


**QUANTIFIERS, QUESTIONS
AND QUANTUM PHYSICS**

Essays on the Philosophy of Jaakko Hintikka

Edited by
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Foreword and Acknowledgements

Jaakko Hintikka is one of the most creative figures in contemporary philosophy. He has made significant contributions to virtually all areas of the discipline (with the exception of moral philosophy) from epistemology and the philosophy of logic to the history of philosophy, aesthetics and the philosophy of science. In our view, part of the fruitfulness of Hintikka's work is due to its opening important new lines of investigation and new approaches to traditional philosophical problems.

In this volume we have gathered together essays from some of Hintikka's colleagues and former students exploring his influence on their work and pursuing some of the insights that we have found in his work. While the book does contain some criticism of Hintikka's views, this certainly does not purport to be a fair and balanced look at his work. We are unabashedly partisan in our admiration for the man and his work and have put this volume together in a collaborative spirit as a celebration of Hintikka's many contributions to philosophy.

In this volume we have included an annotated bibliography of Hintikka's work. We gratefully acknowledge the *Philosopher's Information Center, The Philosopher's Index* and Dick Lineback in particular for permission to reprint some of the abstracts included in the bibliography. By itself, this would serve as an important resource for philosophers and scholars. 'Prolific' is too modest an adjective for Hintikka, as readers can see for themselves from the size of this annotated bibliography. His massive and diverse body of work poses a real challenge for scholars who hope to find a single philosophical agenda or view that we can associate with Hintikka.

300+ articles, many of them groundbreaking, overwhelming and in a certain sense eclipse his 35+ books. There are a number of ways that one can approach the scale and variety of this work. Our purpose in including the bibliography is to permit others to glean what they will from Hintikka's prodigious philosophical output. We eagerly anticipate the publication of a current bibliography of Hintikka's work, including all reprint and translation details in the *Library of Living Philosophers* volume dedicated to Hintikka. That task, unfortunately, was beyond us. Heartfelt thanks also to Anthony E. Nelson for expert assistance with the grueling task of typesetting.

When we considered the importance and impact of Hintikka's work, it occurred to us that its philosophical consequence is not the additive property of the sum of its parts. We struggled for a way to think about the proliferation of research programs, counterarguments and Ph.D. dissertations that Hintikka's work inspires and settled in the end on the awkward analogy of the powerset. Hintikka's philosophical legacy will be something like the powerset of a set S , is the set of possible subsets of S , and by analogy, rather than attempting to synthesize Hintikka's work into well-defined themes or bumper-stickers, our goal here is to represent the proliferation of different ways one can construe his work and the variety of lines of inquiry that it suggests.

We are very grateful to the distinguished group of colleagues who have contributed to this volume. We are a diverse group, from recent students of Hintikka to some of his most distinguished peers. While we are far from agreement on all the issues discussed in this volume, we are all united by a great fondness for this remarkable man. We see him as a central and pivotal figure in our individual and collective pursuits of wisdom.

Anyone who is even remotely aware of what Hintikka may be working on at the moment will have the impression that his next greatest achievement, his next greatest result, is just down the road ahead of us, just around the next bend. Those of us who have the privilege of knowing Hintikka cannot help feeling the intensity and excitement of philosophical discovery. Unlike so many of the cynical, world-weary philosophers who figured so prominently in recent decades, Hintikka's energy, optimism and mental agility are unparalleled. In that respect, he is the most refreshingly immature mature philosopher in our midst. To put it simply, among philosophers Hintikka is youngest at heart, and boldest of mind.

Daniel Kolak and John Symons

THE RESULTS ARE IN: THE SCOPE AND IMPORT OF HINTIKKA'S PHILOSOPHY

Daniel Kolak and John Symons

Jaako Hintikka is more like a scientist or a mathematician than most philosophers in that his greatest contributions derive less from his views than from his results.⁶⁰ Hintikka, probably more than any other major philosopher, works at the intersection of traditional philosophical questions and the technical results of mathematical logic, physics, neuroscience and computer science.⁶¹ In this respect, he is sometimes compared with the great American philosopher W. V. Quine. However, there are many significant differences between the two. While Quine has admitted to regretfully having produced no major contribution to real logical theory, Hintikka brings his mathematical creativity to bear directly on philosophical questions, using logical techniques to reach philosophical results that, once they are understood, are as extraordinary as his technical results are indisputable.

There is another related difference between Hintikka and Quine that helps illuminate Hintikka's unique place in contemporary philosophy. Most readers recognize that Quine's philosophy is shaped by his commitment to the all-encompassing metaphysical framework of philosophical naturalism. By contrast, if there is an all-encompassing framework that future readers will associate with Hintikka's work, they will find it as one of the conclusions, rather than as a premise of his many investigations. Hintikka's philosophy is driven principally by what he can prove. This makes reading Hintikka difficult (if satisfying) work. The lack of any obvious and familiar big-picture assumptions is an obstacle facing many of his readers, but it also makes his philosophy less of a defensive action in support of a particular view and more of a progressive accumulation of insights. Unfortunately, Hintikka has been impatient to explain the philosophical import of technically-driven results to philosophers who may not be able immediately

⁶⁰ In saying this, we are to a certain extent modifying Hintikka's own occasional claims to have adopted a kind of Kantianism. While, the question of the relation between Hintikka's and Kant's philosophy is quite fascinating and well worth further attention, we do not believe that much light is shed on Hintikka's work merely by seeing it through the lens of Kant's transcendental philosophy. To the contrary, in our view, such an interpretation may (and indeed, often does) serve to conceal some of the more radical aspects of Hintikka's philosophy. Since arguing this point here would require us to defend a reading of Kant in addition to Hintikka, we leave this matter for another occasion.

⁶¹ Thus as Wiebe van der Hoeek notes in the *Knowledge, Rationality & Action* special issue of *Synthese*, "Epistemic logicians in computer science acknowledge Hintikka as their origin." (Volume 139, 2, March 11, 2004, p. v).

to grasp them. (As one of us recently put it: "What the machinery conceals is what the machinery reveals."⁶²) Hintikka's reluctance is not due to modesty on Hintikka's part but through the sheer doggedness of his devotion to inquiry. He has rarely engaged in retrospective consideration or explanation of his work as a whole because, as he often says to friends and colleagues, there are too many other interesting things to work on.

Often, Hintikka will end an article or a lecture by introducing a new line of inquiry or a new set of open questions rather than settling on some easily digested philosophical conclusion. Hence, our task in this essay is to make the philosophical import of his work as clear as possible. It is difficult to do justice to Hintikka's results, while at the same time making them accessible. Sometimes we have found that by beginning with some analogy to a point in the history of philosophy, some remark from Aristotle or Leibniz on modality, Peirce on language or quantification, we can see more clearly what Hintikka might be up to. Our strategy in this essay is to begin in the relatively familiar territory of the history of philosophy, mentioning the way some of Hintikka's technical insights figure into his reading of history, before embarking on a more detailed exposition of some of those results.

Section One begins by sketching some of the main features of his approach to the history of philosophy. We can only examine a selection of prominent cases where his technical work is set in dialogue with his interpretation of his predecessors. Hintikka's reading of Aristotle's logic is probably familiar to most philosophers, but we will also discuss some of his less famous studies of Newton, Hume and the Bloomsbury Group. These are likely to surprise readers familiar with Hintikka's work and are, in some ways, more representative of his approach to history than, for example, the more prominent work on Descartes' *Cogito* argument. The historical topics we discuss in Parts One and Two are (with one exception) those which we can directly connect to our more technical overview of Hintikka's work later in this essay. We hope thereby to reinforce our claim that Hintikka's historical discussions are by and large continuous with his technical work. We hope also to show that his systematic work illuminates, and in turn is illuminated by, his forays into the history of philosophy.

Hintikka's contributions to the philosophy of language have been quite prominent. However, to get a clear sense for the general import of his work in this field, it is useful to see the interplay of historical scholarship and technical investigation. His views on language and ineffability are a clear case where he mixes a reading of the history of early analytic philosophy with a set of theses concerning the nature of logic and semantics. In Section

⁶² Daniel Kolak, *On Hintikka* Belmont: Wadsworth.

for future work, to provoke some critical reaction and to highlight the many deep and interesting open questions that Hintikka's work poses.

1. HINTIKKA ON THE HISTORY OF PHILOSOPHY

Hintikka has been criticized for engaging with the work of great historical figures as though they were his contemporaries. There is a sense in which the charge of anachronism inadvertently gets to the heart of what is most interesting about his historical investigation. Critics are right to remind us that Hintikka's approach to the arguments and ideas of his predecessors bears little resemblance to what usually falls under the rubric of "the history of ideas." Rather, his historical inquiry is unabashedly continuous with his purely conceptual work. The refinement of central concepts and methods in the history of philosophy is integral to Hintikka's program of redrawing the traditional notions of analysis, induction, intuition and the principle of plenitude to name but a few. Especially noteworthy are his interpretations of Plato, Aristotle, Descartes, Leibniz, Peirce, Husserl, Hilbert, Wittgenstein, Tarski, and Gödel, about whom and from whom he has drawn important insights.

Traditionally, inquiry into the history of ideas involves analysis of the context and content of technical terms, their corresponding concepts, and the role they play in the views of the particular schools or traditions of a period. For instance, historians might track the social and moral influences that acted on certain key players or they might work to understand the role of key ideas against the intellectual backdrop of philosophical periods and movements.

By contrast, Hintikka is less an historian of ideas than an expositor of the development of ideas *qua* ideas, viewed quite independently of the particular philosophers with whom they are associated or the historical events within which or out of which they can be viewed as emerging. Hintikka's approach is premised on the idea that the history of philosophy is practiced most fruitfully by philosophers. While one can disagree with Hintikka as matter of historiographical principle, it is difficult to deny that when great philosophers read the history of philosophy *qua* philosophers, it is likely to lead to interesting results.

A revealing example of Hintikka's approach to the history of ideas is his interpretation of the origins of formal logic itself. For Hintikka, Aristotle's logic is the result of an investigation into the nature of questioning and specifically of a reflection on the nature of Socratic *elenchus*. In Socratic *elenchus* answers are (at a certain point) clearly necessitated by the interlocutor's response to earlier questions. In some sense, according to Hintikka, the necessity of an inference originally derives from its place

within an interrogative context. This sequence of necessary answers to questions can be represented formally via Aristotle's syllogistic logic and, according to Hintikka, this was precisely the original purpose of the syllogism. The syllogism then is a notion that appears as part of a general theory of questioning. Essentially, Aristotle saw logical and scientific reasoning as occurring within an interrogative framework rather than as an abstracted process of deducing propositions from premises.

Of course, the interrogative approach to logic has been central to Hintikka's own systematic work for many years and so this aspect of his interpretation of Aristotle is clearly filtered through technical observations in that endeavor. This is not the place to get too far into the details of his reading of Aristotle, however a sympathetic reader can find a great deal of textual evidence in its support. For instance, in *Posterior Analytics* (A vi, 75a 22-27), after having laid out the necessary steps in the process of scientific reasoning, Aristotle seems to confirm Hintikka's claim that even in what appears to be a strictly deductive context, we are still within an interrogative framework:

Yet one might perhaps puzzle why we should ask questions... when the conclusion is not necessary; for one might as well ask any chance questions and then say the conclusion. [The answer is that] we must ask the question not because what is asked is necessary, but because necessarily whoever says them says them, and says something true if it is true.

Aristotle can be read as emphasizing that not all steps in a scientific questioning process are implied, in a strictly deductive sense. Hintikka draws on similar passages in defense of his interrogative interpretation of Aristotle.⁶⁴ It is beyond the scope of this essay to take sides for, or against the interrogative reading of Aristotle's logic. However, as we discuss the details of Hintikka's interrogative approach to logic in later sections, it is worth keeping the good Aristotle in mind. Better historians than the present authors are likely to see that even if Hintikka is only partially correct, it is likely to lead to significant changes in the way we understand Aristotle's philosophy.

⁶⁴ See for example his "Socratic Questioning, Logic, and Rhetoric," *Revue Internationale de Philosophie* 47, (1993), 5-30 and more directly his "On the Development of Aristotle's Ideas of Scientific Method and the Structure of Science," in *Aristotle's Philosophical Development: Problems and Prospects*, William Wians, editor, Rowman and Littlefield, Savage, Maryland, 1996, 83-104. There you will find the textual evidence for the interrogative reading of Aristotle's logic.

Unlike his more recent essays on Aristotle, where Hintikka's own results are enlisted in an effort to rethink the history of philosophy, his papers on Leibniz and Aristotle from the 1960's show Hintikka drawing on the history of philosophy in order to form a clear picture of necessity and possibility. Especially noteworthy in this respect are his "Leibniz, Plenitude, Relations and the 'Reign of Law',"⁶⁵ as are his many essays on Aristotle's conception of modality from the 1960's early 1970's.

Returning to cases where Hintikka is applying technical results to historical considerations, we find another important example in his reading of Frege and Russell on the supposedly unavoidable ambiguity of the word "is." By applying game-theoretical semantics to natural languages, Hintikka shows that we do not need to live with this apparent ambiguity. Frege and Russell thought otherwise, which is why they built the machinery necessary to handle the distinction into their logical notation.⁶⁶ Hintikka shows decisively that—in spite of Russell's claim that this is the greatest advance in logic since the Greeks—we do not have to distinguish the *uses* of identity, existence, predication and the general conditional (subsumption). In some cases it is quite impossible to make the distinction in any natural way. Different uses of *is* are distinguished not by reference to different meanings of the operative word but by reference to context. Hintikka's systematic approach to the logic of ordinary language reveals that the traditional or received logic of quantifiers from Frege and Russell is not the only possible model of the semantics of natural language nor is it the most faithful. We will have more to say about this below.

Hintikka's attention to the fit (or failure thereof) between ordinary language and received first-order logic has a number of other important consequences and has served as an important argumentative strategy in much of his work. One prominent case in point is Hintikka's criticism of Chomsky's use of conventional logical form as a representation of the logical form of natural-language sentences. Were Chomsky's account of the nature of quantification in natural language correct, we would be compelled to conclude that no generative methods can fully account for the acceptability of English sentences.⁶⁷

⁶⁵ "Leibniz, Plenitude, Relations and the 'Reign of Law,'" *Ajalus* 31, (1969), 117-144.

⁶⁶ See Hintikka's paper, "'Is,' Semantical Games and Semantical Relativity," *Journal of Philosophical Logic* vol. 8 (1979), pp. 433-468, reprinted in *Paradigms for Language Theory and Other Essays*, vol. 4 of his *Selected Papers*.

⁶⁷ See for example "Quantifiers in Natural Languages: Some Logical Problems II," *Linguistics and Philosophy* 1, (1977), 153-172, and "Quantifiers in Logic and Quantifiers in Natural Language," in *Philosophy of Logic. Proceedings of the 1974 Bristol Colloquium*, Stephan Körner, editor, Basil Blackwell, Oxford, 1976, 208-232. Quantifier phrases behave in natural languages rather like other denoting noun phrases. This fact is not accounted for by using the

Returning to the history of philosophy, if one approaches the work of pre-Fregean philosophers with Hintikka's criticism of the ambiguity thesis in mind, it will actually change how one reads one's predecessors. After all, prior to the 19th century the Frege-Russell ambiguity thesis played no significant role. However, since this thesis is built into our received elementary logic, common applications (by most philosophers and historians of philosophy) of the received logic to pre-nineteenth century work are both dubious and misleading. Why then is our received first-order logic still used as grist for the mill of historians' and philosophers' interpretations of early modern, medieval, and ancient philosophies?

The anachronism of the Frege-Russell ambiguity thesis and, with it, our received first order logic, is not itself a condemnation of the application of logical and semantical analysis of the history of philosophy. Hintikka's work from the 1980's makes this clear, when for example he and Jack Kulas developed their game-theoretical semantics for English quantifiers and anaphoric pronouns.⁶⁸ This treatment relies in no way on the Frege-Russell ambiguity thesis and strikingly, the resulting theory is remarkably similar to Aristotle's theory of categories.

Many have been puzzled by Aristotle's wavering description of his categories: e.g. as widest genera and as etymological categories. Aristotle himself correlated the distinction by using different question words as labels of different categories; his verb for being, for instance, *einai*, is used differently in the different categories. Hintikka argues that Aristotle did not mean just one of these distinctions but rather, all of the above, because in a natural game-theoretical treatment of ordinary-language quantifiers such different distinctions must go together. Aristotle's theory of categories reveals the logical structure of ancient Greek and his categories are an ontological dramatization of this *Sprachlogik*.

To take another example, consider the *historical* development of the notion of induction, specifically, its role in the history and philosophy of science. For instance, many historians of science have found it strange that Newton claims to have derived or *deduced* the most general laws of physics from particular phenomena. Newton's methodology, after all, is strictly experimentalist, in that it relies on controlled experiments. Once we understand that among Newton's "phenomena" are outcomes of controlled

usual first-order logic as one's canonical notation. Hintikka contends that a game-theoretical treatment explains the similarity: each quantifier phrase will denote one particular individual, but only relative to a play of a semantical game. Moreover, the values (denotations) of existential and universal quantifiers are selected by a different player.
⁶⁸ Jaakko Hintikka and Jack Kulas, *The Game of Language* Dordrecht: D. Reidel (1983) and Jaakko Hintikka and Jack Kulas, *Anaphora and Definite Descriptions: Two Applications of Game-Theoretical Semantics*, Dordrecht: D. Reidel (1985).

experiments and, moreover, that what Newton means by *induction* is not making inferences from particulars to general laws but, rather, *extrapolation*, *interpolation* and other combinations of partial generalizations, Newton's claim is made quite clear.

This, Hintikka suggests, has a certain resemblance to Aristotle's methodologically similar assumption that we each have immediate access to certain general truths in so far as we are capable of realizing the relevant forms in our own souls. Thus medieval nominalists, who gave up the Aristotelian idea of a full-fledged realizability of universals, did not have to resort to inductive inference; instead, they postulated suitable "innate ideas" in the mind, thereby demonstrating how it is possible to make up for a paucity of available answers to a given question by strengthening our initial premises. Hintikka's contention is that the problem of induction became a problem as such only after both the metaphysics of forms and innate ideas were discarded.

Not only was "Hume's problem" not a problem before Hume, the reason Hume had a problem to begin with stemmed from a misunderstanding of the nature of the experimentalist methodology in Newton's system. According to Hintikka, Newton did not rely on inference from particulars to general laws. Rather, his methodology presupposed the generalizations and consisted in the extrapolation, interpolation, and integration of already reached partial generalizations. Newton's notion of induction is a quantitative version of Aristotle's puzzling notion of *epagoge*.

Hintikka's historical work is not restricted to the philosophical literature in the narrow technical sense, but includes *belles-lettres*, theology, and aesthetics. This point is easily overlooked because Hintikka is known and admired for looking at the history of ideas from the vantage point of logic and epistemology. Nevertheless, both in his lectures and in a few of his publications, his broader attention to the role and evolution of philosophical ideas outside technical philosophy is revealed. Consider, for instance, his essays on the Bloomsbury intellectuals, whose titles alone reveal quite a bit of the story: "The Longest Philosophical Journey: Quest of Reality as a Common Theme in Bloomsbury" (1995), and "Virginia Woolf and Our Knowledge of the External World" (1979).

Moore and Russell claimed, famously, or infamously—depending on your metaphysical presuppositions—that we *do* have direct access to reality in virtue of the fact that in an experience we can, at least in principle, distinguish the experience as an event in your consciousness, from the object of this experience. The object experienced is not merely subjective. Rather, it belongs, or better to say *is part* of reality in Moore and Russell's view. What, then, are the "objective objects," given to you in different kinds of experience? Hintikka explains a parallelism between, on the one hand, the quest by Moore and Russell of the objects of perceptual experience and, on

the other hand, the search by Bloombsbury's art theorists for the basic objects of aesthetic experience.

This search is illustrated by Rickie, the protagonist of E. M. Forster's *The Longest Journey*. Forster's novel opens with a parody of sophistic Cambridge philosophy undergraduates questioning the reality of external objects: does the world exist when I do not perceive it? Does the cow? As the novel unfolds we discover that this is in fact the theme of the novel; Rickie's story is a prolonged quest for immediate contact with fellow humans and the world, in brief, a quest for reality. What Rickie hopes to avoid is the stultifying effect of conventional social norms and institutions, including conventional marriage and family life, which separate him from others. Forster sometimes described the effect of the kind of marriage that Rickie manages to avoid as being like an "astonishing glass shade" that falls between the couple and the world. Rather than facing the doomed longest journey towards death in an unhappy marriage – to echo the original home of the phrase in Shelley's *Eppisychidion* – Rickie rejects exclusivity in favor of immediate and unrestricted connection with other people.

The members of Bloombsbury were desperate to 'connect' with the world without the intrusion of any kind of mediating factors. Hintikka suggests that knowledge by acquaintance, in Russell's sense, has the same basic character. When Rickie reaches his goal, he finds that life has a new and refreshed meaning, "Because, as we used to say at Cambridge, the cow is there. The world is real again. This is a room, that is a window, outside is the night —." This sentence, Hintikka points out, is almost a paraphrase of G. E. Moore's (in)famous "proof of the existence of the external world" before the British Academy where he held up his hands and said, "This is a hand that is a hand, hands are external objects, hence the external world exists." The search for the objects of immediate awareness is part of the Bloombsbury Group's overall quest for authenticity and immediacy.

Likewise, in his other "Bloombsbury" paper, Hintikka reveals parallels between Russell's construction of the physical world in *Our Knowledge of the External World*, consisting in the experiences of real and possible observers, and Virginia Woolf's construction, through her fictional characters' stream of consciousness, of fictional worlds. These and other such essays by Hintikka are examples of how his rendering of philosophical problems, ideas and concepts reaches well beyond the narrow limits of technical philosophy.

As we turn in earnest to some of the technical details of Hintikka's work in logic and semantics, we will return to some of the historical claims touched upon here. For now, we are merely pointing to some of the highlights of Hintikka's conceptual engagement with the history of philosophy. We have, of course, left most of Hintikka's historical work out of our story. In fact, we have omitted his two most prominent historical

studies, namely, his performative reading of Descartes' Cogito argument and his extensive work on Wittgenstein.⁶⁹ However, a comprehensive survey of this kind is well beyond the scope of this essay.

2. NO EXIT? HINTIKKA AND THE LIMITS OF LANGUAGE

Hintikka's view of the nature of language is informed by a significant distinction between two contrasting views of the relationship of language, reality and human knowledge. While the distinction goes back to Leibniz's contrast between two different projects in logic, namely, *lingua universalis* vs. *calculus ratiocinator* it was articulated in its most influential modern form by Jean van Heijenoort in his paper, "Logic as Language, Logic as Calculus."⁷⁰ Unlike Leibniz and van Heijenoort, Hintikka calls these two contrasting views either *language as the universal medium* vs. *language as calculus* or sometimes the idea of the *universality of language* and of the *model-theoretical view of language*.

These terms are anything but self-explanatory. By "universality" in e.g. "language as the universal medium," Hintikka does not mean some universal features of actual languages. He means, rather, a kind of "inescapability." For the universalist, language is an "iron curtain" between reality and us. We cannot avoid the medium nor can we change it by means of language for the simple reason that everything we say already presupposes the meanings of our language. We thus cannot by-pass the iron curtain and, as it were, speak to what is on "the other side." As such we are simply incapable of seeing how language is related to nonlinguistic reality. Readers should recognize immediately the Kantian and Wittgensteinian quality of this universalist view. Symptomatic of the universalist conception of language are, for instance:

- 1) the continuing fascination in certain philosophical (and broader) circles with the notion of ineffability
- 2) the rejection of metaphysics as nonsense
- 3) the failure of the broader philosophical community to recognize the usefulness of model theoretic techniques in philosophy.

⁶⁹ See e.g. Chapter 8, "Hintikka's Wittgenstein," in Daniel Kolač, *On Hintikka*.
⁷⁰ van Heijenoort, Jean, 1967: "Logic as language and logic as calculus," *Synthese*, vol. 17, pp. 324-330.

The core of the received universalist conception is the view that the semantics of a language is inexpressible in that language. And because meaning relations of a language are inexpressible in that same language, the crucial semantical concept of *truth* is indefinable. That is, according to ideas of language as the universal medium, the notion of truth applied in your working language cannot be defined in that language. Consequently, universalists have great difficulty accepting any sort of correspondence theory of truth. Just as seriously, a universalist cannot describe how meaning relations of his or her language might systematically vary. Since the fundamental idea of model theory is the study of what happens as a consequence of such variation, we can see why, according to this view, model theory has little to contribute to the philosophy of language. For universalists, there simply cannot be any systematic model theory for ordinary discourse. We thus cannot speak about any but our actual world in our language, since trying to speak about some other possible world would presuppose a linguistic shift in the references of our expressions. Consequently, we have to speak as if only the actual world were relevant to our language and its semantics. Nor is there a place within a universalist position for the notions of metalanguage or metatheory. This is what Hintikka dubs the "one-world view."

For a universalist, then, logical truths are truths about the actual world, not about all possible worlds, as Leibniz or Carnap supposed. Russell expressed the same point by saying that the truths of logic are as much about the constituents of reality, i.e., the actual world, as are the truths of zoology, birds and bees.

Thus, to take another example, Wittgenstein defends the ineffability of semantics in the *Tractatus*, without subscribing to the one-world-view. What he does is to adopt instead the lesser, but not unrelated, view that when we speak of different states of affairs we are nevertheless in each case speaking of the same objects, in so far as all possible states of affairs consist in the same simple objects, the same "substance." Tarski similarly showed us the means for defining truth for explicit first-order languages using a richer metalanguage, providing us with a model theory for such languages while at the same time denying the possibility of our ordinary, "colloquial" language having any consistent notion of truth.

Since, for the universalist, the semantic aspects of language cannot be discussed in language and hence cannot be theorized about, the universalist is forced to cultivate a syntactical, i.e., purely formal, study of language. This, in spite of the fact that some universalists, most notably Wittgenstein, suggest definite relations between language and reality. These relations, a proponent of the language as calculus view could argue, make it possible for

us not only to speak, but to provide us with something to speak about, within well defined limits. As such, they surely form the basis for precisely the kind of theorizing that the universalist wishes to block.

The alternative view, "language as calculus", can be understood as a view which embraces precisely those lines of inquiry deemed impossible or illegitimate in the universalist view. However it must be kept in mind that by the phrase "language as calculus" we should not be read as endorsing the notion of language as an *uninterpreted* calculus. Rather, according to this view even our interpreted language, like a calculus, is freely re-interpretable.

The definitive source for studying this fundamental contrast between two opposing philosophies of language is Hintikka's second volume of selected papers, *Lingua Universalis vs. Calculus Ratiocinator* (Kluwer, 1997). Here Hintikka demonstrates and explains how the universalist view has dominated analytic philosophy for well over a century, and why it held sway over Frege, Russell, Wittgenstein, Quine and Church. For a while it held in its grips the entire Vienna Circle, as evinced by their preference for what they dubbed the "formal mode" of speech vs. the "material mode." Chomsky's preference for syntax over semantics may well be another case in point. Gradually, however, logicians were inspired by the various advances contained in Gödel's incompleteness theorems to move beyond the universalist bent for the primacy of syntax. Attempts to force even these theorems to purely formal and computational frameworks persisted for a number of years, but eventually the calculus or model-theoretical view has gained more philosophical respectability, while earlier defenders of the then unpopular calculus view, such as most notably Charles Peirce, have of late grown in stature.

Although Hintikka's publications on the universalist vs. calculus views are focused on the analytic and pragmatist traditions, his broader understanding in relation to the so-called continental philosophies are well known by his students and followers, whom he has inspired to build philosophical rapprochement. Martin Kusch, for instance, one of Hintikka's students, has applied Hintikka's distinction brilliantly to illuminate historical differences in the continental tradition. In his *Language as Universal Medium vs. Language as Calculus: A Study of Husserl, Heidegger and Gadamer* (1989), one of the most significant bridges between the analytic and continental traditions of the past several decades, Kusch dramatically illustrates how different philosophical stances toward Hintikka's distinction helped shape the development of phenomenology since Husserl.

The illuminating distinction between language as a universal medium and language as calculus exemplifies Hintikka's fusion of historical and systematic analysis. The two ways of understanding language have clear parallels at the level of what might seem to be dry and abstract logico-epistemological results. By examining the conceptual situation in the

technical context, we can arrive at a precise and clear way to understand and take a principled stand on one of the grand themes in Twentieth Century philosophy.

Some of the best evidence for the universalist view was once thought to be Tarski's theorem showing that explicit first-order language can only be defined in a richer metalanguage. Since no metalanguage beyond or above our actual working language exists, it was widely believed that our applied "colloquial language" cannot provide a definition of truth, such that the semantics of our own language is to a great extent bound to be inexpressible. But now Hintikka's IF (independence friendly) logic, as we shall show in Section Four below, has illuminated the reason Tarski's result holds: Tarski restricts his analysis to languages with an arbitrarily restricted logic. As we shall see, by overcoming this artificial restriction on first-order logic, Hintikka's technical advances help establish the case for the "language as calculus" view. The implications of this shift are significant. For example, in "Contemporary Philosophy and the Problem of Truth" (1996), Hintikka contends that the expressibility of semantical concepts such as "truth in the same language," renders hermeneutical approaches to language and thought unnecessary.

Similarly, Hintikka's systematic criticisms of Quine (e.g. "Three Dogmas of Quine's Empiricism,"⁷¹ and "Quine's Ultimate Presuppositions,"⁷²) illustrate the broader consequence of Hintikka's perspective for ideas currently central to the work of many leading Anglo-Saxon philosophers. First is the one-world assumption, according to which "the only purpose of our factual discourse . . . is to represent things as they are in this one actual world of ours," which Hintikka's analysis contends is, on the one hand, far too ontologically ambitious and, on the other, too naively realistic. English speaking (and thinking) philosophers who, like Quine, know only the "real world" know of it very little, as Hintikka quotes Kipling's famous lament: "What do they know of England who only England know?" Hintikka's serious point, which he makes light of, is that we cannot do justice to our epistemic practice if we insist on using logic as if there were but one all-comprehensive domain of discourse. It is important to point out too that what blocked realists from interpreting modal logics for Quine was none other than this one-world assumption.

Another important Quinean commitment that comes under critical scrutiny is what Hintikka calls the "atomistic postulate." This is the notion that the input of information into an epistemic system will always take the form of particular, quantifier-free truths. According to Hintikka, if we

⁷¹ *Revue Internationale de Philosophie*, 1997.
⁷² *Theoria*, 1999.

actually examine the formation of scientific theories or even simple informal claims to knowledge, we will find that the "atomistic postulate" is not only defective but misleading. The problem with the atomistic postulate is that it grossly misrepresents actual scientific practice, where nature's answers to our questions—Hintikka's apt characterization of the experimental method—take the form of results from controlled experiments. The results of controlled experiments, as Hintikka argues persuasively, offer a counter-example to the atomistic postulate, since there is no to express them without including some reference to generality. We will have much more to say about the atomistic postulate below.

The fourth Quinean notion that Hintikka criticizes is the view that logic, in the sense of formal inference relations, plays the role of holding our theoretical structures together. If one drops a purely syntactical conception of logic and cognition, then Quine's web of belief must be made of stronger stuff than mere rules for the transformation of schemata. Hintikka has argued that logical relations between propositions cannot be reduced to formal rules of inference. And in a sense, this lesson can already be drawn from Gödel's incompleteness theorems. Quine's attempt to understand logical inference purely formally or schematically runs counter to the entire model-theoretical tradition in logic. One could reject the model-theoretic tradition but, in doing so, one would need to ignore the fact that Gödel's incompleteness theorems seem to make the model-theoretical approach indispensable.

3. HINTIKKA'S EPISTEMIC LOGIC

Hintikka is best known among philosophers, logicians and computer scientists as the creator of modern epistemic logic. His 1962 book *Knowledge and Belief: Introduction to the Logic of the Two Notions* has served as the basis for all subsequent work in this important field. Originally, epistemic logic simply involved the addition of an epistemic operator K to ordinary first-order logic. The relatively formal nature of this work should not be disconnected from what Vincent Hendricks calls "the epistemological ambition of the early Hintikka."⁷³ The semantics of this supplemented first-order logic are modal in nature insofar as to talk about what a person knows is to specify a set of possible scenarios. This space of possible scenarios is divided between those that are compatible with what an agent knows, and those that are not. This is a relation between a knower a in the scenario w_1 and those scenarios that are compatible with everything the knower knows in w_1 . a knows S in w_1 iff it

⁷³ See Vincent Hendricks *Forcing Epistemology*, forthcoming, Cambridge University Press.

is true that S in all scenarios w^* accessible to a from w_1 . w^* is the set of epistemic alternatives to w_1 for a , they are what Hintikka calls a 's knowledge worlds in w_1 . The epistemic operator K_a therefore functions as a universal quantifier ranging over all a 's knowledge worlds. So, not only is one's attitude towards the notions of possibility and necessity important to one's view of epistemic logic, but perhaps even more importantly, the behavior and nature of quantifiers becomes appreciable in Hintikka's presentation as one of the most critical topics in the development of epistemic logic.

We will return to some of the details of the epistemic logic below. However, Hintikka's contribution to epistemic logic is not restricted to the development of a useful formalism. He has begun to rethink all of epistemic logic in a strikingly simple and intuitive manner. Rather than focus on traditional epistemological debates over various modifications to the justified true belief model, Hintikka has developed an approach that models knowledge-seeking and belief formation as a questioning process. In a sense this approach is not radically new, for it can be thought of as an updated version of the Socratic method of questioning. However, the approach allows analyses and applications in a completely precise manner once we have an explicit logic of questions and answers in place. A completely general logic of this kind has recently been formulated as a part of his "second-generation epistemic logic."

Hintikka is in the process of applying the resulting "interrogative model of inquiry" to different epistemological problems. In a series of papers that will appear within the next year or so, Hintikka will argue for the irrelevance of philosophers' notions of knowledge and belief to the actual processes of knowledge-seeking (See, for instance, his forthcoming "Epistemology Without Knowledge and Without Belief"). According to Hintikka, philosophers would benefit by adopting a more pragmatic approach to epistemological theorizing. We use the term 'knowledge,' he suggests, as an honorific label that we attach to information that we are entitled to act on. Information rather than knowledge is the stuff of epistemology, according to Hintikka and, in this new model, the notion of acceptance replaces that of belief.⁷⁴ Additionally in his recent work, Hintikka urges us to revise our view of the varieties and different uses of the notion of information (including its uses in computer science and neuroscience), the presuppositions of questions as revealing the presuppositions of inquiry, the presuppositions of answers as revealing the a priori element in empirical inquiry, the logic of experimental inquiry, the different senses of the notion

⁷⁴ See the brief abstract of his forthcoming paper on this topic in the annotated bibliography in this volume.

of induction, and the notion of explanation (including "how possible" explanation).

An especially intriguing application is to the famous theory of cognitive fallacies developed by Tversky and Kahneman. Hintikka has argued that the so-called conjunctive fallacy is not necessarily fallacious at all. He is extending this point to a general refutation of the Tversky-Kahneman theory, including the other alleged fallacies, especially the so-called base rate fallacy and including the Bayesian presuppositions of the theory. Another application of the interrogative model concerns the question whether omitting data in experimental science is always a violation of scientific methods.

Of course, what makes it difficult, if not impossible, to present the full scope of Hintikka's view of epistemology is that the most philosophically dramatic claims of his second-generation epistemic logic have not yet appeared in print. We have only been able to sketch some of that material here from lectures, conversations and some unpublished material. Again, Hintikka's forthcoming *Socratic Epistemology*⁷⁵ will provide a detailed and unified presentation of these developments.

This having been said, it should also perhaps be pointed out that, from a historical point of view, Hintikka's epistemological revolution in the making might seem so traditional as to be downright counter-revolutionary. Hintikka sees the entire knowledge seeking enterprise as a related series of questioning procedures put to different sources of information. Scientific knowledge is the quest for answers from nature in the form of observations resulting from controlled experiments. This is what Hintikka means when he calls his "the conception of inquiry as inquiry." Knowledge as inquiry means knowledge resulting from interrogation, modeled after the Socratic *elenchus*. The Socrates of Plato's early dialogues claims he asks people questions because he knows nothing. This usually leads, irony of ironies, to Socrates' interlocutors realizing their own ignorance. Perhaps it's not just misery but ignorance too that loves company. But in Plato's middle and late dialogues *elenchus* ceases to be subtly deconstructive and becomes often not very subtly constructive, as when Socrates strategically interrogates Meno's slave toward the expression of a geometrical truth. The model of knowledge-seeking as questioning is a natural product of the spirit of *elenchus*.

Aristotle's *Topics* and *On Sophistical Refutations*, systematic studies of the Socratic questioning games practiced in Plato's Academy, both used question techniques that included the search of the first premises of different sciences keenly tuned on the winning strategies. Just as every trial lawyer knows that success in questioning a witness depends crucially on being able

⁷⁵ Forthcoming with Cambridge University Press.

to anticipate the answers one is likely to receive, Aristotle according to Hintikka is drawing our attention to the art of predicting answers we might get in a questioning game played against various "oracles."

There is a class of answers that any rational person must give, answers that are logically implied by the same answers and their relation to their antecedents, Aristotle discovered systemic relations of logical consequence. In this way Hintikka establishes his view that logic itself originated as result of the study of questioning games. One crucial difference from the traditional Socratic method is that Hintikka's method of questioning requires that the predetermined answers, which he calls logical inference steps, be clearly distinguished from genuine interrogative steps for the simple reason that even if they are responses to questions, what matters is not the interlocutor's identity or attributes but, rather, that the premises occur earlier in the dialogue. As Aristotle put it, *ad argumentum*, not *ad hominem*, is how we must judge our logical inference steps. But now one might wonder why, if the fundamentals of the interrogative approach has been with us so long, why has it not been perfected long ago? The reason is that to use it successfully, one must be armed with an explicit logical theory of questions and answers. No such theory existed before Hintikka's groundbreaking work on the subject.

We do not mean to imply that the logic of questions and answers has not been duly studied. Indeed it has, but without arriving at a satisfactory, fully general, theory. But what might one mean here by *satisfaction*? In this case, satisfaction presupposes solutions to such problems as concern the logical form of questions and the question-answer relation. In other words, there must be distinct parameters, clearly expressible in logical notation, of when a given response is in fact a fully satisfactory answer to a given question? Likewise, *generality* in this case presupposes our being able to analyze all the different forms of questions. That Hintikka has fully solved these problems with a fruitful theory is no less remarkable than the fact that we are presently forced to piece it together from various notes and writings primarily addressed to other subjects. Once again, Hintikka provides no full-scale systematic presentation.

The first step we must take is to approach the logic of questions and answers in view of the obvious truth that they are not statements, whereas our usual logic is one of statements. Here is how Hintikka suggests we solve this problem. We start by noting that questions are themselves primarily and essentially epistemic, insofar as a question expresses the purpose of our coming to know some particular truth. That is why the logical properties of questions is determined, by and large, by their epistemic aim expressed as such by the statement specifying the epistemic state which we want any

