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ESSENTIALISM AND THE MODAL SEMANTICS OF J. HINTIKKA

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In this paper I wish to argue that Jaakko Hintikka's quantification theory is objectual, not substitutional, and that his handling of standard Quinean puzzles about the substitutivity of identicals in modal contexts does not avoid the metaphysical position of general essences. I shall understand a general essence to be a non-trivial property (a general monadic predicate would be an example) that is necessarily true of certain objects, fails to be necessarily true of other objects, and may be shared by distinct objects.

Hintikka develops his semantical theory for modal logic in terms of models and model systems. A model is a set of formulas—from an intuitive point of view, a set of formulas which are all true on one and the same interpretation of the nonlogical constants occurring in them. In fact, the conditions which define a model set, say μ, are essentially parts of the usual semantical truth conditions for sentential connectives and quantifiers. Hintikka ([8], pp. 57-59) formulates them as follows. Where μ is a model set,

(C.$\sim$) If p is an atomic formula or an identity, not both $p \in \mu$ and $\sim p \in \mu$.
(C.&) If $(p \,\&\, q) \in \mu$, then $p \in \mu$ and $q \in \mu$.
(C.v) If $(p \vee q) \in \mu$, then either $p \in \mu$ or $q \in \mu$ (or both).
(C.E) If $(\mathrm{E}x)p \in \mu$, then $p(a/x) \in \mu$ for at least one free individual symbol a.
(C.U) If $(x)p \in \mu$, then $p(b/x) \in \mu$ for every free individual symbol b occurring in the formulas of μ.
(C.=) If p is an atomic formula or an identity, if $p \in \mu$, if $(a = b) \in \mu$, and if $p(a/b) = q(a/b)$, then $q \in \mu$.
(C.self $\neq$) μ contains no formulas of the form $a \neq a$).

It is assumed that all the formulas dealt with have been reduced to a form in which negation-signs occur only where they immediately precede an atomic formula or an identity. The formula referred to by '$p(a/x)$' in (C.E) is the formula obtained from 'p' by replacing free 'x' everywhere by 'a'. Similar notation is used in the other conditions and in that which follows.

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A model system Ω is a set of model sets with a two-place relation (called the alternativeness relation) defined on it in such a way that the following conditions are satisfied:

(C.M*) If $Mp \in \mu \in \Omega$, there is an alternative $\lambda \in \Omega$ to μ such that $p \in \lambda$.
(C.N$^+$) If $Np \in \mu \in \Omega$ and if $\lambda \in \Omega$ is an alternative to μ, then $p \in \lambda$.
(C. refl.) The alternativeness relation is reflexive.[1]

The satisfiability of a set of formulas λ is defined as its imbeddability in some member $\mu \supseteq \lambda$ of model system Ω, $\mu \in \Omega$. If one thinks of λ as a set of interpreted formulas, i.e., sentences, this means that one may think of model sets as descriptions of logically possible states of affairs (possible courses of events, possible worlds). Hence, a set of sentences is satisfiable if and only if there is a possible world in which all its members are true, that is, if and only if there is a description of a logically possible world which includes all the sentences of λ.[2] The basic intuitive idea of necessity and possibility is that the necessity of a sentence 'p' in a possible world μ equals truth in all alternative possible worlds, and that the possibility of 'p' equals truth in at least one alternative possible world.

The conditions listed above serve as the basic structure for Hintikka's semantical theory; however, he has introduced certain modifications of those conditions in light of the breakdown in modal contexts of many of the characteristic laws of first order logic. Hintikka has long argued that these breakdowns stem from a failure of singular terms to specify the same individual in each possible world. This is the problem of the referential multiplicity of singular terms in modal contexts—viz., the failure of a singular term to refer to the same individual through possible worlds. This has been a persistent theme through all of Hintikka's works. See, for instance, [5], pp. 6-7; [6], pp. 138-41; [7], pp. 49-64; [10], p. 491. Examples of this failure and further amplification of the failure follow.

It is the referential multiplicity of 'the number of the planets' that ultimately explains why

(1) N (the number of the planets is odd)

is false, even though

(2) 9 = the number of the planets

and

(3) N (9 is odd)

are true. The 'number of the planets' may refer to the number 2 in λ, and in λ the sentence 'the number of the planets is odd' is false—hence, (1) is false in μ where λ is alternative to μ. But since the numeral '9' is not affected with such randomness of designation, the sentence '9 is odd' is true in all alternative worlds.

The issue of referential multiplicity is at the center of the problems surrounding quantifying into modal contexts. Supposing the truth of

(4) N (the number of the planets = the number of the planets),

we end up with the false statement

(5) $(\mathrm{E}x)N$ (x = the number of the planets)

when we perform **E.G.** on (4). (4) is not about any one individual, for it merely says that in every possible world λ whatever is the number of the planets, is the number of the planets. In some λ it might be the number 2, and in another the number 10.[3] Hintikka observes ([8], pp. 120, 157-59; [6], pp. 152-53) that we cannot expect to go from a statement about different individuals, e.g., (4), to a statement, e.g., (5), which says that there is some one unique individual of which the statement is true. In light of his analysis of the breakdown of certain customary laws of first order logic, Hintikka substitutes for conditions (C.=), (C.U), and (C.E), respectively, the following:

(C.N=) If $p \in \mu$, and if q results from p by interchanging 'a' and 'b' in a number of places which are within the scope of precisely $n_1, n_2, \ldots$ modal operators, respectively, and if $N^{n_1}(a = b) \in \mu$, $N^{n_2}(a = b) \in \mu, \ldots$, then $q \in \mu$.
($\mathrm{C.U_1}$) If $(x)p \in \mu \in \Omega$, if the modal profile of p with respect to 'x' is $n_1, n_2, \ldots$, and if 'b' occurs in the formulas of some member of Ω, and if $(\mathrm{E}x)(N^{n_1}(x = b)\ \&\ N^{n_2}(x = b)\ \&\ \ldots) \in \mu$, then $p(b/x) \in \mu$.
($\mathrm{C.E_1}$) If $(\mathrm{E}x)p \in \mu$, and if the modal profile of p with respect to 'x' is $n_1, n_2, \ldots$, then, for some 'a,' $p(a/x)$ and $(\mathrm{E}x)(N^{n_1}(x = a)\ \&\ N^{n_2}(x = a)\ \&\ \ldots) \in \mu$.

The modal profile of 'p' with respect to 'x' is determined by the number of modal operators within the scope of which the variable 'x' occurs in 'p.' For example, the modal profile of the formula '$(\mathrm{E}x)NPx$' is one.

Condition (C.N=) expresses the familiar claim that necessary identities are intersubstitutible in modal contexts. The intuitive rationale for conditions ($\mathrm{C.U_1}$) and ($\mathrm{C.E_1}$) is clear. A free singular term, say 'a,' which picks out different individuals in alternative possible worlds does not specify a well-defined individual, where a well-defined individual would be some *one and the same* individual to which 'a' refers in all alternative worlds. That 'a' does specify such a well defined individual is expressed by the condition (*) which appears as a part of ($\mathrm{C.U_1}$) and ($\mathrm{C.E_1}$):

(*) $(\mathrm{E}x)(N^{n_1}(x = a)\ \&\ N^{n_2}(x = a)\ \&\ \ldots)$

Thus Hintikka ([8], p. 125) writes: "What ($\mathrm{C.U_1}$) and ($\mathrm{C.E_1}$) imply may be partially expressed by saying that according to them a singular term is an acceptable substitution-value for a bound variable if and only if it picks out one and the same individual in all the relevant possible worlds." Hintikka thinks there are no syntactical categories of singular terms whose members always satisfy (*). Hence, instead of limiting the singular terms of his semantics to some such category, proper names, for instance, he allows a variety of types of singular terms and safeguards quantification by requiring uniqueness premises as in conditions ($\mathrm{C.U_1}$) and ($\mathrm{C.E_1}$). See [3], pp. 141-42 and [4], p. 45.

The values of a bound variable (bound from outside the modal context) are well defined individuals. Thus in applying **E.G.** to a singular term (say 'a') within a modal context, we must have the supporting premise (*) that 'a' picks out a well-defined individual. For example, the move from (4) to (5) is valid only if '$(\mathrm{E}x)N\,(x =$ the number of the planets)' is adjoined to (4). But such an adjunction is strictly a *petitio principii*, being itself the desired conclusion. Hintikka's semantics intends to preserve the claim, pressed so often by Quine, that the same properties are true of identical individuals in modal contexts. He adopts in [8], pp. 129-30, the following condition:

(C. ind=) If $p \in \mu$, $(a = b) \in \mu$, and if q results from p by interchanging 'a' and 'b' in a number of places which are within the scope of $n_1, n_2, \ldots$ modal operators, respectively, and if

$$(\mathrm{E}x)\left[(x = a) \;\&\; N^{n_1}(x = a) \;\&\; N^{n_2}(x = a) \;\&\; \ldots\right] \in \mu$$
$$(\mathrm{E}x)\left[(x = b) \;\&\; N^{n_1}(x = b) \;\&\; N^{n_2}(x = b) \;\&\; \ldots\right] \in \mu$$

then $q \in \mu$.

Condition (C. ind=) insures that whatever is said of a genuine individual can always be said of another individual identical with it. Hence, given that the values of bound variables are genuine individuals, we expect that formulas of the following form are valid in Hintikka's semantics:

(6) $(x)(y)((x = y) \supset (p \supset q))$

where 'p' and 'q' are like each other except for an interchange of 'x' and 'y' at a number of places.

Dagfinn Føllesdal (in [1], p. 278 and [2], pp. 26-27) has claimed that instances of the denial of (6) are satisfiable in Hintikka's semantics—at least in early statements of it. Føllesdal charges that this is so because Hintikka's semantics for quantification is not objectual, but substitutional—that is, the values of variables are expressions, not the objects referred to by these expressions. I hope to show that Follesdal's argument is ineffectual against Hintikka's present semantics, for that semantics is objectual. Føllesdal asks us to consider the following instance of the denial of (6):

(7) $(\mathrm{E}x)(\mathrm{E}y)((x = y) \;\&\; (N(Gx) \;\&\; {\sim}N(Gy)))$

He argues that this formula is imbeddable in the following model system Ω, composed of μ and λ:

μ:
(i) $(\mathrm{E}x)(\mathrm{E}y)((x = y) \;\&\; (N(Gx) \;\&\; {\sim}N(Gy)))$
(ii) $(\mathrm{E}x)((a = y) \;\&\; (N(Ga) \;\&\; {\sim}N(Gy)))$
(iii) $(a = b) \;\&\; N(Ga) \;\&\; {\sim}N(Gb)$
(iv) $(\mathrm{E}x)\; N(a = x)$
(v) $(\mathrm{E}x)\; N(b = x)$
(vi) $N(a = c)$
(vii) $N(b = d)$
(viii) $a = c$

(ix) $b = d$
(x) Ga
(xi) Gb
(xii) Gc
(xiii) Gd

λ: (xiv) $a = c$
(xv) $b = d$
(xvi) Ga
(xvii) Gc
(xviii) $\sim Gb$
(xix) $\sim Gd$

The intuitive meaning of Ω is that the two terms 'a' and 'b', which happen to refer to the same object in μ, refer to distinct objects in the possible world λ, in which one of those objects is G and the other *not-G*. The terms 'a' and 'c' are co-referential in both worlds, as are 'b' and 'd'; hence, the object referred to by 'a' is G if and only if the object referred to by 'c' is G, and similarly for 'b' and 'd'. Of this modal system Føllesdal ([1], p. 278) writes:

> The situation is clear as long as we consider only the terms. However, ordinarily a quantifier is interpreted as saying something not about terms, but about objects referred to by terms, and one might wonder what happens to the object which in our actual world is the common reference of 'a' and 'b' when we pass into the possible world λ. Is this object G or is it *non-G* in λ?

Føllesdal seems to suggest that his question has no answer on Hintikka's semantics. And the reason no answer is forthcoming, according to Føllesdal, is that Hintikka's semantics for quantifiers does not in the end say anything about the objects which are ostensibly the values of the variables.

Føllesdal's argument is ineffectual against Hintikka's present semantics. In light of ($C.E_1$), it is clear that two sentences must be added to Føllesdal's description of μ. In his moves from (iv) to (vi) and from (v) to (vii), he instantiates on existential generalizations. Condition ($C.E_1$) requires that the following sentences be a part of μ:

(xx) $(Ex)\ N(x = c)$
(xxi) $(Ex)\ N(x = d)$

These sentences tell us that the singular terms 'c' and 'd' refer to genuine individuals and, hence, are the sort of singular terms that satisfy (*). But in μ we also have (iv) and (v), which tell us that the singular terms 'a' and 'b' likewise refer to genuine individuals. Moreover, by (iii), (viii), and (ix) we can infer that the singular terms 'a', 'b', 'c', and 'd' all refer to the same individual in μ. By (iv), (v), (xx), and (xxi) we know that 'a', 'b', 'c', and 'd' are the sort of names that refer to the same individual in λ as in μ. This fact, in conjunction with the fact that 'a', 'b', 'c', and 'd' are co-referential in μ, leads to the conclusion that they are co-referential in λ.

Let us suppose that 'a' and 'b' are not co-referential in λ. We have then added to λ the following:

(xxii) $b \neq a$

Our task is to derive a contradiction from (xxii). We turn our attention to μ. For the sake of ease of reference, we list the relevant sentences of μ:

(vii) $N(b = d)$
(iii′) $a = b$ (Simplification of (iii))
(iv) $(\mathrm{E}x)\, N(a = x)$
(ix) $b = d$
(xxi) $(\mathrm{E}x)\, N(x = d)$

From (iii′) and (ix) we derive by (C.N=) (or by C.=))

(xxiii) $a = d$

Utilizing the condition (C.ind=),[4] we derive from (vii), (xxiii), (iv), and (xxi) that

(xxiv) $N(b = a)$

is true in μ. By condition (C.N+) we derive that

(xxv) $b = a$

is true in λ. Hence (xxii) and (xxv) violate condition (C.∼). The terms 'a' and 'b' are co-referential in λ, and by condition (C.=) it is simple to show that all four terms are co-referential in λ.

Returning then to Føllesdal's counterexample, we discover that the addition of (xxv) results in λ containing a contradiction. By condition (C.=), we derive from (xxv) and (xviii) that

(xxvi) $\sim Ga$

is true in λ. The conjunction of (xxvi) and (xvi) violates condition (C.∼). This contradiction shows that (7) is *not* imbeddable in Ω; therefore, Føllesdal's counterexample to (6) fails. That Føllesdal's argument fails was to be expected since, as was mentioned earlier, the bound variable version of the substitutivity principle, i.e., (6), is valid on Hintikka's semantics.[5] Føllesdal's characterization of λ allows us to reformulate λ on the basis of the prior analysis as

λ: $a = c$
$b = d$
$a = b$
Ga
Gb
Gc
Gd

On the basis of λ thus reconstructed, we note that the genuine individual referred to in μ by 'a,' 'b,' 'c,' and 'd' is G in λ. Føllesdal's comment in

[1], p. 279 that "the fate of the object refereed to by 'a' and 'b' in μ remains in the dark" is seen as now ill-taken. That object satisfies the predicate G in both μ and λ, and, on the assumption of a two world model, the predicate 'NG' in μ.

Hintikka's semantics is referential, and his quantification is objectual. Whereas A. F. Smullyan ([16], pp. 31-39) sought to challenge Quine's arguments by arguing for the substitutivity of descriptions with wide scope, Hintikka has in effect taken the other course. Hintikka has recognized along with Quine the failure of *de facto* coreferential terms (with descriptions given small scope) to be substitutible in modal contexts, but he has sought to analyze this failure and construct a semantics that accounts for it while allowing quantification into these contexts.

Hintikka's semantics is referential at the cost of essentialism. That this is so should be quite evident by now. Consider the following sentences:

(8) $N(\phi a)$

(9) $N(\phi a)$ & $(\mathrm{E}x)N(x = a)$

Sentence (8) merely says that it is necessarily true that whatever is 'a' is ϕ. The key here is that the term 'a' may refer to different individuals in various possible worlds. Perhaps this will be clearer if we substitute in (8) to produce

(8*) N (the number of planets $\geqslant 0$).

In μ the descriptive term refers to the number 9; in λ it refers to (say) the number 2. But in both cases the sentence 'the number of planets $\geqslant 0$' is true.

On the other hand, sentence (9) says that it is necessarily true that the genuine individual referred to by 'a' is ϕ. The uniqueness conjunct in (9) indicates that '$N(a$ is $\phi)$' is about a particular object, namely the object which 'a' refers to in all possible worlds. Hence, the uniqueness conjunct serves to tell us that '$N(x$ is $\phi)$' is a predicate true of a specific well-defined object. For example,

(9*) N (9 is odd) & $(\mathrm{E}x)N(x = 9)$

says that '$N(x$ is odd)' is true of an object, viz. the number 9. Moreover, the predicate is true of the object which is, as a matter of contingent fact, the number of the planets, but since the term 'the number of planets' fails to satisfy the uniqueness condition (*) we cannot reckon

(10) N (the number of planets is odd) & $(\mathrm{E}x)N(x =$ the number of planets)

as true. The term 'the number of planets' merely refers to one manifestation of the number 9, its manifestation in the actual world.[6] Hence, the number 9 is contingently the number of the planets, but according to (9*) it is necessarily odd. And, presumably, there are objects which are not necessarily odd, the number 2, for instance, so we have here an object which satisfies a contingent predicate and a necessary predicate, a necessary predicate which other objects do not satisfy.

Essentialism in Hintikka's semantics comes in when an appropriate uniqueness premise is conjoined with a modal statement in which a singular term appears. For example, sentence (8) does not commit one to the claim that some genuine individual satisfies the predicate '$N(x$ is $\phi)$'. And the statement '$(\mathrm{E}x)\,N(x = a)$' which says that some individual is necessarily denoted by 'a' could be claimed to be non-essentialistic, in the sense that everything in the domain could have the property of being necessarily denoted by some term or other. The property of '$N(x = a)$,' though itself not true of everything, does depend for its being satisfied upon what Marcus calls the referential occurrence of 'a' in the predicate. And some are disposed to speak of such predicates as trivial, at least not essentialistic in any problematic way—so Marcus, [11], pp. 91-96 and Parsons, [14], pp. 184-86.

It is the *conjunction* of '$N(a$ is $\phi)$' and '$(\mathrm{E}x)\,N(x = a)$' that involves essentialism. In that '$(\mathrm{E}x)\,N(x = a)$', that is, a uniqueness premise, is a neeessary feature of the commitment of (9) to essentialism, Quine's claim in [15], p. 174 that essentialism arises only in *quantified* modal logic is partially justified. However, in a modal semantics like Føllesdal's (see [1], pp. 274-75) where the stock of singular terms is limited to those which (in Hintikka's words) specify a unique individual, a sentence like (8) is essentialistic, provided of course that ϕ is a non-trivial predicate. (8) is interpreted as saying that some one object is ϕ in every possible world. Thus essentialism can arise in modal logic at the second grade of modal involvement, where the modal operator attaches to statements.

Hintikka's own reservations about quantification into *alethic* modal contexts rests on the problem of identifying an individual in one world as the same individual in another world. For logical modalities, he argues, it seems possible to generate possible worlds that are so irregular as to cause our customary methods of cross-identification to fail. "If so, we cannot quantify into contexts governed by words for such logical modalities, for such quantification depends essentially on criteria of cross-identification (individuating functions, world lines)", Hintikka ([8], p. 145) concludes.

Hintikka is aware that one might postulate some individuating essence (or set of essences that serve to individuate) for each individual, and that such an individuating essence could serve as a means of cross-world identification. In [4], pp. 40-44 he explicitly rejects this notion of essentialism. Hintikka does not address himself to the merits or demerits of that position which Quine calls "Aristotelian essentialism". Whatever Hintikka's opinion is of this variety of essentialism, it is evident that his analysis of Quine's number-of-the-planets arguments has not avoided it. Perhaps Hintikka would say that no sentence of the form in (9), where ϕ is a non-trivial predicate, would be true in his systems of **QML**, even when extended to include mathematical truths.[7] He has not said that, however; and his handling of examples (as in (9*) and (10)) suggests that the opposite would be true. My point, then, is that the interpretation of sentences of the form in (9) according to Hintikka's semantics, involves an object's having some non-trivial, necessary property, which other objects do not have, and (by common assumption) some contingent property. In so far as these sentences are true in a model system **M** of Hintikka, **M** is committed to essentialism.

NOTES

1. If we disregard the quantificational aspects of the present modal system set up by Hintikka, it turns out to be a semantical counterpart to von Wrights' deductive system M. If we specified that the alternativeness relation is both reflexive and transitive, we obtain a semantical counterpart to Lewis' S4. The combined requirement of reflexivity, transitivity, and symmetry gives rise to a counterpart to S5. See Hintikka, [8], pp. 60-61, 74-75.

2. Two qualifications are needed here. One, model sets are not complete descriptions of possible worlds. They are only partial descriptions, large enough to show that the state of affairs in question is really possible. Two, it is not quite accurate to say that imbeddability in a model set is equivalent to satisfiability in the usual sense of the word. It is only equivalent to satisfiability if the empty domain of individuals is admitted on a par with non-empty ones as a domain with respect to which our formulas may be interpreted. In the empty domain, of course, every universal sentence is true and every existential one false. Hintikka, [8], pp. 25-26 and 72-73.

3. Hintikka ([8], p. 121) notes that a sentence like (4) is ambiguous and could be translated as 'the number which is in fact the number of the planets is necessarily identical with the number of the planets'. This reading of (4) makes (4) false, for there is no number, not even the number which satisfies the description 'the number of the planets', which is necessarily identical to the number of the planets. This is, of course, why (5) is false. This interpretation of (4) takes the sentence to be about the unique individual in the actual world to which the term refers. Although Hintikka does not point it out, such a reading of (4) can be generalized to show that every predicate uniquely satisfied by an object is a necessary predicate. Assume

   (i) $N((\iota x)\phi x = (\iota x)\phi x)$,

   where '$(\iota x)\phi x$' is any definite description uniquely satisfied in the actual world. Interpreting '$(\iota x)\phi x$' in (i) to refer to the unique individual who ϕ's, we get

   (ii) $(\mathrm{E}x)[(y)(\phi x \equiv y = x) \,\&\, N(x = (\iota x)\phi x)]$

   or

   (iii) $(\mathrm{E}x)[(x = (\iota x)\phi x) \,\&\, N(x = (\iota x)\phi x)]$,

   depending on how we translate the definite description. In both cases the unique ϕer has the predicate '$N(x = (\iota x)\phi x)$'.

4. All along we (as well as Føllesdal) have implicitly assumed that the referent of 'a', 'b', 'c', and 'd' exists in μ. This assumption could be made explicit by the addition of appropriate existential statements to μ. I have omitted these in order to compress the proof.

5. Hintikka sharply distinguishes (6) from

   (6*) $(a = b) \supset (p \supset q)$

   where 'p' and 'q' are alike except for the interchange of 'a' and 'b' at a number of places. (6*) is a statement of the substitutivity of *de facto* coreferential free singular terms, a principle which Hintikka rejects.

Hintikka's analysis ([3], p. 139; [8], pp. 130-31) at this point follows very closely that of Richard Montague in [12], p. 266 and [13], p. 298. Quine's failure in arguments such as (1)-(3), according to Hintikka, is his failure to distinguish (6) from (6*). The phrases '9' and 'the number of planets' are mere *de facto* coreferential singular terms and are not substitutible *salva veritate* in modal contexts.

6. In speaking of an individual that appears in several different possible worlds, Hintikka ([8], pp. 101-103; [9], pp. 410-13) distinguishes between the individual and the "manifestations" or "stages" of the individual in possible worlds. The individual may be thought of as a world-line through possible worlds, and a manifestation of an individual as a piece of that world-line.

   This is suggestive of the doctrine of essentialism. Some terms merely refer to a fragment of a world-line, to but one role; these terms refer to a fragment of some other world-line in another possible world. When such terms are definite descriptions, it is clear that the world-line satisfies this description fragmentarily (i.e., contingently). A term which satisfies condition (*) refers to the same individual in all its roles, and when a necessary predicate 'Np' is truly affirmed of this individual, the individual has 'p' in *all* its roles.

7. One can formalize mathematical truths in modal logic so as to avoid essentialistic implications. Hence, (3) can be formalized as

   (3*) $N(x)(x \text{ is nine} \supset x \text{ is odd})$

   which does not suggest that any one object is both nine and odd in every possible world. A staunch anti-essentialist might wish to add to (3*) the following

$$(x)M \sim (x \text{ is odd}).$$

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