenty-one potential premises, do the "rules of inference" tell you which conclusions you should draw from them? What conclusions a rational person would draw? To what conclusions would "the laws of thought" lead you from these premises? Or, descriptively, what conclusions do people usually draw from them? The right answer is: None of the above. Logic texts' "rules of inference" only tell you which inferences you may draw from the given premises without making a mistake. They are not rules either in the descriptive sense or in the prescriptive sense. They are merely permissive. They are guidelines for avoiding fallacies. Recently, some philosophers have been talking about "virtue epistemology." But in practice, the virtues that most epistemologists admire in this day and age are in fact Victorian rather than Greek. They are not concerned with true epistemological virtue in the sense of epistemological excellence, but only with how not to commit logical sins, how, so to speak, to preserve one's logical or epistemological virtue. Logical excellence—virtue in the sense that is the first cousin of virtuosity—means being able to draw informative conclusions, not just safe ones.

One main thrust of the results presented in this volume is that this defensive picture of the prospects of epistemology is not only inaccurate but radically distorted. A logic of discovery is possible because it is already actual. There exists a logic of pure discovery, a logic that is not so-called by courtesy, but a logic that is little more than the good old deductive logic viewed strategically. In contrast, there does not exist, and there cannot exist, a fully self-contained theory of justification independent of theories of discovery. If this change of viewpoint is not a "paradigm shift" in the Kuhnian sense, it is hard to see what could be.

But paradigm shifts are not implemented simply by deciding to do so, by merely shaking the kaleidoscope, so to speak, even though some seem to think so. In actual science, they require a genuinely new theory or a new method. In the case of the present volume, the "new" method is in a sense as old as Western epistemology. I am construing knowledge acquisition as a process of questioning, not unlike the Socratic *elenchus*. I have been impressed by Socrates' method as strongly as was Plato, who turned it into a universal method of philosophical argumentation and philosophical training in the form of the questioning games practiced in his Academy. They were in turn systematized and theorized about by Aristotle, who thought of the questioning processes among other uses as the method of reaching the first premises of the different sciences. (See Hintikka 1996.)

In a sense, even the main formal difference between Plato's dialogical games and my interrogative ones had already been introduced by Aristotle. He was as competitive as the next Greek, and hence was keenly interested in winning his questioning games. Now any competent trial lawyer knows what the most important feature of successful cross-examination is: being able to predict witnesses' answers. Aristotle quickly discovered that certain answers were

indeed perfectly predictable. In our terminology, they are the answers that are logically implied by the witness' earlier responses. By studying such predictable answers in their own right in relation to their antecedents, Aristotle became the founder of deductive logic. Since such predictable answers are independent of the answerer, they can be considered *ad argumentum*—that is to say, by reference to the structure of the argument only. They might even be provided by the questioner rather than by an actual answerer. Hence, in my interrogative model, logical inference steps are separated from interrogative steps and are thought of as being carried out by the inquirer. It is historically noteworthy, however, that Aristotle still thought of the entire epistemological process, including deductive inferences, as being performed in the form of question-answer dialogues. (For the interrogative approach to epistemology, see Hintikka 1999.)

The general applicability of the interrogative model admits of a kind of transcendental deduction. This argument is sketched in the essay "Abduction—Inference, Conjecture, or an Answer to a Question?" (Chapter 2 in this volume). The format of the argument is simple. Let us assume that each step in an inquiry allows for rational evaluation. If so, for each step that introduces new information into the argument, it must be specified where that novel information comes from. Furthermore, it must be known what other responses the same source of information might have provided, and if so, with what probabilities, what other "oracles" the inquirer could have consulted, what their responses might have been, and so on. But if all of this is known, we might as well consider the new information as a reply or an answer to a question addressed to a source of information—that is to a source of answers. It can also be argued that the role of questions in the interrogative model is closely similar to the role of abduction according to C. S. Peirce, even though abduction has been repeatedly and misleadingly considered as inference to the best explanation.

An important aspect of this general applicability of the interrogative model is its ability to handle uncertain answers–that is, answers that may be false. The model can be extended to this case simply by allowing the inquirer to tentatively disregard ("bracket") answers that are dubious. The decision as to when the inquirer should do so is understood as a strategic problem, not as a part of the definition of the questioning game. Of course, all the subsequent answers that depend on the bracketed one must then also be bracketed, together with their logical consequences. Equally obviously, further inquiry might lead the inquirer to reinstate ("unbracket") a previously bracketed answer. This means thinking of interrogative inquiry as a self-corrective process. It likewise means considering discovery and justification as aspects of one and the same process. This is certainly in keeping with scientific and epistemological practice. There is no reason to think that the interrogative model does not offer a framework also for the study of this self-correcting character of inquiry.

From this, it follows that much of the methodology of epistemology and of the methodology of science will be tantamount to the strategic principles of bracketing. From this, it is in turn seen that a study of uncertain answers is an enormously complicated enterprise, difficult to achieve an overview of. It nevertheless promises useful insights. A sense of this usefulness of the interrogative model in dealing with the problems of methodology and inference can perhaps be obtained by considering suitable special problems of independent interest. The two brief essays, "A Fallacious Fallacy" and "Omitting Data—Ethical or Strategic Problem" (Chapters 9 and 10), illustrate this purpose. The former deals with the so-called conjunctive fallacy. This allegedly mistaken but apparently hardwired mode of human probabilistic reasoning is a prize specimen in the famous theory of cognitive fallacies proposed by Amos Tversky and Daniel Kahneman. The interrogative viewpoint helps to show that this would-be fallacy is in reality not fallacious at all, but instead reveals a subtle problem in the Bayesian approach to probabilistic reasoning. This result cries out for more discussion than can be devoted to the problem of cognitive fallacies here. Are the other Tversky and Kahneman "fallacies" perhaps equally dubious?

Omitting observational or experimental data is often considered a serious breach of the ethics of science. In the second brief essay just mentioned, it is pointed out, as is indeed fairly obvious from the interrogative point of view, that such a view is utterly simplistic. Even though data are sometimes omitted for fraudulent purposes, there is per se nothing ethically or methodologically wrong about omitting data. Such a procedure can even be required by optimal strategies of reasoning, depending on circumstances.

But if the basic idea of the interrogative approach to inquiry is this simple and this old, it might seem unlikely that any new insights could be reached by its means. Surely its interest has been exhausted long ago, one might expect to find. The interrogative approach has in fact been used repeatedly in the course of the history of Western philosophy, for instance in the form of the medieval *obligationes* games and in the guise of the "Logic of questions and answers" in which R. G. Collingwood saw the gist of the historical method. However, Collingwood's phrase (taken over later by Hans-Georg Gadamer) indirectly shows why the *elenchus* idea has not generated full-fledged epistemological theories. Collingwood's "logic" cannot be so-called by the standards of contemporary logical theory. In the absence of a satisfactory grasp of the logical behavior of questions and answers, the idea of "inquiry as inquiry" could not serve as a basis of successful epistemological theorizing. Such a grasp has only been reached in the last several years. Admittedly, there have been much earlier attempts at a logic of questions and answers, also known as "erotetic logic." But they did not provide satisfactory accounts of the most important questions concerning questions, such as the questions about the relation of a question to its conclusive (desired, intended) answers, about the logical form of different kinds of questions, about their presuppositions, and so on. One

might be tempted to blame these relative failures to a neglect of the epistemic character of questions. For in some fairly obvious sense, a direct question is nothing more and nothing less than a request for information, a request by the questioner to be put into a certain epistemic state. Indeed, the specification of this epistemic state, known as the desideratum of the question in question, is the central notion in much of the theory of questions and answers, largely because it captures much of the essentially (discursive) notions of question and answer in terms of ordinary epistemic logic.

But the time was not yet ripe for an interrogative theory of inquiry. As is pointed out in "Second-Generation Epistemic Logic and its General Significance" (Chapter 3), initially modern epistemic logic was not up to the task of providing a general theory of questions and answers. It provided an excellent account of the presuppositions and conclusiveness conditions of simple *wh*-questions (*who*, *what*, *where*, etc.) and propositional questions, but not of more complicated questions, for instance of experimental questions concerning the dependence of a variable on another. However, I discovered that they could reach the desired generality by indicating explicitly that a logical operator (or some other kind of notion) was independent of another one. Technically considered, it was game-theoretical semantics that first offered to logicians and logical analysts a tool for handling this crucial notion of independence in the form of informational independence. These developments form the plot of Chapter 3.

The interrogative model helps to extend the basic concepts and insights concerning questions to inquiry in general. Some of these insights are examined in the essay "Presuppositions and Other Limitations of Inquiry" (Chapter 4). They even turn out to throw light on the earlier history of questioning methods, including Socrates' ironic claim to ignorance and Collingwood's alleged notion of ultimate presupposition.

Even more radical conclusions ensue from an analysis of the "presuppositions of answers," which are known as conclusiveness conditions on answers. They can be said to define the relation of a question to its conclusive answers. They are dealt with in the essay "The place of the *a priori* in epistemology" (Chapter 5). It quickly turns out that the conclusiveness conditions on answers to purely empirical questions have conceptual and hence *a priori* components. Roughly speaking, the questioner must know, or must be brought to know, what it is that the given reply refers to. For a paradigmatic example, nature's response to an experimental question concerning the dependence of a variable on another can be thought of as a function-in-extension—in other words, as something like a curve on graph paper. But such a reply truly answers the dependence question only if the experimental inquirer comes to know what the function is that governs the dependence between variables—in other (mathematical) words, which function the curve represents. Without such knowledge, the experimental question has not been fully answered. But this collateral knowledge is not empirical, but mathematical. Hence, *a priori* mathematical

knowledge is an indispensable ingredient even of a purely experimental science. Among other consequences, this result should close for good the spurious issue of the (in)dispensability of mathematics in science.

Since experimental questions are a typical vehicle of inductive inquiry, the entire problem of induction assumes a new complexion. Inductive reasoning has not just one aim, but two. It aims not only at the "empirical generalization" codified in a function-in-extension or in a curve, however accurate, but also at the mathematical identification of this curve. In practice, these two aims are pursued in tandem. Their interplay is not dealt with in traditional accounts of induction, even though its role is very real. For instance, if the mathematical form of the dependence-codifying function is known, an inductive inference reduces to the task of estimating the parameters characterizing the function in question. This explains the prevalence of such estimation in actual scientific inquiry.

In another kind of case, the task of identifying the mathematical function in question has already been accomplished within the limits of observational accuracy for several intervals of argument values. Their induction becomes the task of combining several partial generalizations (and reconciling them as special cases of a wider generalization). This kind of induction turns out to have been the dominating sense of *inductio* and *epagoge* in earlier discussions, including the use of such terms by Aristotle and by Newton. (See Hintikka 1993.)

Thus, conclusiveness conditions are seen to play a pivotal role in the epistemology of questioning. They are also a key to the logic of knowledge. They express *wh*-knowledge (knowing *who, what*, *where*, etc.) as distinguished from knowing *that*, and show how the former construction can be expressed in terms of the latter. However, from this expressibility it does not follow that the truth conditions of expressions such as knowing *who* also reduce to those governing knowing *that*. They do not. The underlying reason is that the measuring of quantifiers depends on the criteria of identification between different epistemically relevant scenarios (possible worlds, possible occasions of use) as distinguished from criteria of reference. For this reason, we have to distinguish an identification system from a reference system in the full semantics of any one language, be it a formal language or our actual working language—called by Tarski "colloquial language." I have argued for the vital importance of this distinction in numerous essays, some of which are reprinted in Hintikka (1999).

The unavoidability of this distinction is highlighted by the intriguing fact that in our actual logico-linguistic practice, we are using two different identification systems in a partnership with one and the same reference system all the time. This dichotomy means a dichotomy between two kinds of quantifiers, public and perspectival ones.

This dichotomy and its expressions in formal and natural languages have been explained in my earlier papers. However, what has not been fully spelled

out is the even more intriguing fact that the two identification systems are manifested neuroscientifically as two cognitive systems. This insight is spelled out and discussed in the essay (written jointly with John Symons, Chapter 6 of this volume) entitled "Systems of Visual Identification and Neuroscience: Lessons from Epistemic Logic" in the case of visual cognition. These two systems are sometimes known as the *what* system and the *where* system. It is known from neuroscience that they are different not only functionally but anatomically. They are implemented in two different areas of the brain with different pathways leading to them from the eye. Symons and I point out the conceptual distinction that manifests itself as the difference between the two cognitive systems and the consequences of this insight for neuroscience.

This opens up an unexpected and unexpectedly concrete field for logical and epistemological analysis. An epistemologist can tell, for instance, what was conceptually speaking wrong with Oliver Sacks's "Man Who Mistook His Wife for a Hat." (Sacks 1985.) Such possibilities of conceptual clarification are not restricted to systems of visual cognition and their disturbances, but occur *mutatis mutandis* in the phenomena of memory, and might very well be offered also by such phenomena as dyslexia and autism.

The most important aspects of epistemology illuminated by the interrogative model are likely to be the strategic ones. Considering inquiry as a question-answer sequence enables us to theorize about entire processes of inquiry, including strategies and tactics of questioning, not only about what to do in some one given situation. Aristotle already had a keen eye on the tactics of questioning. The strategic viewpoint can be dramatized by considering interrogative inquiry as a game. However, an explicit use of game-theoretical concepts and conceptualizations is not necessary for most of the philosophical conclusions, even though it can be most instructive for the purpose of conceptual analysis.

In fact, in many goal-directed processes, including the strategic games considered in the mathematical theory of games, one can distinguish the definitory rules of the game from its strategic rules or strategic principles. The former define a game, by specifying what is permissible in it—for example, what are the legitimate moves of chess. Such rules do not by themselves tell a player anything about what he or she (or it, if the player is a computer) should do in order to play well, to increase one's chances of reaching the goal. Such advice is what the strategic rules of a game provide to a player. We can thus express the earlier point concerning the merely permissive character of the so-called rules of inference of logic by saying that such rules are merely definitory, serving to specify what is permitted in the "game" of deduction.

Another point that can be made here is that even though one can distinguish in interrogative games definitory rules governing deductive "moves" from definitory rules governing question-answer steps, in the strategic rules of such games one cannot likewise consider deductive rules and interrogative rules apart from each other.

As has been to some extent spelled out in my earlier work (largely collected in Hintikka 1999), the strategic viewpoint necessitates radical changes in philosophers' ideas of what the task of epistemology is and how it can be achieved. For one thing, it is the strategic viewpoint that enables us to uncover the logic of discovery mentioned earlier. It turns out that in the case of pure discovery—that is, in the case where all answers are known to be true—the choice of the optimal question to be asked is essentially the same as the choice of the optimal premise to draw an inference from in a purely deductive situation. Thus, Sherlock Holmes was right: Strategically speaking, all good reasoning consists of "deductions," if only in the case of pure discovery.

But we can say more than that contexts of discovery can be theorized about epistemologically and logically, notwithstanding the misguided traditional paradigm. It is contexts of justification that cannot be studied alone, independently of the task of discovery. For discovery and justification have to be accomplished both through the same process of inquiry as inquiry. Hence the strategies of this process have to serve both purposes. There are no separate strategies of justification in isolation from strategies of discovery. For instance, reaching the truth early, even by means of a risky line of thought, may subsequently open previously unavailable avenues of justification.

Some other repercussions affect more directly the nitty-gritty detailed work of epistemologists. Typically inquiry is thought of by them in terms of particular steps of the epistemological process. For instance, the justification of the results of empirical inquiry is assumed to depend on the justifiability of the several steps that have led to that conclusion—for example, in terms of what "warrants" there are to back each of them up. Now, whatever else we may learn from game theory, it is that a player's performance can be judged absolutely only in terms of his or her (or its, if the player is a team, a computer, or nature) entire strategies. (The term "strategy" should here be taken in the strong sense used in game theory, roughly amounting to a completely determined strategy.) As a game theorist would put it, utilities can in the first place be associated with strategies, not with individual moves.

From this it follows that no epistemological theory can tell the whole story that deals only with rules for particular moves or with the epistemic evaluation of a single cognitive situation. Such a theory may yield us truths and nothing but truths, but it does not tell the whole truth. This limitation obviously applies, among other conceptualizations, to the rules of inductive inference, to the rules of belief revision, and to all theories of inferential "warrants." But it applies even more centrally to most of the epistemological discussion concerning the concept of knowledge. For the typical question concerning it in traditional epistemology is whether a given body of evidence justifies bestowing on a certain belief the honorific title "knowledge." While such a question perhaps makes sense, its place in a realistic theory of knowledge and knowledge acquisition is marginal, and the question itself, glorified by philosophers

as a question concerning the definition of knowledge, may not be answerable in general terms.

The overall picture of the structure of the epistemological enterprise at which we thus arrive is outlined in the central essay, "Epistemology without Knowledge and without Belief" (Chapter 1). If we review the questioning process through which we obtain our knowledge and justify it and inventory the concepts employed in the process, we find all the notions of a logic of questions and answers, the notions of ordinary deductive logic, and something like the notions of acceptance and rejection in the form of rules of bracketing and unbracketing. We also find an notion roughly tantamount to the concept of information. What we do not find are philosophers' concepts of knowledge and belief. Hence the problems of knowledge acquisition can be examined, and must be examined, without using the two concepts. This is perhaps not surprising, for if knowledge is going to be the end product of interrogative inquiry, it cannot be one of the means of reaching this goal. The role of the concept of knowledge deals with the evaluation of stages that our interrogative inquiry has reached. But if so, it is not likely that such an evaluation can be carried out independently of the subject matter at hand. And if so, the quest of a general definition of knowledge, supposedly the main task of epistemologists, is a wild goose chase. It can also be argued that belief should not be thought of as a naturalistic state, either, but likewise as a term related to the evaluation of the results of inquiry.

Admittedly, the logic of questions and answers that plays a crucial role in interrogative inquiry involves an intensional epistemic notion. But this concept is not the philosophers' concept of knowledge, but something that could perhaps most happily be called information. Unfortunately, Quine's misguided rejection of the analytic versus synthetic distinction has discouraged philosophers from examining the notion of information, even though this term is current as an epithet of our entire age. As a result, it has been purloined by various specialists, from communication theorists to theorists of computational complexity. In the essay "Who Has Kidnapped the Concept of Information?" (Chapter 8), an attempt is made to find some method in this madness. Among the main results reported in that essay, there is a distinction between two kinds of information—depth information and surface information—the behavioral indistinguishability of the two (this is the true element in Quine's views), the depth tautologicity of logical truths, the inevitable presence of factual assumptions in any measure of either kind of information, and the possibility of interpreting complexity theorists' notion of information as a variant of surface information. The consequences of these results require further analysis (and synthesis).

A strategic viewpoint also relates the interrogative approach to epistemology to the theory of explanation. (See Halonen and Hintikka 2005.) A convenient reference point in this direction is offered by the covering law

explanation. In the simplest terms, according to this theory to explain an *explanandum* E is to deduce it from a suitable theory or generalization T. But neither what is true nor what is false in this covering law view has been fully spelled out in the earlier discussion. In the essay "Logical Explanations" (Chapter 7), it is spelled out, as the covering law theorists never did, in what way a deduction of E from T can explain their connection. It is also argued that procedurally and substantially, explaining does not consist of a deduction of E from T but of the finding of the ad hoc facts A from which E follows in conjunction with T.

As a bonus, we obtain in this way also an explicit analysis of *how possible* explanations. Such explanations turn out to have an important function in the overall strategies of inquiry in that they can be used to investigate which answers perhaps an inquirer should perhaps bracket—namely, by examining how the different answers could possibly be false.

Thus, epistemic logic turns out to be able to put several different aspects of the epistemological enterprise to a new light. This it does by making possible a viable theory of questions and answers, which in turn enables us to develop a theory of information acquisition by questioning.

References

Halonen, Ilpo, and Jaakko Hintikka, 2005, "Toward a Theory of the Process of Explanation," *Synthese*, vol. 143, pp. 5–61

Hintikka, Jaakko, 1999, *Inquiry as Inquiry: A Logic of Scientific Discovery*, Kluwer Academic, Dordrecht.

Hintikka, Jaakko, 1996, "On the Development of Aristotle's Ideas of Scientific Method and the Structure of Science," in William Wians, editor, *Aristotle's Philosophical Development: Problems and Prospects*, Rowman and Littlefield, Lanham, Maryland, pp. 83–104.

Hintikka, Jaakko, 1993, "The Concept of Induction in the Light of the Interrogative Approach to Inquiry," in John Earman, editor, *Inference, Explanation, and Other Frustrations*, University of California Press, Berkeley, pp. 23–43.

Kleiner, S. A., 1993, *The Logic of Discovery: A Theory of the Rationality of Scientific Research*, Synthese Library, Kluwer Academic, Dordrecht.

Sacks, Oliver, 1985, *The Man Who Mistook His Wife for a Hat and Other Clinical Tales*, HarperCollins, New York.