JAAKKO HINTIKKA

A SECOND GENERATION EPISTEMIC LOGIC AND ITS GENERAL SIGNIFICANCE

1. THE PRIMA FACIE CONUNDRUM OF EPISTEMIC LOGIC

Epistemic logic was practiced already in the middle ages (see (56), (70)). It was thrust to the awareness of contemporary philosophers by von Wright in his *An Essay on Modal Logic* ((79), see chapter 4). In this paper, I will consider epistemic logic primarily in relation to its epistemological applications. Surely any satisfactory epistemic logic ought to be able to prove its mettle as an epistemo-logic, to coin a phrase. From this perspective, the half-century long career of epistemic logic presents us with something of a paradox. Epistemic logic was created by philosophers for philosophical purposes. It is one of the core areas in what is (misleadingly) known as philosophical logic. Yet its most promising philosophical suggestions were put forward relatively late, and even then they have received but lukewarm attention on the part of philosophers. These potential philosophical applications are in my judgment incomparably more interesting and significant than the technicalities of epistemic logic that routinely receive the lion's share of attention in books and papers on epistemic logic. In typical surveys of epistemic logic (cf. (72), (74)), little attention is paid to the epistemological perspectives opened by epistemic logic.

There are several partial explanations of this paradoxical state of affairs. Reasoning about knowledge has become an important subject in such branches of computer science as AI and data base theory. Epistemic logic has been harnessed to the service of such studies, which has encouraged work on the more computation-oriented aspects and hence more technical aspects of the subject. Furthermore, since epistemic logic provides a refutation of Kripke's so-called New Theory of Reference (see (68) and cf. below), the uncritical acceptance of this 'theory' has discouraged serious interest in epistemic logic.

Even more generally, in spite of a nearly unanimous professed rejection of formalistic philosophy of logic and mathematics by contemporary philosophers, their argumentative practice exhibits a formalist bias. They tend to feel safest in discussing the formal behavior of different notions. When they venture on the uncharted seas of interpretational questions, their ideas are far too often arbitrary and myopic. A simple example may illustrate what I am saying. I understand perfectly what kind of reasoning the logicians have in mind when they speak of reasoning in terms of 'arbitrary individuals', but the notion of such an individual has by itself no explanatory value. I have never seen, heard, smelled, touched or kissed an arbitrary individual. Reifying logicians' jargon into such chancy entities seems to me entirely, well, arbitrary.

V.F. Hendricks, K.F. Jørgensen and S.A. Pedersen (eds.), Knowledge Contributors, 33–55.

Nevertheless, it seem to me that there are—or perhaps I should say there were—valid reasons for philosophers' suspicion of the promised philosophical applications of epistemic logic. In this paper, I propose to outline, first, what the promises were, second, why they did not at first pan out and, third, how those reasons for disregarding the philosophical implications of epistemic logic can be removed by means of important new ideas which can be said to launch a new generation of epistemic logics.

But, first, what was the old first-generation epistemic logic like? Syntactically, all that we need is to add to a suitable many-sorted but otherwise ordinary first-order language epistemic operators of the form K_a, to correspond roughly to the English expression *a knows that*. Often the identity of the knower does not matter. Then we can drop the knower indicator and read K as *it is known that*. This notation may not be entirely self-explanatory. For one thing, it hides the fact that the knower indicator a is semantically speaking outside the scope of the epistemic operator. Further clarifications are made in the following when we proceed.

Many of the basic properties of epistemic logic emerge already in application in which we have only one epistemic operator.

But what is the semantics of such an epistemic language? In order to answer this question, it is useful to raise the question of the pragmatic role of our notion of knowledge. Why do we have this notion in our conceptual repertoire? Suppose I am some morning considering how to prepare for the trials and tribulations of the impending day. Should I carry my raincoat and my umbrella? Should I don a suit in order to impress my boss? Then I learn from the weather forecast that the day will be sunny and warm and from my trusted secretary that my boss will be out of town. How does this enhanced knowledge affect my behavior? I do not have to tell you. I leave my raincoat and umbrella at home and instead of the uncomfortable suit don a comfortable blazer. What has happened? What has happened that I have been able, because of my newly acquired knowledge, to leave out certain possibilities as to what might happen during the day out of my planning and other considerations.

This shows the general conceptual role of the notion of knowledge. In order to speak of what a certain person a knows and does not know, we have to assume a class ('space') of possibilities. These possibilities will be called scenarios. Philosophers typically call them possible worlds. This usage is a symptom of intellectual megalomania. In most applications 'possible worlds' are not literally worlds in the sense of universes but merely 'small worlds', that is, so many applications of the language in question, typically applications to some relatively small nook and corner of our four-dimensional world. Such a space of scenarios is essentially the same as what probability theorists mean by sample space. It might be called the epistemic space. Depending on the application, the elements of

that space can be states of affairs or sequences of events. What the concept of knowledge accomplishes in any case is a dichotomy (relative to the knower) of the elements of the epistemic space into those that are ruled out by a's knowledge and those that are compatible with everything he or she (or it, if we are dealing with a computer) knows in a given scenario. Its abstract semantical manifestation is relation $R(a, w_1, w_2)$ between a knower a in the scenario w_1 and those scenarios w_2 that are compatible with everything a knows in w_1. It is then true that a knows in w_1 that S if and only if it is true that S in all the scenarios w^* such that $R(a, w_1, w^*)$. These scenarios w^* are called the epistemic a-alternatives to w_1 or more loosely a's knowledge-worlds in w_1.

Thus the epistemic operator K_a is a kind of quantifier, viz. a universal quantifier ranging over a's knowledge-worlds. Much of the logic and semantics of epistemic notions can be considered as implications of this simple insight.

This pragmatic motivation of epistemic logic calls for several comments. For one thing, in order to be considered seriously for the purposes of acting (or of being acted on), the possibilities that I have called scenarios must be in some sense real (concrete) possibilities. Hence it is not realistic (pace the likes of Chalmers) to introduce a separate dimension of epistemic possibilities different from real or metaphysical ones.

Furthermore, what has been said does not separate the notion of knowledge from those of information or even true belief. All of them have a similar role in guiding our actions. All of them induce similar dichotomies of the epistemic space, and all of them have therefore a similar logic. One difference is that in the case of knowledge the rejection of excluded scenarios must be justified. However, much of the logic of knowledge is independent of the precise nature of this justification. For this reason, it need not be discussed here.

Another difference is that it is usually required that whatever is known must be true. This requirement is not discussed here, either. It is impossible to implement in many real-life applications of epistemic notions. For this reason, it might in fact be more appropriate to speak of the logic of information than of the logic of knowledge. Unfortunately the term 'information' has other misleading overtones. But fortunately this issue does not affect what will be done in this paper.

Another problem area which I will not deal with fully in this paper is the behavior of identity. One reason why it would need a longer discussion is that the received approaches are seriously off the mark. The source of the problem is the fact that in epistemic and other intensional context we have to consider individuals as potential members of several scenarios. This is true in particular of individuals considered as values of bound variables. Hence we must have—or, rather, there must be implicit in the

http://www.springer.com/978-1-4020-1747-6

Knowledge Contributors

Hendricks, V.F.; Jørgensen, K.F.; Pedersen, S.A. (Eds.)
2003, IX, 203 p., Hardcover
ISBN: 978-1-4020-1747-6