JAAKKO HINTIKKA

CARNAP'S SEMANTICS IN RETROSPECT

One of the most genuine tributes one can pay to any thinker who has recently passed away is to be able to say that his work does not have to be given a special consideration as a kind of venerable museum specimen but can be discussed on its own merits as if its author were still among us. This tribute we can pay in full measure to Rudolf Carnap's work in logical semantics as in other areas, and I am sure that it is the way in which Carnap himself would have preferred to have his work remembered.

In this paper, I shall accordingly not shy away from those aspects of recent discussions of semantics which might at first appear to by-pass Carnap's work or even to stand in an opposition to it. An important additional reason for doing so lies in the fact (which I shall try to argue for) that much of this recent work in semantics is, appearances notwithstanding, an outgrowth of Carnap's ideas or consists of attempts to solve the important problems Carnap raised in semantics. Much of the credit of his successors' work is thus due to Carnap.

What, then, is crucial in Carnapian ideas? Recently, it was said by David Kaplan that Carnap's *Meaning and Necessity* – the book I will mostly concentrate on – represents the culmination of the golden age of (logical) semantics.[1] This age, if I have understood Kaplan correctly, is supposed to extend from Frege to Carnap, and to be characterized by that familiar contrast which in its several variants has been known by such labels as *Bedeutungen* vs. *Sinne*, references (or nominata) vs. senses, or extensions vs. intensions. In *Meaning and Necessity* Carnap uses the last pair of terms.[2]

Carnap's work in *MN* and elsewhere may very well seem to be the end product of this tradition. The importance of the extension-intension dichotomy to him is amply shown by the table of contents of *MN*. It reads, in part:

I. The Method of Extension and Intension.

---

5. Extensions and Intensions.

Synthese **25** (1973) 372–397.

6. Extensions and Intensions of Sentences.
---
9. Extensions and Intensions of Individual Expressions.
---
11. Extensional and Intensional Contexts.

---
22. L-determinate Intensions.
23. Reduction of Extensions to Intensions.
---
28. Frege's Distinction between Nominatum and Sense.
29. Nominatum and Sense: Extension and Intension.
---------.

And even in sections whose titles do not sport the terms 'extension' and 'intension' these two concepts loom large. For instance, the fourth of Carnap's five chapters is devoted almost exclusively to the question of how the distinction is to be accommodated in one's metalanguage.

MN represents the Fregean tradition also in that Carnap emphasizes the primacy of intensions over extensions, to the point of speaking of a reduction of extensions to intensions (*MN*, Section 23). In his own abstract of Section 27 we likewise read: "... a semantical rule for a sign determines primarily its intension; only secondarily, with the help of relevant facts, its extension." This goes back in some form or other to Frege who said in so many words that "in the conflict between extensional and intensional logicians I am taking the side of the latter. In fact I do hold", Frege continues, "that the concept is logically prior to its extension."[3]

The intensions we need in a Carnapian semantics include such old friends of philosophers as propositions, properties (as distinguished from the classes they determine), and individual concepts. Needless to say, their *prima facie* philosophical importance could not be greater. The postulation of such intensional entities has been claimed by Carnap's critics to violate the standards of enlightened scientific empiricism. The most important of these critics is W. V. Quine.[4] It has been made beautifully clear by Quine himself how much of his philosophy of language can be understood as a reaction to Carnap's semantics.[5]

This is not a place to try to adjudicate the whole of Carnap-Quine exchange. It seems to me fair to say, nevertheless, that Quine has spotted certain weak spots in Carnap's position, at least insofar as *MN* is concerned. This is not decisive, however, for I shall argue that Carnap's ideas

allow for developments which serve to solve Carnap's difficulties to an incomparably greater extent than the critics, and the philosophical community at large, have so far acknowledged. At the same time, these developments show that the strict intension-extension contrast is far too narrow a framework for a realistic semantics, and that Carnap's own ideas can easily be extended so as to widen this framework essentially. These, at any rate, will be the main theses of the present paper. If I am right, Carnap was not the last Mohican of Fregean semantics, based on the extension-intension contrast, but rather the first and foremost herald of a new epoch of possible-worlds semantics.

Usually, Carnap's critics have focused on what the critics claim amounts to the unobservability or perhaps rather inevitable empirical underdeterminacy of intensions. To put their point very briefly: We cannot ever hope to find out for sure what the intensions are that underlie a heathen tongue – or our own idiolect, for that matter. All the speech disposition of the speakers of any given language are compatible (according to Quine) with the postulation of more than one set of incompatible intensions.

These criticisms seem to me somewhat premature – as premature in fact as the views under criticism. We shall return to the problems of empiricism and observability later. Meanwhile, I want to emphasize that the true weakness of Carnap's position in *MN* is not the non-empirical character of his main semantical concepts. Especially in some of the papers appended to the second edition of *MN*, Carnap in fact presents plausible arguments to show that his concepts do carry an empirical import. The reason why these arguments have not swayed more philosophers than they have done is not so much due to the arguments themselves. It is due to the fact that the crucial intensional concepts themselves were not analyzed far enough by Carnap in *MN*. They were not developed in a way which would have created a viable framework for Carnap's own arguments and for the further development of his semantics, e.g., so as to allow a natural and convincing treatment of belief-sentences. What is missing in *MN* are not reasons for the empirical character of intensional concepts but rather all penetrating analyses of them in some more informative and more easily operationalizable terms.

Whoever deserves the credit for the analyses which we just found wanting in *MN*, they are found in a full-fledged form in what is often called

possible-worlds semantics. Its main outlines will emerge from a comparison with Carnap's position in *MN*.

The historical fact which one cannot but find absolutely fascinating is that in *MN* Carnap came extremely close to the basic ideas of possible-worlds semantics, and yet apparently did not formulate them, not even to himself. The conceptual framework developed in the first chapter of *MN* is that of state-descriptions. It is in terms of state-descriptions that Carnap defines all his crucial concepts, such as those of range, L-truth, L-equivalence, identity of intensions, and so on.[6] Technically, this almost amounts to a possible-worlds semantics. All that Carnap had to do here was to take a good hard look at his state-descriptions and to ask: What are they supposed to be descriptions *of* in some realistic, down-to-earth sense? One natural answer is that they are descriptions of the different possible states of affairs or courses of events (in short, 'possible worlds') in which a speaker of the language in question could conceivably find himself and which he could in principle distinguish conceptually from each other. From this answer it is only a short step to the crucial idea that the rules for using the language will have to be shown – in principle – by the way a well-informed speaker would use it in these different circumstances according to the rules, i.e., by the extensions which the expressions of the language would have in those several 'possible worlds'. This is all we need to arrive at the basic ideas of possible-worlds semantics.

It is especially tantalizing to see that Carnap in fact says in so many words in *MN* that his state-descriptions "represent Leibniz' possible worlds" (p. 9). In his intellectual autobiography,[7] Carnap likewise mentions Leibniz' possible worlds as one of the original guiding ideas of his distinction between logical truth and factual truth (p. 63). What is missing is thus apparently only an insight into the possibility of using these possible worlds for the purpose of analysing the intensional objects Carnap in fact leaves unanalysed in *MN*.

The move from *MN* to possible-worlds semantics is closest at hand in the case of intensions of sentences, i.e., in the case of propositions. The class of those state-descriptions in which a sentence '*S*' is true is called the *range* $R(S)$ of '*S*' (*MN*, p. 9).[8] According to Carnap, this range determines the identity of the intension $I(S)$ of '*S*' in the sense that $I(S) = I(S')$ iff $R(S) = R(S')$ (*MN*, p. 23, Def. 5–2). In the same sense, $R(S)$ determines the proposition expressed by '*S*'. What, then, is more natural

than to *define* this proposition as $R(S)$ or as something closely related to $R(S)$, such as the characteristic function of the set of worlds described by the members of $R(S)$? In the latter case, propositions will be functions from possible worlds to truth-values. This definition is most natural because it is natural to say that to understand a proposition is to know what restrictions its truth places on the world. Such restriction is precisely what the membership in the set of worlds described by the members of $R(S)$ amounts to. Here we have a good example of the kind of structural analysis of fundamental semantical notions which possible-worlds semantics enables us to carry out but which I found missing from *MN*.[9]

This kind of structural insight is not restricted to intensions of sentences. Historically, perhaps the most crucial question is what can be said of the intension $I(i)$ of an individual expression 'i'.[8] In *MN*, Carnap never formulates explicit criteria for the identity of the intensions $I(i)$ and $I(i')$ of two individual expressions 'i' and 'i'' comparable with his criteria for the identity of the intensions of sentences. Implicit in his discussion (see e.g. p. 40) is nevertheless a criterion according to which $I(i) = I(i')$ iff '$i = i'$' is true in every state-description. By the same token as in the case of the intensions of sentences, this naturally leads us to identify the intensions of individual expressions (dubbed by Carnap *individual concepts*) with functions that for each possible world W pick out a member of some domain of individuals (or with some essentially equivalent entity). (This domain must obviously be thought of as depending on W, if we want to have a flexible, presuppositionless treatment of the situation.[10]) Thus if $I(i)$ is the intension of 'i', the function I must be thought of as having a second argument, too, and thus as being of the form $I(i, W)$, where W is the possible world in which we are considering the reference of 'i'.

In fact, one's interpretation of the intensions of sentences as sets of possible worlds (or, essentially equivalently, functions from possible worlds to truth-functions) tends rather strongly to prejudice the case for a similar treatment of individual expressions. As I have pointed out on several occasions,[11] if one introduces the modal operators 'N' ('necessarily') and 'M' ('possibly') and formulates the truth-conditions in the most natural manner imaginable, merely requiring the substitutivity of identity for atomic expressions, then it can be shown that be criterion of substitutivity, (say of 'a' and 'b' for the case of just one layer of modal operators) is the truth of '$N(a = b)$'. According to the treatment of sentences, how-

ever, this is true iff '$a = b$' is true in all (relevant) possible worlds, i.e., iff 'a' and 'b' pick out the same individual from each of these possible worlds. This is the analogue to Carnap's explicit criterion for the identity of the intensions of two sentences, and in the same way suggests the identification of $I(i)$ with a function from possible worlds to their respective domains of individuals.

What is remarkable in this analysis of individual concepts is how very closely it comes to the intentions (with a 't'!) of modern semanticists from Frege on. Frege said that the intension (*Sinn*) of a name must include more than just its reference. It must also include *the way in which this reference is given* (*die Art des Gegebenseins*, 'Sinn und Bedeutung', p. 26 of the original edition[12]). Now the functional dependence which this phrase "way of being given" clearly means can – and must – be spelled out by specifying how the reference depends on everything it might depend on, which in the last analysis is the whole possible world we are dealing with.[13] (Of course this does not preclude that it depends only on certain particular aspects of that world!) But this is precisely what the function $I(i,W)$ gives us. Here, possible-worlds semantics therefore follows as closely as one can hope in Frege's and Carnap's footsteps. I cannot but find it very strange that it apparently never occurred to Frege that to speak of "die Art des Gegebenseins" is *implicite* to speak of a functional dependence of a certain sort. There does not seem to be an inkling of this idea in his writings.

Clearly predicators can be dealt with in the same way as individual expressions. Their intensions will be functions from possible worlds to sets of n-tuples of the members of their domains, or some similar entities.

This completes my sketch of the step from *MN* to possible-worlds semantics. The step is so short that it is not surprising to find a report according to which in his unpublished work Carnap did take something essentially tantamount to it. Richard Montague reports in his paper, 'Pragmatics and Intensional Logic',[14] last paragraph, that "Carnap had... proposed in conversation that intensional objects be identified with functions from possible worlds to extensions of appropriate sorts...". In fact, in addition to conversations, Carnap's 'Replies and Expositions' in the Schilpp volume contain a sketch of what he calls "translation of a modal language into an extensional language" (pp. 894–6). Apart from minor technical differences, this 'translation' is to all practical purposes an out-

line of a model-theoretical treatment of intensions, with what Carnap called models playing the role of possible worlds. In fact, propositions are in so many words 'represented' as classes of models, certain other intensions as functions from models to suitable specifications of the properties of their individuals, and the necessity of a proposition amounts to its truth in all possible worlds. In brief, we seem to have here a full-fledged possible-worlds semantics explicitly outlined by Carnap. Yet this impression is definitely misleading. Carnap has most of the basic technical ingredients of a possible-worlds semantics right there in his hands, but he does not know what to do with them philosophically and interpretationally. His notion of a model is not that of a possible world, for he is, e.g., allowing descriptive predicates to be arbitrarily re-interpreted in a model.[15] In a different possible world surely those and only those things are to be called red that *are* red there. Hence the interpretation of descriptive predicates must be assumed to be constant between different possible words. This is *not* required of Carnap's models, however.

Montague reports that, according to Carnap's verbal suggestions, too, "possible worlds [are] identified with models".[16] In other words, possible worlds were not thought of by Carnap as the real-life situations in which a speaker might possibly find himself, but as any old configurations – perhaps even linguistic – exemplifying the appropriate structures. As we shall see, it is this apparently small point that precludes Carnap from some of the most promising uses of possible-worlds semantics.

Although possible-worlds semantics thus may be said to be (in some respects) a natural and perhaps even fairly small further development beyond Carnap, it nevertheless puts the whole of the classical Frege-Carnap semantics into a radically new perspective. Here I shall only comment on three aspects of the new perspective. (1) First, the new semantics opens the door to the treatment of a large class of philosophically interesting notions, thus answering a number of Carnapian questions. (2) Second, I shall argue that possible-worlds semantics shows conclusively the insufficiency of a semantics which is primarily based on the intension-extension distinction. (3) Third, I shall suggest that possible-worlds semantics perhaps points to a way of removing the objections which Quine and others have raised against intensional concepts because of their alleged unobservability, empirical vacuousness, behavioral non-specificity or because of some similar defect.

1. Already in *MN*[17] Carnap put his semantics to work for the purpose of spelling out the logic of modalities ('necessarily' and 'possibly'). It is not always appreciated sufficiently that this made Carnap into the first modal logician to employ semantical methods.

The details of Carnap's modal logic are rather predictable, and need not detain us here. If Carnap had formulated his point in the suggestive terminology of 'possible worlds', all that is really involved in Carnap's modal logic (apart from the treatment of individuals, their existence, and their uniqueness) is the old idea that necessity means truth in every possible world and possibility truth in at least one possible world. Once again, the necessity of dragging along all intensions as unanalyzed entities leads Carnap to a lengthy discussion of how we ought to address them in our metalanguage.

Carnap's failure (in *MN*) to analyze his intensional concepts seems to be a partial reason for a much more serious oversight, however, than his worry about a bunch of somewhat scholastic problems concerning one's metalanguage. The point is perhaps made most forcefully in a somewhat technical-sounding jargon. When propositions become functions from possible worlds to truth-values and individual concepts functions from these worlds to members of their respective domains of individuals, all sorts or interesting conceptualizations can be reached by restricting the domains of these functions (in the relation-theoretical sense of domain) to subclasses of the class of all possible worlds.

The first major novelty in the subsequent technical development of the semantics of modal logics was in fact the idea that not all possible worlds are on a par. Given a world W, only some possible worlds are relevant alternatives to W. Then necessary truth of a sentence in W has to be characterized as its truth (truth *simpliciter*) in all the alternatives to W, and its possibility *a fortiori* as its truth in at least one alternative to W. The first heady discovery in this area was that by imposing simple restrictions on the alternativeness relation we obtain the semantical counterparts to all of the most important axiomatic systems of modal logic.[18] Their semantics is (with one exception) unobtainable in the simple-minded Leibniz-Carnap assumption of the parity of all possible worlds.

This does not seem to affect Carnap's immediate purpose, for he was trying to explicate the notions of *logical* necessity and *logical* possibility. For them, it is natural to argue, all worlds are equal: what is necessary

or possible in one is likewise necessary or possible, respectively, in any other. Hence Carnap's modal logic seems to be unobjectionable as far it goes, and the advantages of the alternativeness relation appear primarily technical.

This is not the whole story, however. The most important philosophical uses of alternativeness relations are for the purpose of studying certain notions in which Carnap was interested, especially the notion of belief. The use of an alternativeness relation makes it possible to accommodate such notions within possible-worlds semantics.[19] In fact, the interpretation of the alternativeness relation itself is exceptionally clear in this case. (It turns out that it has to be relativized to a person.) Worlds alternative to W (with respect to a person a) are then worlds compatible with everything a believes in W. Understanding the concept of belief will then become tantamount to mastering this particular kind of alternativeness relation (relation of *doxastic* alternativeness). How close this comes to our actual ways with notions like belief can perhaps be seen by pointing out that to know what a believes (say, in the actual world) is clearly very close to knowing which possible states of affairs or courses of events are ruled out by his beliefs and which ones are compatible with it. This, of course, is just what the alternativeness relation specifies. Our analysis thus constitutes an important step beyond Carnap in the analysis of the concept of belief.

Carnap was apparently prevented from analyzing the concept of belief in this way by the very same peculiarity which made us say above that he never reached full-fledged possible-worlds semantics, viz. by his failure to interpret his models as genuine possible worlds, i.e., real-life alternatives to our actual world. This does not matter as long as one is merely studying the notions of logical necessity and logical possibility. It already begins to matter if we are interested in analytical necessity and analytical possibility, for here arbitrary reinterpretation will destroy those relations of synonymy (or whatnot) which do not reduce to the formal truths of logic. This may perhaps be handled by means of explicit meaning postulates, but no comparable trick has much appeal in the case of belief. Hence the step from Carnap's "translation of modal language into extensional language" to possible-worlds semantics, small though it might seem, makes all the difference in the world to our analysis of belief. By the same token, it enables us to undertake similar analyses of several of

the most important philosophical concepts, including knowledge, memory, perception, obligation, etc.

One marriage of the problem of belief to possible-worlds semantics does not solve all the problems concerning belief-sentences Carnap discusses in *MN*. However, it opens the door to new developments in this direction. Carnap's own terminology enables us to describe the situation succinctly. Carnap called an expression *intensional* iff the identity of intensions (*L*-equivalence) is a necessary and sufficient criterion of substitutivity in that expression. (For a more accurate definition, see *MN*, p. 48.) Carnap pointed out that belief-expressions are not intensional in this sense. In fact, the failure of intensionality is here twofold. If '*i*' and '*i'*' are individual expressions, $I(i) = I(i')$ is neither a necessary nor a sufficient condition of substitutivity. Carnap's discussion in *MN* is addressed solely to the problem created by the latter fact. What is at issue here is of course the fact that even if '*i*' and '*i'*' are L-equivalent (logically equivalent), a rational believer may very well be unaware of their equivalence, and an interchange of '*i*' and '*i'*' may therefore make a difference to his beliefs. For this reason, we need for the purpose of analyzing the concept of belief a relation which is (at least sometimes) stronger than logical equivalence. In the Schilpp volume (pp. 897–900) Carnap in effect calls equivalence classes with respect to the former (stronger) relation senses, those with respect to the latter intensions. This does not alone help us very much, however. The main problem here is the characterization of the new, stronger relation.

This problem is not automatically solved by possible-world semantics but remains a problem there. However, gradually we seem to be getting even this problem under control.[20]

Carnap's own attempted solution to this problem was in terms of what he called intensional structure.[21] Roughly speaking, two expressions have the same intensional structure iff they are built up in the same way of logically equivalent unanalyzed parts. The intensional isomorphism of *S* and *S'* is proposed by Carnap as a sufficient criterion for the logical equivalence of '*a* believes that *S*' and '*a* believes that *S'*'. This solution appears to me *ad hoc*, however, until some general theoretical reasons are given why it is just differences of intensional structure that essentially tend to obscure our insights into logical interrelations of sentences. For it was precisely this failure of us humans to be 'logically omniscient' that

causes the failure of intensional identity to be a sufficient condition of substitutivity here. Hence the formal restrictions on substitutivity ought to reflect those structural factors that are principally responsible for the failure of 'logical omniscience'. However, if the question is put in this way, it seems to me clear that more interesting candidates for this role can be suggested.[22]

Let us leave this half of the problem and return to the failure of L-equivalence to constitute a *necessary* criterion of substitutivity. What the fault-finders uniformly overlook is that this part of the problem is beautifully solved by possible-worlds semantics. According to this semantics, 'i' and 'i''' are interchangeable in discussing a's beliefs iff they pick out the same individual in all the possible worlds we have to consider here. These worlds, in turn are all the worlds compatible with what a believes. Hence the identity of the references of 'i' and 'i''' in these worlds means that a believes that $i = i'$. But if so, quite obviously 'i' and 'i''' *are* interchangeable in discussing a's beliefs, provided they are consistent. Hence possible-worlds semantics at once leads to the right condition of substitutivity, thus carrying the analysis of an important problem of Carnap's essentially further.

The reason why the identity of intensions is not a necessary criterion for substitutivity here is nicely brought out by the fact that $I(i) = I(i')$ means that the functions which pick out the references of 'i' and'i''', respectively, coincide on the whole set of possible worlds, while the truth of

$$\text{'}a \text{ believes that } i = i''$$

in a world W only requires that they coincide on the much smaller set of alternatives to W.

2. This brings us already toward my second main point. It is that possible-worlds semantics conclusively shows the insufficiency of a semantics based solely on the distinction extension-intension or *Bedeutung-Sinn*. This distinction is all right, but it just does not do the whole job nor even one of the most important parts of the job that a satisfactory semantical theory must do. Hence, the classical Frege-Carnap semantics is very seriously incomplete, notwithstanding its closeness in some respects to possible-worlds semantics.

In order to see what the problem is, it may be useful to try to have

an overview of the aims of the Frege-Carnap semantics. Four our present purposes, the relatively unproblematic part – the part to which Frege in fact paid less attention – is the semantics of purely first-order (quantificational) notions. Only a small selection of the problems concerning it were taken up by Carnap. (Some of them are in fact very naturally suggested by the basic ideas of possible-worlds semantics, but I shall not discuss them here.) The problems I want to focus on here are due to the failure of our expressions to behave in modal contexts (in the wide sense of the word in which 'propositional attitudes' like belief are also considered modal notions) in the same (relatively) unproblematic way as in first-order contexts. Now the *locus classicus* of the Frege-Carnap semantics is of course Frege's paper 'Sinn und Bedeutung'.[23] The very first question Frege asks in this paper concerns the behavior of identities like '$i = i'$' vis-à-vis the notion of knowledge. More generally, to explain the failure of the substitutivity of identity in modal contexts is obviously one of the basic tasks of any satisfactory semantics.

The basic answer Frege-Carnap semantics gives is that what matters in modal contexts are not the *extensions* of one's expressions but rather their *intensions*. At first blush, this seems quite wrong-headed, for the right criterion of substitutivity in, say, belief-contexts (doxastic contexts) is certainly not the identity of the intensions (*Sinne*) of the intersubstituted expressions. As was already noted, we do not need to have $I(i) = I(i')$ in order to have 'i' and 'i'' interchangeable in discussing a person's beliefs. Hence Frege's answer to his own first and foremost question seems to be seriously amiss. Likewise, it was already indicated that Carnap failed to say very much of interest about substitutivity in belief-contexts in terms of his theory of extensions and intensions.

However, here possible-worlds semantics rushes to the rescue of Frege and Carnap. When the intensions of (say) individual expressions are analyzed as functions from possible worlds to the members of their respective domains of individuals, it becomes clear that intensions are after all essentially involved in the substitutivity conditions. The only new thing that happens in belief-contexts is that it is not the identity of these unrestricted functions that matters, but rather the identity of their restrictions to a certain subset of the set of all possible worlds. (Typically, it is the set of worlds compatible with everything someone believes.) The same account is seen to work for many other propositional attitudes.

Hence the Frege-Carnap semantics does come close to giving the right answer to the question of substitutivity conditions in modal contexts, although their own formulations did not spell out the matter quite fully. It is instructive to notice how our treatment of the substitutivity problem was made possible by the insight into the relation of the possible worlds to the notion of belief via the doxastic alternativeness relation. Here the tremendous advantages that accrue from the insignificant-looking step from models to possible worlds are beginning to tell. Both our *prima facie* objection to the Frege-Carnap treatment of substitutivity and the simple answer to it would have been impossible to formulate without this step. Among other things, Frege's first and foremost problem would have remained unsolved as a consequence.

However, the substitutivity problem is not the only one here, and those logicians who have tried to make it into the only major problem in interpreting modal logic have only succeeded in clouding the issues. The substitutivity problem is a paradigm problem caused by the failure of the usual *identity laws* in modal contexts. Another set of problems is created by the failure of *quantificational laws* in these contexts. The paradigmatic problem here is to account for the failure of existential generalization, i.e., of many inferences of the form

(EG) $F(a)$, therefore $(Ex)\ F(x)$.

where '$F(x)$' contains modal operators.

Possible-worlds semantics at once yields a natural explanation. The individual expression 'a' may pick out different individuals in the different possible worlds we have to consider in '$F(a)$'. If so, the truth of '$F(a)$' does not give us any opening for maintaining that '$F(x)$' is true *of some particular individual* x, as '$(Ex)F(x)$' claims. Hence (EG) is not valid in general.

It is also seen at once (at least roughly) when (i.e., on what additional conditions) (EG) is valid. It is valid iff 'a' picks out one and the same individual from all the different possible worlds as a member of which we are tacitly considering a in '$F(a)$'. What these worlds are can be read from '$F(a)$', and it turns out that the requisite uniqueness condition can even be expressed by a suitable sentence of our modal language.[24]

Precisely how this happens is an interesting question, but it need not concern us here. Our main interest lies in the fact that in order to make

sense of the reasons for the failure of existential generalization as well as of the conditions of its success we have to be able to *cross-identify*, that is, to say of a member of (the domain of individuals of) one possible world that is or is not identical with a member of another. (For we had to say that '*a*' picks or does not pick *the same individual in different possible worlds*.)

The interpretational aspects of cross-identification offer all sorts of problems. However, the overriding fact is clear enough, and sufficient for our purposes: cross-identification must make objective sense.

To see what this means, consider a 'world line' connecting the 'embodiments' or perhaps better the 'roles' of one and the same individual in all the different possible worlds. These members of the different possible worlds may be thought of as being picked out by a function. This function is of the nature of an intension in the sense that it is of the same logical type as those functions which serve as intensions of individual expressions. Let us call à la Carnap functions of this kind *individual concepts*. The objectivity of cross-identification then means that a subclass of the class of all such special individual concepts has to be objectively given, viz., the class of those special functions which define world lines of one and the same individual.

Clearly, it will be a *proper* subclass of the class of *all* individual concepts, for obviously not any old function which picks out an individual from a number of possible worlds picks out *the same* individual from all of them in any conceivable sense of identity. Let us call the narrower class of those functions that do so the class of *individuating functions*.

When an explicit semantics is developed,[25] it turns out that individuating functions, or, rather, their restrictions to certain sets of possible worlds, are the main ingredients of the truth-conditions for quantified sentences. They are the most important entities we have to quantify over in these truth-conditions.

Now it is obvious that the class of individuating functions cannot be defined in the sole terms of the class of individual concepts. As far as I can see, it cannot be reduced in any other sense, either, to the class of individual concepts.

What this means is that a semantics which only recognizes the whole unanalyzed set of individual concepts as a primitive idea will be incapable of formulating satisfactory truth-conditions for quantified sentences in

modal contexts and also incapable of explaining the failure of existential generalization in modal contexts. The classical Frege-Carnap semantics is a case in point, give or take a few minor qualifications. Hence their type of semantics is insufficient for dealing with quantified modal logics. More specifically, it is incapable of dealing with the other paradigmatic puzzle case in this field, viz. the failure of existential generalization. No wonder Quine has been unhappy with Carnap's semantics, for unlike Frege he has explicitly considered the problem of existential generalization in modal contexts over and above the problem of substitutivity of identity. Small wonder, too, that Quine has directed his main attack against the idea of quantified modal logic.

From one important point of view, the classical Frege-Carnap semantics is thus seriously incomplete, requiring an essentially new conceptual element in order to be able to deal with the problem which more than perhaps anything else has been the bone of contention between Carnap and his critics, viz. the problem of combining quantification and modality. To put the main point in a nutshell, the Frege-Carnap semantics explains the behavior of identity in modal contexts (and propositional-attitude contexts), but not the behavior of quantifiers in such contexts. The difference between the two problems is almost like a quantifier-switch. In the case of identity, the problem is to tell when *two* singular terms pick out the same individual in *each* possible world (of a certain sort). In the case of quantification, we have to ask when *one and the same* singular term picks out the same individual in *all* possible worlds (of a certain kind). Only the second problem involves cross-identification between possible worlds. For this reason, it does not reduce to the first.

At the same time, possible-worlds semantics supports Carnap against his critics in the crucial matter of the possibility of using intensional concepts in a way which, e.g., makes it possible to construct a semantics for quantified modal logic. Admittedly there are further problems here which may bring out the bite of some of Quine's specific criticisms.[26] However, on the level at which most of the Carnap-Quine controversy has been carried out, possible-worlds semantics is not only an outgrowth of Carnap's ideas but also their partial vindication.

This conclusion is so important that it deserves a few further comments and a few supplementary arguments in its favor. It is not only the case that the dichotomy extension-intension requires some supplementation

in order to be workable. What is even worse for those dichotomizers who still try to rely on the contrast, the introduction of individuating functions messes up thoroughly the neat intuitive contrast between references (extensions) and meaning entitites (intensions) which is one of the apparent attractions of the Frege-Carnap semantics. For the position of individuating functions in the alleged dichotomy of references and meanings is hopelessly ambivalent.

On the one hand, individuating functions constitute a subclass of the class of those paragons of intensionality, individual concepts. Moreover, they serve to solve one of the main problems for the treatment of which meaning entitites (intensions) have usually been introduced in the first place.

On the other hand, what individuating functions do is to give us the individuals which serve (albeit in some cases only potentially) as the references of our individual expressions. Almost the only reason, it may be suggested, why we have to deal with such functions here is that we have to keep an eye on more than one possible world and hence to keep track of our individuals – the very normal unexciting kinds of entities that inhabit our actual universe – in these different worlds. The technical counterpart to this (essentially correct) intuitive view is that the main role of individuating functions (or suitable restrictions of them) is to supply the entities one's quantified variables range over in modal contexts (more accurately, when we quantify into a modal context) precisely when we insist on quantifying over normal, down-to-earth sort of individuals in the normal 'objectual' sense of quantification (to use Quine's terminology).[27]

The details of the truth-conditions can easily be spelled out, but they are not our concern here. They have been spelled out – to some extent at least – elsewhere.[28]

The role of individuating functions and/or their similarity with intensions is sometimes overlooked in possible-worlds semantics. Some imes this semantics is developed by postulating a class of individuals (possible individuals, if you prefer) which then simply show up or fail to show up in the several possible worlds. This procedure, though entirely justified for many purposes, is seriously oversimplified, however.[29] It hides the processes by means of which cross-identifications are actually carried out and which may rely on many things besides the individuals themselves,

such as the structure of each of the two possible worlds in question and comparisons between them. However, the postulation of possible individuals is not only oversimplified pragmatically. It is also oversimplified semantically. The behavior of individuating functions can in principle be such that the 'manifestations' of individuals they connect cannot simply be appearances of one and the same individual.

For one thing, it has been argued that world lines can split when we move from a possible world to another.[30] Although this particular point is controversial, it seems very hard to rule out all splitting altogether.

What is more important, in some situations we have two different classes of individuating functions in operation at one and the same time.[31] Such a situation cannot be done justice to by simply speaking of a given class of (possible) individuals. The functional character of individuating functions, and hence their similarity with intensions, has to be recognized. We simply cannot save the traditional dichotomy by considering individuating functions as unproblematic dramatizations of the identity functions.

3. While possible-worlds semantics thus demonstrates a major insufficiency in the traditional semantics which operates with the intension-extension contrast, it seems to me that in a deeper sense Carnap's work in semantics will perhaps be only enhanced by this insight. It seems to me that there are many suggestions and ideas in his writings which will be thrown into a sharper relief by the perspectives which possible-worlds semantics opens. This semantics may perhaps even be said to be closer to the spirit of Carnap's semantical ideas than the traditional intensions-extensions contrast.

The main new perspective that opens here consists of certain increased prospects of convincingly and systematically demonstrating the empirical and perhaps also behavioristic import of both intensional concepts and also of propositional attitudes such as belief, even when they are used non-extensionally. Quine is undoubtedly right in emphasizing that the two are apt to stand or fall together. Hence it suffices to discuss the notion of belief.

In *MN* (pp. 53–5), Carnap proposes as the first approximation toward interpreting belief-sentences the following paraphrase of 'John believes that D':

(B) 'John is disposed to an affirmative response to some sentence in some language which expresses the proposition that D'.

This analysis suffers from several difficulties.[32] Among them there are the following:

(i) There is no guarantee that under (B) belief is invariant with respect to intensional isomorphism (see above) as Carnap assumed. (John might respond differently to two intensionally isomorphic sentences.)

(ii) Interpretation (B) leads to problems whenever John understands a language incompletely or wrongly. (He might assent to a sentence expressing the proposition that D thinking that it expresses something else.)

(iii) An explication along the lines of (B) is inapplicable to unverbalized and perhaps unverbalizable beliefs (e.g., the beliefs of a dog).

(iv) In the form (B), Carnap's criterion is largely inapplicable, because it presupposes that the applier knows which sentences express which propositions in different languages – and also in one and the same language. Finding this out easily leads to considerations of the belief of the speakers of the languages in question. Hence (B) ought to be reformulated in terms of John's responses to 'D' itself, not to its synonyms or L-equivalents.

The source of all these difficulties (except the first one, which becomes spurious as soon as one gives up the belief in intensional isomorphism as the touchstone of substitutivity in belief-contexts) is Carnap's reliance in (B) on John's responses to certain *sentences*. In this respect, an entirely different procedure is suggested by the possible-worlds analysis of belief. Knowing what John believes means on this analysis knowing which possible worlds are compatible with his belief and (by implication) which ones are not. In order to explain what it means for John to believe something one thus has to explore what this dichotomy between two different kinds of possible worlds (in relation to John) amounts to. Now it clearly lies close at hand here to explain it in terms of John's different reactions to the two different kinds of worlds.

In brief, the idea is this: put John suddenly in a world incompatible with his (current) beliefs, and he will react in one way. Put him in a world compatible with his beliefs, and he will evince a different reaction. John will then believe that D if he exhibits the first reaction in no possible world in which it is the case that D.

This suggestion is of course oversimplified. However, it is neither trivi-

ally unrealistic nor subject to the difficulties which bothered Carnap's analysis. Nor does it necessarily violate reasonable standards of empiricism and observability. In short, it seems to open a much more promising line of thought than the analysis of belief in terms of responses to sentences.

For instance, the problem of attributing unverbalised beliefs to people and even animals (cf. (iii) above) reduces to the much more general problem of spelling out the responses which distinguish doxastic alternatives from other possible worlds. In fact, a dog's beliefs are likely to present a much simpler case vis-à-vis this general problem than the beliefs of us humans, for in the case of dogs it is clear that we do not attribute beliefs to them on the basis of what we think of as going on inside their minds but on the basis of their characteristic behavior when a belief turns or fails to turn out to be true.

Likewise, the problem of linguistic mistakes (cf. (ii) above) presents no difficulties in principle. A person believes that p quite apart from his responses to any particular sentence synonymous with 'p' if and only if his reactions to worlds in which 'p' is true and to those in which it is false exhibit the appropriate difference. Such a difference may even obtain between two complementary classes of possible worlds which are *not* the ranges of 'q' and 'not-q' for any 'q' in some given language L. Then a believes a proposition which is not expressible in L.

Moreover, insofar as the a's different responses to worlds compatible and incompatible with his beliefs can be spelled out, we have an explication of the notion of belief which even satisfies some of the stringent methodological canons apparently adhered to by Quine. For this belief will be more or less on a par with any old dispositional concept, and Quine explicitly admonishes us to "remain free to allow ourselves one by one any general terms we like, however subjunctive or dispositional their explanations".[33]

True, Quine seems to be completely happy with dispositional terms only when the dispositions in question are believed to be somehow tied to the physical structure of the objects they are dispositions of.[34] As long as we are not required to spell out this structure, however, I do not see that this desideratum is not satisfied in the case at hand, given some fairly reasonable view of the physiological basis of our beliefs. (Cf. here Carnap's remarks on the intensions of a robot in 'Meaning and Synonymy in Natural Languages'.)

It may also be questioned whether it is a reasonable one in the first place, if it is intended to imply that some unique structure is present in all cases of the dispositional concept. Surely computer scientists can legitimately speak of the software of computers without committing themselves to a particular way of realizing them in actual hardware. Statements like 'such-and-such an item of information is stored in the memory of a computer' may have a well-defined and unambiguous sense even if the kind of memory involved is left completely at large. Hence it appears that Quine's reservations about dispositional terms do not constitute valid reasons for denying the possibility of explicating the concept of belief along the lines suggested by possible-worlds semantics.

Similar remarks can be addressed to intensional concepts proper instead of the concept of belief. They, too, can perhaps be analyzed in terms of an informed language-user's behavior in different possible worlds. I find it rather strange that the promising new opportunities that are opened here by possible-worlds semantics for the philosophy of language have not been explored or commented on by philosophical semanticists.

In fact, virtually the only extant discussion that can (almost) be fitted into this framework is Carnap's own. In his highly interesting paper 'Meaning and Synonymy in Natural Languages' (*MN*, second ed., pp. 233–47),[35] Carnap envisages a procedure of empirically determining not only the extension but also the intension of a predicate. At first blush, it looks rather analogous to the explication of belief sketched earlier, and it seems to me that it is basically very much in the same spirit. The extension of a predicate to a speaker is the class of actual objects to which he would apply the predicate. In order to get from this to intensions, Carnap says, we only have to take into account also 'possible cases'.

It is here that differences come in. Carnap is thinking of people's reactions to possible *objects* or kinds of objects–these locutions are actually used by him – rather than possible *worlds*. Thus he relies on the dubious notion of the procedure, of a possible individual, which in any case greatly restricts the applicability for often the applicability of (say) a general term to an individual depends on other things besides this individual itself. (One and the same possible flea can be a big flea in one world and not a big flea in another, even if its size remains the same, depending on the size of the other fleas in the two worlds.)

This is connected with the fact that Carnap allows in his formulations

the consideration of a respondent's reactions to *verbal descriptions* of non-actual but possible cases. On our explication, we are dealing with dispositions to respond in certain way to possible situations, perhaps ultimately including the whole 'possible world' in question. Only in this way will our intensions of predicates be of the right logical type. Once again, Carnap fails to interpret 'possible worlds' realistically and to use them systematically as a tool of his semantics and/or pragmatics. This failure has probably been especially unfortunate in the present context, for Carnap's overt reliance on language has apparently suggested to critics a covert reliance on mental entities of some sort or other. The possible-worlds reformulation makes it at once clear that, however much we have to rely on counterfactual considerations here, this does not necessarily imply reliance on mental entities or other non-behavioristic factors.

In spite of its shortcomings, I therefore find it exceedingly puzzling that Carnap's paper has not made a greater impact on the philosophical community. The probable reason for this seems to be that most philosophers have not realized how extremely demanding – not to say unrealistic – the standards of observability are that such critics of Carnap as Quine have been presupposing. In his recent formulations, Quine operates with the notion of "the totality of possible observations of nature, made and unmade" and "the totality of possible observations of verbal behavior, made and unmade".[36] He claims that those notions that cause the indeterminacy of intensions, prominently including the notion of belief, are underdetermined by these totalities of observations. On our explication, however idealized it may be, this simply is not the case. The extensions which a speaker would pick out from all the different possible worlds will determine (what he believes to be) the intension of the predicate, for this intension *is* the function that determines these extensions as a function of the possible world in question. This is a place in which the possible-worlds analysis of intensional notions (and of the notion of belief) turns out to have a powerful methodological thrust. Critics like Quine have probably felt that somehow the procedures envisaged by Carnap, even when amplified along the lines I have sketched, will be powerless to exhaust the content of such apparently mental entities as beliefs and intensions. On the possible-worlds analysis, the very idea of a possible world serves to guarantee this kind of exhaustiveness. There cannot be any conceivable im-

port to a feature of someone's beliefs which does not show up in his attitudes to some conceivable world or other.

The true explanation of this discrepancy between Quine and our reconstructed Carnap is the wide gap between what Quine would count as "possible observations" and what most other philosophers, including Carnap, would presumably include under this heading. There is an ambiguity in Quine's notion of "the totality of possible observations". It would naturally be taken, it seems to me, to refer to observations one could have made had the course of events been different, i.e., observations made in certain different 'alternative' possible worlds. However, Quine's latest explanations[37] show that he means possible observations of the actually realized course of events, i.e., observations that could have been made in this actual world of ours. This is so restrictive an idea that it tends to cast doubts on the admissibility of any dispositional terms, including the ones Quine is himself using (e.g. 'stimulus meaning').

Furthermore, it is clear that Quine does not admit counterfactual concepts referring to the past, for otherwise there would not be any problem of separating the effect of past information from the influence of meanings in people's linguistic behavior. (Cf., e.g., *Word and Object*, pp. 62–3.) For in order to spell out this crucial difference we only have to specify what someone's behavior would have been if the information (stimulations) he received earlier had been different. All this helps to explain the contrast between Quine's views and our reconstructed Carnapianism, but it also shows how extremely rigid a standard of empirical significance has been presupposed by Carnap's critics and how little persuasion the criticisms therefore are apt to produce when their basis is fully understood.

Another possible reason for critics' dissatisfaction with Carnap's discussion in 'Meaning and Synonymy in Natural Languages' is that the pragmatical suggestions he makes there are not tied in any natural way to his semantics. For instance, Carnap does not in fact define the intension of a predicate as a class of possible objects (or perhaps of kinds of possible objects), as his discussion of how to find empirically the intension of predicate seems to presuppose.[38] This is one of the many places where Carnap's failure to analyze his intensional concepts can be used against him with a vengeance. When this failure is corrected, however, Carnap turns out to be on the side of the angels, it seems to me.

Needless to say, tremendous difficulties remain for a possible-worlds semanticist in his attempts to demonstrate the empirical and possibly even behavioral character of beliefs and intensions. For instance, I tend to think myself that the totality of possible worlds with which one has to operate here is a highly dubious notion, however legitimate it may be to consider particular possible worlds one by one or even certain restricted sets of possible worlds. For another thing, there clearly is no unique, easily characterizable response which would separate worlds compatible with someone's beliefs from those incompatible with it. Rather, belief must somehow be construed as a theoretical term. Furthermore, I have not said anything constructive in the present paper about the problems due to the failure of the identity of intensions to be a *sufficient* criterion of substitutivity in belief-contexts.

But even so, it seems to me that possible-worlds semantics overwhelmingly suggests that Carnap was on the right track. It makes the weight of his reply to Quine (that is what 'Meaning and Synonymy in Natural Languages' essentially is) felt in a new way, and it puts the onus of producing specific criticisms much more on Carnap's critics than has been recognized in recent discussion. What is even more important, it suggests new constructive, empirical approaches to the pragmatics of beliefs and intensions. As such, it amounts to an important partial vindication of Carnap vis-à-vis his critics, and shows the power of his ideas to inspire and to guide further development of the studies to which he himself already contributed so much.

Academy of Finland
and Stanford University

NOTES

[1] Rudolf Carnap, *Meaning and Necessity*, University of Chicago Press, Chicago, 1947; second ed., with additions, 1956. In the sequel I shall refer to it as *MN*.

[2] A distinction is made by Carnap between intensions and senses in 'The Philosopher Replies' in *The Philosophy of Rudolf Carnap* (ed. by P. A. Schilpp), Open Court, La Salle, Illinois, 1963, especially pp. 897–900. The reasons for the distinction, which does not matter at this stage of our study, will be mentioned later.

[3] Gottlob Frege, 'Kritische Beleuchtung einiger Punkte in E. Schröders *Vorlesungen über die Algebra der Logik*', *Archiv für systematische Philosophie* **1** (1895) 433–56, esp. p. 455.

[4] See W. V. Quine, 'Carnap on Logical Truth' in the Schilpp volume (note 2 above),

pp. 385–406 and Quine's other writings on the philosophy of language and of logic since 1941.

[5] See Quine's commemorative note on Carnap in *Boston Studies in the Philosophy of Science*, vol. VIII (ed. by Roger Buck and Robert S. Cohen), D. Reidel Publishing Company, Dordrecht, 1971.

[6] *Meaning and Necessity*, first chapter.

[7] Schilpp volume (note 1 above), pp. 3–84.

[8] In this paper, I shall treat (for simplicity) such *placeholders* for sentences as '*S*' and such *placeholders* of individual expressions as '*i*' (see below) as if they were themselves sentences or individual expressions, respectively. I shall also let quotes be absorbed into such functions as *R* and *I* (for the latter, see below).

[9] The role of possible-worlds semantics in providing structural analyses of various intensional concepts has been stressed especially forcefully by Richard Montague. See, for instance, 'Pragmatics' in *Contemporary Philosophy – La philosophie contemporaine*, vol. I, La Nuova Italia Editrice, Florence 1968, pp. 102–22; 'On the Nature of Certain Philosophical Entities', *The Monist* **53** (1969), 159–94; 'Pragmatics and Intensional Logic', *Synthese* **22** (1970–71), 68–94.

[10] The first to carry out systematically this liberalization seems to have been Saul Kripke.

[11] See, for instance, 'Existential Presuppositions and Uniqueness Presuppositions' in Jaakko Hintikka, *Models for Modalities: Selected Essays*, D. Reidel Publishing Company, Dordrecht, 1969, pp. 112–47, and 'Individuals, Possible Worlds, and Epistemic Logic', *Nous* **1** (1967), 33–62.

[12] *Zeitschrift für Philosophie und philosophische Kritik*, Neue Folge, **100** (1892), 25–50.

[13] In R. M. Martin, *Logic, Language and Metaphysics*, New York University Press, New York 1971, pp. 59–60, it is objected to this point that the difference in "the *expressions* that do the referring" suffices as the relevant difference between the ways in which different objects (or the same object) can be given. This objection is surely completely foreign to Frege's intentions, for senses were for him non-linguistic entities. In 'Sinn und Bedeutung', p. 27, he emphasizes that *Sinn* is independent of language and can be shared by different expressions in one and the same language. For another thing, Frege's very first puzzle about the epistemic difference between the identities '$a = a$' and '$a = b$' would have been vacuous on Martin's view.

Instead of 'the way of being given' we could also say '*how* the reference is given'. It turns out that the analysis of the relevant how-expression requires in general the consideration of several possible worlds, just as happens in the possible-worlds semantics. See, for instance, my survey 'On the Different Constructions in Terms of the Basic Epistemological Concepts' in *Contemporary Philosophy in Scandinavia* (ed. by R. E. Olson and Anthony M. Paul), Johns Hopkins Press, Baltimore, 1972.

[14] See note 9 above.

[15] There are no restrictions to rule this out in Carnap's characterization of a model in the Schilpp volume, pp. 890–1.

[16] 'Pragmatics and Intensional Logic' (note 9 above), p. 91. In general, Montague emphasized (before any one else I know of) clearly and appropriately the crucial difference between possible worlds and models.

[17] *Meaning and Necessity*, chapter V.

[18] The first to put forward this idea explicitly in print was Stig Kanger; see his dissertation *Provability in Logic* (Stockholm Studies in Philosophy, vol. I), Stockholm,

1957. The same discovery was made independently by others, especially by Saul Kripke.

[19] In his paper, 'The method of Extension and Intension' in *The Philosophy of Rudolf Carnap* (note 2 above), pp. 311–49, Donald Davidson already pleaded persuasively for a uniform treatment of intensional contexts and belief-contexts in logical semantics.

[20] See my paper, 'Knowledge, Belief, and Logical Consequence', *Ajatus* **32** (1970), 32–47, and the literature referred to there, especially 'Surface Information and Depth Information' in *Information and Inference* (ed. by Jaakko Hintikka and Patrick Suppes), D. Reidel Publishing Company, Dordrecht, 1970, pp. 263–97.

[21] *Meaning and Necessity*, pp. 56–64.

[22] Cf. 'Knowledge, Belief, and Logical Consequence' (note 20 above).

[23] Note 12 above.

[24] I have tried to examine the conditions on which it is valid in several papers, most fully in 'Existential Presuppositions and Uniqueness Presuppositions' in Jaakko Hintikka, *Models for Modalities: Selected Essays*, D. Reidel Publishing Company, Dordrecht, 1969, pp. 112–47.

[25] A sketch is found in my paper, 'Semantics for Propositional Attitudes' in *Models for Modalities*, pp. 87–111.

[26] Some important further problems are discussed in Jaakko Hintikka, 'The Semantics of Modal Notions and the Indeterminacy of Ontology', *Synthese* **21** (1970), 408–24.

[27] See W. V. Quine, *Ontological Relativity and Other Essays*, Columbia University Press, New York, 1969, pp. 63–67, 104–8.

[28] See, e.g., the papers referred to in notes 24 and 25 above.

[29] See 'The Semantics of Modal Notions and the Indeterminacy of Ontology' (note 26 above).

[30] For the systematic background of this problem, see my *Models for Modalities*, pp. 130–3, 140. For an argument for allowing splitting, see Gail Stine, 'Hintikka on Quantification and Belief', *Nous* **3** (1969), 349–408.

[31] See my papers, 'On the Logic of Perception' in *Perception and Personal Identity* (ed. by N. S. Care and R. M. Grimm), The Press of Case Western Reserve University, Cleveland, 1969, pp. 140–73, reprinted in *Models for Modalities*, pp. 151–83, and 'Objects of Knowledge and Belief: Acquaintances and Public Figures', *Journal of Philosophy* **67** (1970), 869–883.

[32] They are discussed perceptively by Barbara Hall Partee in her contribution to *Aspects of Natural Languages: Proceedings of the 1970 Stanford Workshop on Grammar and Semantics* (ed. by Jaakko Hintikka, Julius M. E. Moravcsik, and Patrick Suppes), D. Reidel Publishing Company, Dordrecht, 1973, pp. 309–336. I am greatly indebted to Mrs Partee's paper.

[33] *Word and Object*, The MIT Press, Cambridge, Mass., 1960, p. 225.

[34] Cf. *op. cit.*, p. 223.

[35] First published in *Philosophical Studies* **7** (1955), 33–47.

[36] See W. V. Quine, 'Replies' in *Words and Objections: Essays on the Work of W. V. Quine* (ed. by Donald Davidson and Jaakko Hintikka), D. Reidel Publishing Company, Dordrecht, 1969. (See p. 302.)

[37] See 'On the Reasons for Indeterminacy of Translation', *Journal of Philosophy* **67** (1970), 178–83. In order to spell out fully the logic of the situation, we would have to use relative modalities in the sense of Hilpinen and distinguish observations that are possible for us humans to make (leaving the rest of the world intact) from observations

that are possible *simpliciter* (observations made in a possible world which differs from the actual one also in its non-human aspects). Cf. Risto Hilpinen, 'An Analysis of Relativised Modalities' in J. W. Davis, D. J. Hockney, and W. K. Wilson (eds.), *Philosophical Logic*, Synthese Library, D. Reidel Publishing Company, Dordrecht, 1969, pp. 181–93.

[38] *Meaning and Necessity*, pp. 236–40.