POSSIBLE WORLDS: A CRITICAL ANALYSIS

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1 The Emergence of Possible Worlds

Frege has proposed to consider names as denoting objects, predicates as standing for concepts and sentences as denoting truth values. He was, however, aware that such denotation does not exhaust all what is to be said about meaning. Therefore he has urged that in addition to such denotation (*Bedeutung*) an expression has sense (*Sinn*). The sense is the "way of presentation" of denotation; hence the expressions *Morning Star* and *Evening Star* have identical denotations, but different senses.

Carnap has proposed to replace Frege's distinction between *Sinn* and *Bedeutung* by the distinction between *intension* and *extension*. Extension is, according to Carnap, what is shared by every two expressions which can be truthfully declared equivalent; where equivalence means a bit different things for different grammatical categories. In the formalism of the classical logic, the equivalence of two terms T_1 and T_2 is expressed by the formula $T_1=T_2$, that of two sentences S_1 and S_2 is by the formula $S_1 \leftrightarrow S_2$, and that of two unary predicates P_1 and P_2 by the formula $\forall x P_1(x) \leftrightarrow P_2(x)$. Hence the extension of a term can be identified with the individual the term stands for, that of a statement with its truth value, and the one of a unary predicate with the class of individuals which fall under the predicate. This means that Carnap's intension is something quite close to Frege's sense.

Carnap's intension is, on the other hand, not a mere reincarnation of Frege's sense. Frege has been never quite explicit with respect to the nature of sense, but his reluctance to speak about it quite explicitly was conscious and purposeful: Frege was convinced that the only entities that can be really talked about are objects, and sense was not an object for him. To speak about a sense we would have to name it, and hence make the sense into a denotation of an expression. Carnap's intension is, on the other hand, not an entity of a category essentially different from that of extension, it is only something that casts a finer net over the space of expressions.

Carnap has defined both extension and intension as derivatives of an equivalence, as that what so-and-so related expressions share. However, while in the case of extension there has been suitable things that could be considered as reifications of such equivalence (namely individuals, truth values and classes of individuals), in the case of intensions no such candidates were at hand.

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Help came from formal logic. In 1963 Kripke has developed the model theory for modal propositional calculi; he has based it on the concept of *possible world*. This concept, and the whole Kripkean semantics has proven itself to offer a fruitful explication of the notion of intension. The era of possible-worlds-semantics begun. Kripke's idea has come to be amalgamated with an idea of another logician, with the ideas underlying Church's formulation of the simple theory of types, and this has given rise to the grandiose systems of intensional logic as we know them from the writings of Montague, Cresswell, Tichý and others.

The notion of a possible world, reminiscent of the philosophical views of Leibniz, thus has moved to the centre of discussion of theoreticians of language. However, although the results reached by means of the intensional logic (and its possible-worlds semantics) have been considered great, the nature of the concept of the possible world has been subject to various discussions. What is such a possible world? Are possible worlds "real", are they elements of our "mental world", or are they objects of a Platonic "third realm"? Is it at all reasonable to transfer this more or less obscure notion into a rigorous conceptual framework of formal semantics? These are questions which bothered people dealing with possible-worlds semantics and which in fact have not stopped bothering us yet.[2]

The first step to a proper solution of a philosophical problem is to achieve its proper formulation. In the present context this means that we have to consider the above mentioned questions and inspect them to see if we are able to make a proper sense of them. The first thing to see is that it is not right to speak about a *transfer* with respect to the concept of possible worlds: the terms of a formal system necessarily have a rigorous formal definition (explicit or implicit) and by giving them one or another name we do not "give" them anything belonging to the intuitive sense of the name. Such a term can only more or less faithfully render the character of the corresponding intuitive notion; i.e. it can be more or less considered as its *explication*[3]. By calling an element of our formal system a *possible world* we in no way guarantee that it has anything in common (besides the name) with possible worlds in the intuitive sense; that this is so is something to be shown.

2 The model theory for modal calculi

For the Kripkean introduction of the concept of possible world as well as for the Montagovian logistic formalization of natural language the methods of the model theory are essential. Let us thus now investigate into the very nature of the notion of model and into the place of the concept of possible world within the theory.

A model of a theory, i.e. of a class of statements (propositional formulas) of a language, is a special kind of interpretation of the language. An *interpretation* is considered as a function assigning extralinguistic entities to expressions of the language; a *model* of a theory is then such an interpretation which to all and only statements belonging to the theory assigns a distinguished element (typically the value T, "the truth").

However, not every mapping of the class of expressions can act as an interpretation. For specific logical systems restricted classes of such mappings are defined as admissible

[2]See e.g. Cresswell (1973), Putnam (1975) or Partee (1980).

[3]In the sense of Carnap (1950) and Quine (1960).

interpretations. An interpretation of the traditional propositional calculus is, for example, a mapping which assigns (i) one of the two truth values T or F to any atomic propositional formula; (ii) the usual truth tables (i.e. certain functions from {T,F} or {T,F}x{T,F} to {T,F}) to propositional operators; and (iii) the relevant function value of the relevant truth table to any non-atomic propositional formula. The model theory for the classical first-order predicate calculus employs, in addition, a *universe of discourse* (an arbitrary set), such that individual terms are interpreted by elements of the set and predicates by relations over the set.

In general we can say that we have defined a model theory for a given logical calculus iff we have specified a class of interpretations of the language underlying the calculus such that any propositional formula is derivable in the calculus if and only if it is assigned the distinguished element by any of the class of interpretations. We then also say that the calculus is sound and complete with respect to this class of interpretations[4]. Let us also notice what kinds of functions interpretations in general are. First, it seems that a substantial characteristic of any interpretation is that it is *compositional*, i.e. that the interpretation of a complex expression is a function of the interpretations of its parts. Moreover, the interpretation of one of the parts of a complex expression is usually a function and the interpretation of the complex is the function value of this function applied to the interpretations of the other parts. Second, the interpretation of expressions which are considered as "logical" is fixed once for all while that of the other, "non-logical" expressions is left open[5].

Let us try to consider what kind of modifications the model theory of the non-modal logic would require to be applicable to the modal calculus. It can be shown easily that if L is a logical calculus and I an admissible interpretation of it, then two propositional formulas which have the same interpretation must be "L-intersubstitutive", i.e. that if we substitute one for the other in a complex propositional formula, then the resulting formula belongs to L if and only if the original did. It is clear that if L is the classical propositional calculus, then two propositional formulas are L-intersubstitutive if and only if they have the same truth value; this enables us to interpret propositional formulas directly by their truth values.

However, the situation is different with respect to the modal propositional calculus: there are propositional formulas which coincide in truth values, although they are not intersubstitutive. From this it follows that propositional formulas of the modal calculus cannot be interpreted by means of their truth values.

So let us assume that propositional formulas will be interpreted by elements of a set P; members of P will be called *propositions*. Then, however, to retain compositionality, the logical operators have to be interpreted by functions from P or PxP into P. This seems to be implausible: the classical logical operators have been explicated in terms of the non-modal calculus in an exhaustive way, and now we seem to have to abandon their truth-functional interpretation. It seems that it would be plausible to define their interpretation within the modal

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[4]Note that such a class of interpretations exists not only for first-order logic. Leblanc (1976), for example, shows that in spite of the well-known results of Gödel there exists a class of interpretations with respect to which the second-order predicate calculus is sound and complete. In fact, by means of the well-known method of Henkin (1950) the model theory in the present sense can be defined for a predicate calculus of any order.

[5]For a detailed discussion see Peregrin (1992b).

calculus in such a way that it would be reducible to their classical interpretation.

The solution of this problem is, of course, simple; it is based on the identification of the members of P with subsets of a set L, or, which is clearly the same, with functions from L to {T,F}. If we denote the class of all functions from a set A into a set B as $[A\rightarrow B]$, the propositions become members of $[L\rightarrow\{T,F\}]$ and the interpretations of the logical operators become functions from $[L\rightarrow\{T,F\}]$, or $[L\rightarrow\{T,F\}]x[L\rightarrow\{T,F\}]$, into $[L\rightarrow\{T,F\}]$; they then can be induced in a natural way by functions from {T,F}, or {T,F}x{T,F}, into {T,F}.[6] Besides this it is possible to interpret also the operator of necessity in a plausible way within this framework; the relevant completeness proofs have been presented by Kripke (1963)[7]. Kripke has called members of such a set L *possible worlds*.

So returning to the questions of the nature of possible worlds we can conclude that a possible world is something on the basis of which a proposition yields a definite truth-value. This means that *(Kripkean) possible worlds are entities relative to which the truth values of propositions obtain*.

Let us add some explanations. It is clear that the definition of the concept of possible world within Kripke's approach is not explicit; we cannot put the concept on one side of an equality sign. However, an implicit definition is also a definition; the concept of possible world is defined in the same way as the concept of number within Peano arithmetic or the concept of a set within the axiomatic set theory. In contrast to the explicit definition, the implicit one, however, does not allow us to reduce the concept to simpler ones, we cannot *explicate* it. Roughly speaking, anything could be a possible world, providing it has the capacity of sorting propositions into true and false.[8] Let us now try to look for an explicit definition of the concept.

3 Which worlds are 'really' possible?

The Kripkean theory thus assumes that there are possible worlds (i.e. that there is something relative to which statements have truth values), but it makes no attempt to inquire into the 'real nature' of the space of possible worlds. On the contrary, the theory purposefully aims at truths valid independently of what such a space might in reality look like, just as the predicate calculus aims at truths independent of what the domain of individuals might be. However, there has to be one 'real' space of possible worlds, just as there seems to be one 'real' domain of individuals.

To expose the problem from this side, let us return to the point of departure of the model theory for modal logic from that of the non-modal one. We have concluded that we have to interpret propositional formulas by means of elements of a set P which has to be "richer" than

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[6]The "modal" interpretation of a classical binary logical operator is then that function which to any two propositions (i.e. functions from L to {T,F}) P and P' assigns such a proposition P" that, for any element l of L, P"(l) equals the "extensional" interpretation of the operator applied to the truth values P(l) and P'(l).

[7]Kripke introduces a binary relation over L, called the *relation of accessibility*, and he interprets modal operators as functions assigning to a subclass L' of L the subclass of all elements of L accessible from L'.

[8]Stalnaker (1986) writes: "What is a possible world? It is not a particular kind of thing or place; it is what truth is relative to, what it is the point of rational activities such as deliberation, communication and inquiry to distinguish between."

the set of the two truth values. The reason is that some formulas coinciding in truth values are not intersubstitutive within the modal calculus and thus have to be interpreted by different items. Formulas which surely are intersubstitutive even in this calculus are those the equivalence of which is derivable, i.e. which have *necessarily* the same truth value; such necessarily equivalent formulas thus need not be interpreted differently. This indicates that it would be possible to identify propositions with the classes of necessarily equivalent propositional formulas.

Explicating propositions in this way we can see that the class P constitutes a Boolean algebra. Indeed, if we consider logical entailment as inclusion, then all axioms of Boolean algebra are fulfilled (see Rieger, 1967); the supremum of two propositions is their disjunction[9] and their infimum is their conjunction.

The well known theorem of Stone states that any Boolean algebra is isomorphic with the Boolean algebra of subsets of a set, in the typical case of the set of the atoms of the original algebra. An atom is in our case a proposition which is not inconsistent and from which any other proposition or its negation follows. In this way a natural transfer from propositions to subclasses of a set L can be achieved; just as required by the Kripkean strategy. The elements of L, i.e. of the Boolean algebra of propositions, then do really have the capacity of sorting propositions into true and false: we have observed that truth or falsity of any proposition is, indeed, implied by any possible world.

Atoms are in fact infima of some "maximal" classes of propositions, and as infima are conjunctions, possible worlds are conjunctions of certain maximal lists of propositions. It seems to be reasonable to assume that for every maximal consistent class of propositions there is a corresponding possible world and vice versa. Here we have come close to the way in which the model theory for the modal calculi has been approached by Hintikka (1969). Let us call the resulting notion of a possible world *Hintikkian*. Now we can give an alternative answer to the question of the nature of possible worlds: *(Hintikkian) possible worlds are maximal consistent classes of propositions.*[10]

In contrast to the Kripkean definition, this definition is explicit and it allows us to reduce the concept of a possible world to the concept of proposition, which in turn can be reduced to the quite transparent concept of an equivalence class of propositional formulas. This seems to deprive the concept of a possible world of whatever mysteries might be connected with it.

4 Are possible worlds POSSIBLE WORLDS?

So far we have discussed the definition(s) of the concept of possible world in terms of formal logic. If we now want to conclude that possible worlds do belong to logic, we have to show something more: that what has been defined within logic under the name of possible world really corresponds to what we normally understand under this name.

Let us write POSSIBLE WORLDS for possible worlds in the intuitive sense of the expression,

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[9]If [F] and [F'] are two equivalence classes of propositional formulas, then [F&F'] is their conjunction. It is easy to prove that this is a correct definition; similarly for the other operators. This means that we can speak about conjunction, disjunction, negation etc. of propositions.

[10]The case of truth value gaps is left out of considerations here; however, under suitable restrictions this case need not be incompatible with the present view.

not for the possible worlds of formal logic. Let us investigate into the correspondence between POSSIBLE WORLDS and classes of statements of our natural language. Let us associate with any POSSIBLE WORLD the class of all and only statements which hold in this world. What can be said about such a correspondence?
First, let us recall that for me to posit two distinct POSSIBLE WORLDS makes sense only when I am able to tell one from the other. This leads to the following principle

THE PRINCIPLE OF DISCERNIBILITY

For any two distinct POSSIBLE WORLDS there exists a statement which is true in one of them and false in the other.

From this principle it follows that the mapping of possible worlds onto the classes of statements true in them is injective.
From the other side, whatever is possible, holds in some POSSIBLE WORLD. This gives

THE PRINCIPLE OF ACTUALIZATION OF POSSIBILITIES

Any consistent class of statements (i.e. any class of statements which is imaginable as true simultaneously) is true in some POSSIBLE WORLD.

Further we surely cannot refute

THE PRINCIPLE OF CONSISTENCY

The class of all statements which are true in a POSSIBLE WORLD is consistent.

Finally, a POSSIBLE WORLD is a *world*, it is maximal, it cannot be a proper part of another world.[11] Thus we can formulate

THE PRINCIPLE OF MAXIMALITY

If a statement is consistent with what holds in a POSSIBLE WORLD, then the statement holds in the POSSIBLE WORLD.

The four principles clearly guarantee that there obtains a bijective correspondence between POSSIBLE WORLDS and maximal consistent classes of statements of our language. The notions of consistency and maximality now, of course, cannot be defined formally; however, they possess a clear sense: a class of statements is consistent if all the statements can be true simultaneously, and it is maximal if adding any statement to it makes it inconsistent. From these four principles which seem to be indisputable it now follows that *a possible world in the intuitive sense can be explicated as a maximal consistent class of statements.* This shows that (Hintikkian) possible worlds may serve as good explications for POSSIBLE WORLDS.

[11]It is, of course, possible to work with "partial possible worlds", but we prefer to call these *situations* or something like that.

5 Possible Worlds vs. Classes of Statements

The first outcome of our identification of possible worlds[12] with maximal consistent classes of statements is that some possible mysteries may be swept away from the concept in this way. This is not to say that all problems regarding possible worlds vanish; however, they are no more mysterious. We cannot say for sure if there is a possible world in which there is a round square; however, now we know that this problem can be reduced to the problem if the sentence *there is a round rectangle* may be true and that our indecision regarding it arises due to an inner obscurity of the statement and not due to an obscurity of our notion of a possible world. We are not sure if there is a POSSIBLE WORLD in which the fifth Euclid's postulate is false; however, we now know that this is the problem of our uncertainty of whether the axiom might or might not be false.

The possible worlds actualize possibilities; and they do it in a most straightforward and transparent way. If we were able to decide perfectly which statements are consistent and which are not, possible worlds would be specified without any vagueness. However, as we are vague with respect to consistency, also possible worlds reflect this vagueness. Pythagoras' theorem states a quite precise relation between the sides of a triangle; however, if we measure the two sides with some vagueness, we cannot expect that the third one will be computed precisely.

Another outcome is that we can reveal possible worlds even where they are not declared as such. For this it is essential to realize that what follows from our analysis is not that possible worlds are *reducible* to classes of propositions, but rather that they *are* such classes, and any class meeting the conditions stated above is a possible world[13]. In this way we have gained a substantial criterion for marking approaches to semantics as possible-worlds-based, a criterion which is independent of what proponents of these approaches declare.[14]

Let us take as an example the logical system presented Bealer and Mönnich (1988). It is a system the interpretation of which is based on model structures which the authors specify as follows: "Omitting certain details for heuristic purposes, we may characterize an algebraic model structure as a structure containing (i) a domain *D* comprised of (items playing the role of) individuals, propositions, properties, and relations, (ii) a set *K* of functions which tell us the actual and possible extensions of the items in *D*, and (iii) various fundamental logical operations on the items in *D*" (p.215). Then they describe the basic difference between this kind of model structures and the more traditional ones: "In a possible-worlds model structure, ..., (i) is typically replaced by a domain consisting of actual individuals and 'nonactual individuals'; then PRP-surrogates are constructed from these items by means of set-theoretical operations; and (ii) and (iii) are omitted" (p.216). Now I agree that there is a substantial difference between the two kinds of model structures, and I also agree that the employment of the algebraic model structures

[12]As we have concluded that POSSIBLE WORLDS coincide with possible worlds, there is no more need of capitalization.

[13]This is what Wittgenstein (1921) says: "The world is a collection of facts."

[14]Such an independence seems to be quite important: I think that if one presents a theory equivalent to the set theory, then he does use *sets* even if he happens to call the members of the universe of his theory, say, *lattices*. Or, to offer a more metaphorical but a more lively example, an absolutist society remains absolutist no matter how intensely it may declare itself democratic.

is really superior to the more traditional approaches; however, what I do not agree with is that this difference or superiority has something to do with an absence of possible worlds. In fact, they are not absent within Bealer's and Mönnich's approach, as (for all that has been concluded so far) their set K is nothing other than a set of possible worlds. Thus, I think, we can conclude that this approach does not abandon possible worlds.[15]

6 Possible Worlds as First-order Structures

Various explications of the notion of possible world have been historically presented; from Leibnitz' considerations[16] to Cresswell's complicated formal metaphysics[17]. Our results need not be in contradiction with such explications[18]. However, if what has been said so far is correct, then any acceptable explication of the notion of possible world should be compatible with our notion of such a world as a class of propositions. Let us use an example to show how a concretization of the notion corresponds to positing certain restrictions with respect to the space of propositions.

One of the most straightforward approaches to possible worlds is to view them as classes of all distributions of some set of basic properties among a given universe of individuals. This would mean that the space of possible worlds can be considered as the class of all structures of a relational language with a given carrier, i.e. as the class of all models of a first-order theory without special axioms with a fixed universe[19]. Such a space would be plausible to deal with; therefore this approach is tempting[20]. We shall not consider the question of adequacy of such a view here; we only want to show what its adoption would mean for our framework.

Without going into technical details, it is clear that as under the view in question the class of possible worlds coincides with the class of all structures of a relational language, any possible world is to contain the diagram[21] of one and only one structure and the diagram of any structure is to be contained in one and only one world. This, roughly speaking, means that there exists a class P of "protocol statements" such that[22]

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[15]What it does abandon is the *reduction of meanings to possible-worlds based functions*, and this is what the ingenuity of the approach consists in.

[16]See Mates (1968).

[17]Cresswell (1973).

[18]As Stalnaker (1986) claims, "it is not part of any widely shared conception of possible worlds semantics that possible worlds are indefinable or unanalyzable."

[19]Thus logical truth, i.e. truth in all possible worlds is closely connected in such a framework with first-order logical validity.

[20]The approach is not only promising from the point of view of knowledge representation; also, e.g., a thorough ontological analysis of Tichý (1988) leads to a similar view.

[21]I.e. the class of all first-order propositional formulas without quantifiers holding in the model structure.

[22]The situation is quite simple if any individual is supposed to have a name; in the opposite case everything is much more complicated; however, these are technical complications, by the treating of which we would not like to obscure the main idea.

(i) any statement of P is of an atomic structure, i.e. it is a statement of a certain relation holding among certain individuals;

(ii) the truth values of all statements are fixed by fixing the truth values of the statements of P;

(iii) the statements of P are independent, i.e. each of them can be true or false independently of the truth values of other statements; and

(iv) if a statement belongs to P, then a statement which arises from the substitution of a subject term for another subject term in P also belongs to P.

I do not say that these four conditions are not fulfilled in reality, but I insist that we cannot simply assume that they are fulfilled without a thorough discussion. In fact the discussion has been started by Carnap, Schlick and the other logical positivists, and it does not seem to have yielded a definite conclusion.

7 Possible Worlds and Beliefs

Probably the most tricky problem the possible world semantics has to face is the interpretation of belief sentences. The problem reappears in writings of nearly anyone who inquires into the semantics of natural language.[23] The problem is that while the sentences

One plus one equals two. (1)
Every first-order theory which has a model has an at most denumerable model. (2)

are both true under any imaginable circumstances, the statements

John believes that one plus one equals two. (3)
John believes that any first-order theory which has a model has an at most denumerable model. (4)

may well differ in truth value.

As it seems to be clear, two statements which are not intersubstitutive *salva veritate* cannot coincide in meaning[24], (1) and (2) differ in meaning, i.e. express different propositions. However, if we then apply the conclusions of the previous paragraphs, we come to the conclusion that there has to exist a possible world in which (1) and (2) differ in truth value (there has to exist an atom of the corresponding Boolean algebra of propositions which belongs to one of them and does not belong to the other). So do there exist possible worlds in which some truths of mathematics do not hold?

The answer to this question is not at all simple. A positive answer to the question seems to be in contradiction with our Principle of Consistency. However, should *to be consistent* be understood as *to be imaginable as true*, then either the negation of (2) would have to be consistent, or (4) could not be false. The point is that if belief sentences are accepted into the

[23]For a survey see Bäuerle and Cresswell (1989). Cf. also Peregrin (1987).

[24]Elsewhere (Peregrin, 1992b) I have called this fact *the Principle of Verifoundation*; Bäurle and Cresswell (1989) call it *the Most Certain Principle*.

range of our investigation, then in fact any subject we are able to speak about is granted the power to establish a distinction between the meanings of two statements. This leads to the conclusion that the possible worlds which arise in this way are something of the kind of Hintikka's (1978) *epistemically possible worlds*.[25] However, it is important to realize that the existence of such epistemically possible worlds is not a conclusion of metaphysical considerations; simply if we insist on calling the atoms of the Boolean algebra of propositions *possible worlds*, then the *possibility* mentioned cannot be *logical possibility*.

Elsewhere (Peregrin, 1988) we have argued for a "gradual" view of meaning in correspondence to what kinds of contexts are included in semantic analysis. Four kinds of contexts were distinguished: (i) extensional contexts; (ii) intensional contexts; (iii) contexts involving propositional attitudes; and (iv) quotational contexts. To this inclusive chain of four kinds of contexts there correspond four semantic correlates of sentences ("levels of meaning") in a natural way: (i) extension (sentences denote truth values, predicates denote classes of individuals); (ii) intension (sentences denote classes of possible worlds, predicates denote functions from possible worlds to classes of individuals); (iii) "hyperintensions" (disambiguated correlates of sentences such as Lewis', 1972, structured meanings, Barwise and Perry's, 1983, situations-based meanings or tectogrammatical representations of Sgall et al., 1986); and (iv) surface shapes. I think that here we have another fact corroborating this view: if we consider the algebras of propositions corresponding to these contexts and their atoms we can see that we have: (i) a single element (the "actual world") for extensional contexts[26]; (ii) logically possible worlds in intensional contexts; (iii) epistemically possible worlds in contexts involving propositional attitudes. As for quotational contexts, for them also the outer form of statements comes into consideration; this means that corresponding atoms become something like "inventories of sentential expressions".

8 Conclusion

Possible worlds are, as far as semantics is concerned, primarily mere indices relative to which propositions have truth values. However, if we accept the principles of Section 4 (which I consider indispensable), then we see that there is an intrinsic interconnection between possible worlds and propositions, namely that a possible world can be identified with a maximal consistent class of propositions. Any asserted structure of possible worlds and/or their space means certain structure of propositions and/or their consistent classes. For example, to say that possible worlds consist of individuals and relations is to say that atomic propositions have the predicate-terms structure; and to say that there is a one-to-one correspondence between possible worlds and first-order structures is to say that atomic propositions are independent.

It is, of course, more usual to go the other way round and to identify a proposition with a class of possible worlds. Such identification is surely useful for various purposes, but is not useful for the explication of either the concept of possible world (which it takes as primitive), or

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[25]Cf. also an interesting essay of Kroy (1976), in which the author argues for an identification of possible worlds and "products of imagination".

[26]The Boolean algebra of propositions contains in this case two elements ("truth" and "falsity"), and hence is isomorphic to the Boolean algebra of the power set of a set with a single element.

the concept of proposition (which is reduced to the problematical concept of possible world). The viewpoint proposed here hints, on the other hand, at a real explication: the concept of possible world is reduced to the concepts of proposition and consistency, whereas that of proposition is in turn reduced to the concepts of sentence and logical equivalence. As the concepts of consistency and logical equivalence are definable in terms of (logical) consequence, the terms we have to take as basic and unanalyzed are *sentence* and *consequence*; and this seems to be really the concepts which are given to us quite directly[27].

Someone might object that my conclusion implies that possible worlds are language-dependent. However, I am convinced that this is indeed the case: there is no absolute, unbiased reality structured independently of any language, there is, as Goodman (1960) puts it, no "innocent eye"[28]. Semantics is no metaphysics; but I do not believe that there is a metaphysics beyond semantics.

[27]This indicates that, contrary to the usual opinion, I believe that model-theory should be reduced to proof theory, not vice versa. For the general grounds for such a belief see Peregrin (1992a,b).

[28]See Peregrin (1992b).

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