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ON SOME PROPOSALS FOR THE SEMANTICS OF MASS NOUNS*

Simple mass nouns are words like 'water', 'furniture' and 'gold'. We can form complex mass noun phrases such as 'dirty water', 'leaded gold' and 'green grass'. I do not propose to discuss the problems in giving a characterization of the words that are mass versus those that are not. For the purposes of this paper I shall make the following decrees: (a) nothing that is not a noun or noun phrase can be mass, (b) no abstract noun phrases are considered mass, (c) words like 'thing', 'entity' and 'object' are not mass, (d) I shall not consider such words as 'stuff', 'substance' or 'matter', (e) measures on mass nouns (like 'gallon of gasoline', 'blade of grass', etc.) are not considered, (f) plurals of count terms are not considered mass. Within these limitations, we can say generally that mass noun phrases are those phrases that 'much' *can* be prefexed to, by 'many' *cannot* be prefexed to, without anomaly.[1] Semantically, such phrases usually have the property of *collectiveness* – they are true of any sum of things of which they are true; and of *divisiveness* – they are true of any part (down to a certain limit) of things of which they are true. All of this, however, is only 'generally speaking' – I shall mostly use only the simple examples given above and ignore the problems in giving a complete characterization of mass nouns.

In the paper I want to discuss some problems involved in casting English sentences containing mass nouns into some artificial language; but in order to do this we should have some anchoring framework on which to justify or reject a given proposal. The problem of finding an adequate language can be viewed as a case of translation (from English to the artificial language), where the translation relation must meet certain requirements. I shall suggest five such requirements; others could be added. Let S_i be a sentence of English and S_i^* be its translation into an artificial language, then

1. If S has a truth value, then S^* must have that truth value
2. If S is analytic, then S^* must be analytic

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3. If S is deducible from $S_1, S_2 \ldots S_n$, then S^* must be deducible from $S^*, S^*, \ldots S_n^*$
4. S and S^* must be about the same entities
5. S_1 is a paraphrase of S_2 if and only if S_1^* is a paraphrase of S_2^*.

I state condition 3 syntactically; the reason is not so much that I object to the semantical 'is a consequence of' as it is that I insist on the relationship being "obvious". One could cook up all kinds of consequence relations on an *ad hoc* basis one for each mass term (see Section I below on 'corresponds to'). But given some standard uninterpreted artificial language, it is rather more difficult to cook up *ad hoc* deducibility relations. For 'paraphrase' in condition 5, I mean 'synonymy' (to the extent that it applies to artificial languages – see Lewis on "meaning"). Doubtless these conditions could be clarified more, but their intent should be clear (except perhaps for #4, which will be discussed later).

I. CLASSICAL QUANTIFICATION THEORY

The classical view is presented in Quine's *Word and Object* (henceforth *W & O*). I shall argue that this view of the translation relation violates condition 3 and condition 2.

Classical quantification theory allows for two distinct uses of mass nouns. In the predicative use (like 'water' in 'this puddle is water') it is treated as a general term, which is "true of each portion of the stuff in question, excluding only the parts too small to count" (*W & O*, p. 98). General terms, of course, are translated by a predicate letter. On the other hand, when a mass noun occurs in subject position (like 'water' in 'water is wet'), it is treated as a singular term (*W & O*, pp. 97–98). So the English argument "This puddle is water, Water is wet, *ergo* This puddle is wet" would be translated

$$Ft, Gw \vdash Gt$$

(where F: is water, G: is wet, t: this puddle, w: water) which is obviously not deducible. But since the English argument of which it is the translation obviously *is* deducible, this constitutes a violation of condition 3.

Furthermore, the English sentence 'water is water' is obviously analytic, yet its translation into classical quantification theory would be

$$Fw$$

which (equally obviously) is not analytic, thus violating condition2. Perhaps, though, Quine would want to claim that in certain circumstances we should treat 'is' as 'identity', so that we would get the analytic

$$w = w$$

for this sentence. But then we would be at a loss to account for the analyticity of sentences like 'Dirty water is water'. Another possible adjustment might be to claim "If a is a singular term and F is the general term corresponding to a, then Fa is analytically true". In addition to the difficulties in giving a syntactical explication of the 'corresponding to' relation, I still fail to see how this could account for the analyticity of 'Dirty water is water'. For we would have

$$Fd$$

(where d: dirty water), which, while true, is not analytic.

II. A MEREOLOGICAL INTERPRETATION

One might have doubts about the rationale of this "dual treatment" of mass terms by Quine and also about his assertion that this is "the simplest plan", but he has good reasons both for giving this dual treatment and for the assertion. He does consider the possibility that mass terms be treated as singular terms regardless of their grammatical role, but rejects this proposal for two reasons. First, it requires that the copula be ambiguous. In sentences like 'Socrates is a man' it would have to be taken as the "'is' of predication" (or, if one prefers a set-theoretic interpretation, as "set membership"), while in sentences like 'this puddle is water' it would have to be taken as 'is a part of'. Secondly, conditions 1 and 5 fail since the representations of 'x is water' and 'x is a part of water' would be identical and yet the English sentences are *not* paraphrases of one another and haven't even the same truth-value (since not all parts of water are themselves water – e.g., the atoms).

The problem with the dual approach seems to be that it cannot exhibit sufficient intra-sentential logical form to abide by our first three conditions. However, Julius Moravcsik (1973) claims that there is a way to exhibit sufficient intra-sentential logical form. That way is to take the "pure mereological" approach rejected by Quine, and to use the Leonard-Goodman calculus of individuals to exhibit the form.

Obviously, in order for Moravcsik to succeed he must dispose of Quine's objections to the "pure mereological" approach. He does this by giving a re-interpretation of 'is a part of' and tries to show that this re-interpretation does not violate the "paraphrase condition". What we need here, claims Moravcsik, is some general scheme by which we can indicate what the smallest part of any given mereological entity are. Any part of such an entity, e.g., Water, can be specified by saying it is a part (in the ordinary sense) of Water and it has certain empirically describable structural properties (abbreviated 'SP'). Thus the proposal is to translate '*x* is *M*' where '*M*' is a mass term as '*x* is a part (with the required SP) of the individual *M*'.

Doing this, of course, is to give up Quine's "simplest plan"; but, Moravcsik says, we do not want this simplicity anyway – we want to be able to illustrate the difference between mass and count terms. Here this is done by exhibiting the internal structure of a sentence in different ways: with count terms the copula is construed as ordinary predication (or set-membership), with mass terms the copula is construed as 'is a part (with SP) of'. And in support of this proposal we might note that it does meet the objections to Quine's dual approach. (First though, it should be noted that Moravcsik allows certain adjectives (e.g., 'wet') to also be treated mereologically. And while I decreed earlier that I shall not consider adjectives to be either mass or count, for the purposes of the discussion here let's agree to concede Moravcsik this point.) The argument whose deducibility Quine could not demonstrate was "Water is wet, This puddle is water, *ergo* This puddle is wet". Moravcsik could translate it

$$W <_{sp} T, P <_{sp} W \vdash P <_{sp} T$$

where W: the individual Water, T: the individual Wet, P: this puddle, and '$<_{sp}$' is interpreted as 'is a part of (with SP)'. Given the transitivity of '$<_{sp}$', this argument is obviously valid. Quine also could not account for the analyticity of 'Dirty water is water'. But since for Moravcsik a noun phrase with an adjective plus mass noun denotes the overlap of the individual denoted by the adjective and the individual denoted by the noun, he could demonstrate the analyticity of this sentence as:

$$(x)\,(y)\,((x<_{sp}D\ \&\ y<_{sp}W)\supset xy<_{sp}W)$$

where D: the individual Dirty, W: the individual Water, and 'xy' is interpreted as 'the overlap of x and y'. This is analytic in the pure calculus of individuals (i.e., without the 'sp' subscripts), and intuitively says "The overlap of the dirty-parts and water -parts is a water-part."

Unfortunately, it seems clear that this pure mereological approach will not work. There are two objections, either of which being sufficient to show this. The first has to do with the interpretation given to '$<_{sp}$'. As Moravcsik makes clear, it is not *simply* to be interpreted as 'is a part of', since there are to be 'smallest' parts of (say) water – for instance, the water-molecules. What Moravcsik has in mind is an "intensional interpretation": in order to determine the truth of '$x<_{sp}y$' we must look at the *description* given by 'y'. Thus we could have two descriptions, 'a' and 'b', which denote the same thing (i.e., the same mereological whole), and yet '$x<_{sp}a$' and '$x<_{sp}b$' might have different truth-values, since the SP-set relevant to 'a' might be different from the SP-set relevant to 'b'. Moravcsik in fact makes such a claim when he says (p. 281), "F and G are distinct if and only if there is a part of one, say F, that is an F-part but though it may be a part of G is not a G-part". Moravcsik does not find this objectionable, but he should, since we then would not meet one of his own conditions of adequacy of a semantics; namely, we would not be able to compute the denotations of complexes containing mass terms on the basis of the denotations of the contained terms. And furthermore, such an interpretation effectively denies transitivity to '$<_{sp}$', since the SP relevant to 'y' in '$x<_{sp}y$' might be different from the SP relevant to 'z' in '$y<_{sp}z$', so that we cannot conclude '$x<_{sp}z$'. But Moravcsik needs the transitivity of '$<_{sp}$' to demonstrate the deducibility of the argument given above. I believe Moravcsik's only alternative here would be to retain '$<$' of the pure calculus of individuals and make 'SP' be a predicate (a large number of them, one for each mass term). Thus 'This puddle is water' would be translated

$$(P<W)\ \&\ \mathrm{SP}(P)$$

where P: this puddle, W: the individual Water, SP: has the structural properties of water. But if this is what is meant, then surely it would be easier to just drop the superfluous calculus of individuals and say merely

$$SP(P).$$

So we see that Moravcsik's attempt to add 'SP' as a covering scheme to avoid Quine's objection merely brushes all the difficulties under the rug.

The second objection is aimed at *any* attempt to introduce mereological entities (whether Quine's partial approach or Moravcsik's pure approach), and can be found in T. Parsons (1970), about which we shall talk later. Given a suitable state of affairs, it might be the case that all the wood in the world was, is, and will be made into furniture and that all the furniture in the world was, is, and will be made of wood. So all parts of the individual Wood are parts of the individual Furniture and vice versa; and thus the two mereological entities are identical. But some pieces of wood are not pieces of furniture, so the mereological approach is false. Moravcsik recognizes the applicability of this objection to his position and says (p. 282), in addition to the principle quoted above:

> ... we have two choices for the denotation of a mass term. It is either the class whose members are the mereological units from each possible world, or the mereological unit ('super-individual') that is made up of all the mereological units from the various possible worlds.

Moravcsik opts for the former alternative for good reason, for the latter involves the conceptual absurdity of one individual being simultaneously in all possible worlds. But this first alternative also strikes me as too facile. Suppose we have two mereological units *F* and *G* which are identical in some world (all *F*-parts are *G*-parts and vice versa). How now are we to tell if the *F* (which is *G* in this world) is still *F* (when it is not *G*) in some other possible world? To do this we surely need some criterion for distinguishing *F* from *G*. And if we do have such a criterion, what could it be but that some predicate applies to *F* but not to *G*? And if this is so, the mereological interpretation is otiose – we should rather let '*F*' be a predicate (the one indicated by our criterion). Thus, Moravcsik's proposal destroys the very position it is designed to salvage.

III: SOME SET-THEORETIC INTERPRETATIONS

There have been suggestions e.g., by Strawson in *Individuals*, and perhaps also (sometimes) by Quine in *W & O* and his review of Geach's *Reference* *and Generality*, and by Clarke (1970), to the effect that uses of mass terms should be understood as elliptical for some more complex phrase in which there is an explicit "individuating standard" (or count phrase) by means of which we can give sense to there being a certain *number* of things of which the mass term is true. Thus, 'is water' might be elliptical (in some circumstances) to 'is a body of water' or (in other circumstances) 'is a kind of water'. 'Is sugar' might be rendered 'is a shipment of sugar'; 'is gold' might be short for 'is a vein of gold' or as 'is a nugget of gold', depending on the context.[2]

It is instructive to see that this position is an improvement over the mereological interpretation, for it at least avoids the problem where all furniture is, was, and will be wooden, and all wood is, was, and will be furniture. Under the present interpretation, we need not bring into play any such objectionable entities as "other possible worlds", for in the actual world there are "individuating standards" applicable to wood which are not applicable to furniture. E.g., the set of pieces of wood is distinct from the set of pieces of furniture. The leg of a chair is an element of the set of pieces of wood but not of the set of pieces of furniture. Thus 'wood' and 'furniture' do not denote the same sets, and the case does not pose a problem for this interpretation.

This view has been elucidated and criticized in Helen Cartwright (1965) (henceforth "H"). I shall briefly mention a few of the difficulties to be found in it. First, if we were to incorporate such a view into our translation relation, we would find that certain sentences would have no representation. Consider the sentence 'What Jeff spilled is the same coffee as what he wiped up'. This sentence is an identity claim, so what is on one side of the equal sign must be identical with what is on the other side; and that implies that the same "individuating standard" must be applicable to both sides. But what could it be? It cannot be 'puddle of coffee' for that cannot be spilled. It cannot be 'cup of coffee' for that is not the kind of thing which one can wipe up. Second, certain sentences violate condition 1, the "truth-value sameness" condition. Consider the sentence 'The sugar here is the same sugar as that which was on the boat when the sugar which was on the boat was melted before it came here. The extension of 'this sugar here' contains no lumps, grains, etc., so there no longer is a set of these things. Thus the purported set-equality fails, yet the English sentence may very well be true. And thirdly, there can be no *general* translation procedure, for given a particular case, we may have no way to tell *which* of the "individuating standards" is to be used (of all the ones that truly apply). For instance, sameness of shipment of sugar is also sameness of lumps of sugar and sameness of grains of sugar. How, in any particular case, do we know which one to use? And finally, a sentence like 'This shipment of sugar is constituted by the grains of sugar' is true, but it is quite unclear just what "individuating standard" will apply here – it looks as if we need a use of 'sugar' that does *not* depend on the individuating standards of 'shipment', 'lump', or 'grain'.

Thus, this method of calling into play context-dependent "individuating standards" is seen to be unsatisfactory. It seems that if one wishes to call sets into play at all, what is required is the same set for all occurrences of that mass term. Perhaps the simplest plan would be to allow mass terms to denote the set of the smallest entities of which it is true – the set denoted by mass noun '*M*' would be all and only those things which are *M* and of which no part is *M*. For example, 'furniture' would denote the set of individual pieces of furniture, the set denoted by 'water' might be the set of water molecules. Note that this proposal also avoids Parsons' objection: just because all furniture is wood, and all wood furniture, still it does not follow that furniture is (identical with) wood, because the minimal parts of each are distinct.[2a]

However, it is obvious that this proposal cannot work; it implies that for every mass term there will be some count term with the same denotation. Suppose that water molecules are the minimum parts of water. It would then follow that 'water molecules' (a count term) and 'water' (a mass term) would have the same denotation. But this is obviously false, since (a) it invokes an empirical claim about the meanings of mass terms (that there always is such a count term), and (b) the *extensions* of 'water' and 'water molecules' would still have to be distinct since 'water' is true of this puddle but 'water molecules' is not. But this is impossible, since by hypothesis they have the same denotation. And finally, (c) the copula would have to be regarded as ambiguous: sentences like 'This molecule is water' would be translated as

$$a \in W$$

but to translate 'This puddle is water' we would have to graft something like the calculus of individuals onto our set-theoretic base. What is required is some sentence like 'All parts of this puddle that are exactly the right size are (elements of) water'. So we need to add something (Moravcsik's SP?) which will say which ones are big enough to count. And we have already seen that this involves many insuperable difficulties.

These objections seem to show that any position which would have a mass term '*M*' denote some, but not all, of the things that are *M*, cannot be maintained. The obvious way to proceed then, would be to have '*M*' denote the set of all things that are *M*. Such a position is the one advanced by Helen Cartwright in "H" and also in "Quantities" (henceforth "Q"). I think this position is also wrong, but first it needs to be laid out; thus, I shall state the central thread in "H" and "Q". (Not in detail of course, but enough to give the proposal a fair run and to bring out what seems to me wrong).

In English there is a partitive quantifier, 'some'. This quantifier can be used with count terms in both the singular and plural, and with mass terms but only so long as they are understood as 'kind of' plus mass term. There is another word in English, a word that can be used only with count terms in the plural and with mass terms understood normally. This word happens to be spelled the same as the partitive quantifier, but is pronounced with weak stress, and for typographical convenience I shall indicate it by '*sm*'. (The distinction was first made in the philosophical literature, I believe, in "H".) Perhaps some examples will bring out the difference.

1. Give John *sm* water.
2. Some man wants water.
3. *Sm* water would taste good now.
4. Some water tastes worse than L.A. water.

In 1 and 2 it is clear enough what is going on. If the request in 1 is carried out, John will receive some quantity or other of water – some indeterminate amount is asked for (within certain contextual limits). In 2 'some' is a quantifier: there is a man who wants water. In 3, '*sm*' functions as in 1: it is not that a *kind* of water (say mineral water) would taste good now, but simply that the having of (any amount of) water would taste good. In 4, we have the quantifier 'some' together with an apparent mass term. This means that 'water' must be understood as 'kind of water': and that is precisely what the sentence asserts – the water which tastes worse than L.A. water is a kind of water, say water from Badwater, Death Valley. In the cases where '*sm*' is used with mass terms, its function is similar to that of '*a*' in

5. A river is good to bathe in.
6. John is a man.

and might be called the indefinite article appropriate to mass nouns. It is the presence of '*sm*' that makes

7. For some *x*, *x* is *sm* water, and Heraclitus bathed in *x* yesterday, and Heraclitus bathed in *x* today.

rather than

8. For some *x*, *x* is water, and Heraclitus bathed in *x* yesterday, and Heraclitus bathed in *x* today.

be the correct analysis of

9. Heraclitus bathed in water yesterday and bathed in the same water today.

In the sense in which we would normally say 9 was false, it is because Heraclitus bathed in some water *x* yesterday and did not bathe in that same water *x* today – the same state of affairs which falsifies 7. But to falsify 8 we need to suppose in addition that what Heraclitus bathed in today was (say) milk. But now we need to find out what the permissible values of '*x*' are in '*x* is *sm* water'.

In "H" p. 485, Cartwright suggests that the permissible values are *quantities* (of water). In "Q" she explicates the notion of quantity, but seems to give a different answer to what the permissible values are. Let's start with a brief indication of Cartwright's notion of quantity. The first caution is to avoid identifying it with an *amount*. We could have the same amount of water but not have the same quantities of water; non-identical quantities may be the same amount, and to bring this out Cartwright adopts the terminology of saying that a quantity *contains* a certain amount of it (rather than that it *is* that amount). It is also important to mention that Cartwright's notion of the amount contained in a quantity is *not* dependent upon a choice of measure, and is *not* dependent upon the conditions of measurement (for justification, see "Q").

Now, with these preliminaries granted, Cartwright says

> the sense in which a quantity of something contains an amount of it is just analogous to the sense in which a set of things contains a number of them. A set of things [determined by a count term like 'cat' or 'apple'] may be defined by
>
> D1: *x* is a set of *A* if and only if, for some *y*, *x* and *y* are comparable with respect to the number of *A* each contains, and *x* contains nothing other than *A*... .
>
> ... we my put D1 by saying that a set of things is anything which may be numerically equal to something with which it need not be identical...
>
> D2: *x* is a quantity of *B* if and only if, for some *y*, *x* and *y* are comparable with respect to the amount of *B* each contains, and *x* contains nothing other than *B*.

Cartwright's strategy now is to make an analogy which goes as follows: we (think we) understand quantification in the set (count) case. If we do, it is because we understand what a set is and what quantification over the entities contained in a set comes to. If we are to understand quantification in the mass case, we must find something which performs the role performed by the entities collected into a set. The point of D1 and D2, then, is to evoke this analogy.

But to explain quantification we must explain how one can satisfy open sentences like '*x* is a man' or '*x* is *sm* coffee'. In the former case, it is clear enough what Cartwright has in mind: 'man' denotes the set of men and to satisfy the open sentence under some interpretation is for that interpretation to assign something *contained in* this set to '*x*'. In "H" p. 485, Cartwright claims that the values of '*x*' which would satisfy '*x* is *sm* coffee' under an interpretation are quantities of coffee. But this would be analogous to saying that it is sets of men which satisfy '*x* is a man' under an interpretation. And since this last is false, I see no reason to hold that the former is true. In "Q" p. 39, Cartwright has changed her mind: here it is what is *contained in* a quantity of coffee which satisfies '*x* is *sm* coffee' under an interpretation. But what is contained in a quantity is an *amount*; and *that* is not what we want to quantify over. The amount of coffee is just irrelevant (as Cartwright herself noted in "H"). Further, every quantity contains exactly one amount ("Q" p. 33), yet sets contain ever so many elements. So, we are not quantifying over the quantity, for that corresponds to the set; and we are not quantifying over the amounts, for that corresponds to the number (measure) of the set. What is it that corresponds to elements of a set? *Those* are what we want to quantify over. Nothing in the account will tell us, and so I conclude that the analogy is not drawn closely enough to justify accepting either of Cartwright's recommendations.

A charitable thing to say here is that Cartwright wants a mass noun '*M*' to denote the *set of quantities of M*. But even this seems not to be sufficient, for there is an objection to having mass terms denote *any* physical object or set of physical objects: the mass term may not be true of any actual object. Consider two never-to-be-realized (but realizable and describable) substances called 'Kaplanite' and 'Suppesite'. The two sets would then be identical, but 'Kaplanite is a liquid' might be true while 'Suppesite is a liquid' is false,[3] thus violating condition 1.

Perhaps the answer here is that the "charitable" formulation of Cartwright's view (if it could be made out clearly) gives us the *extension* (that is, the "things" of which it is true) of the mass terms over which we quantify, but that it does not give us their denotation (that is, the entity assigned by the semantics to that term). And perhaps this is all that Cartwright intended. But if so, it still leaves open the question of what the denotation of mass terms are, and how one can state their semantics.

IV. MASS NOUNS AS DENOTING ABSTRACT SUBSTANCES

Faced with the failures of the "physical" interpretations – the mereological and set-theoretic interpretations, perhaps the most plausible thing to do would be to allow occurrences of mass nouns to name abstract entities. It is important to note here that under such a proposal, mass terms are names and not, e.g., predicates or other general terms. Such is the approach of Parsons (1970).

Let us give the simple mass terms – 'water', 'gold', and the like – simple names, such as '*w*' and '*g*' respectively. Under Parsons' interpretation, these name "substances", a word which "is to be taken in the chemist's sense, to stand for any *material*". We also introduce the relational constant '*C*' to be understood as 'is constituted of'. Thus a sentence like 'My ring is gold' is translated as

$$rCg$$

So '*C*' is a relation between objects and substances which is true just in case the matter of the object is a *quantity* of the substance. The relation 'is a quantity of', symbolized 'Q', is a primitive in Parsons' analysis, but (p. 367)

I can explain it roughly as follows: A substance like gold, is found scattered around the universe in various places. Wherever it "occurs" we have a bit of matter which *is a quantity of* gold .... If it is true to say of an object (a physical object) that it "is gold", then the matter making it up will be *a quantity of* gold.

Of course, Parsons is aware of Quine's objections to analyzing terms after the copula as singular terms and construing the copula as 'is a part of'; but he claims that all this shows is that his 'is a quantity of' does not mean the same as Quine's 'is a part of': "What 'parts' of x are quantities of x depends on x, and not some abstract notion of 'part'" (p. 366fn). This suggestions obviously has some connection with Moravcsik's SP, but we shall investigate that after we look at the rest of the proposal.

The relata of 'Q' are abstract substances on the one hand and "bits of matter" on the other. The latter are characterized as, first, not necessarily being identical with any object of which such a bit comprises all its matter, and secondly, as being "Goodman individuals" – i.e., obeying the laws of the calculus of individuals. After giving this characterization of "bits of matter", Parsons now claims that we are in a position to quantify over them. We can symbolize 'Water is wet' as

$$(x)\,(xQw \supset Wx)$$

where w: the substance water, W: is wet. And taken together with the symbolization of 'This puddle is water' as

$$pQw$$

where p: this puddle, we obviously can deduce

$$Wp,$$

'This puddle is wet' – a feat that Quine could not perform. We can also demonstrate the analyticity of 'Dirty water is water' as

$$(x)\,((xQw \,\&\, Dx) \supset xQw)$$

another feat beyond classical quantification theory.

Parsons wants to introduce a "substance abstraction operation", $\mathcal{O}x[..x..]$, which is to be on a par with the set abstraction operator, $\hat{x}[..x..]$. The set operator refers to the set of those x's which satisfy the formula inside the brackets; the substance operator is to refer to the substance of those x's which satisfy the formula inside the brackets. Now that we (supposedly) know the permissible values of variables of quantification, we are in a position to represent complex mass terms by means of this operator. For example, the substance Dirty Water is referred to by

$$\mathcal{O}x[Dx \;\&\; xQw]$$

i.e., the substance whose quantities are dirty quantities of water. (Of course, the substance Water could be referred to by

$$\mathcal{O}x[xQw]$$

as well as simply by 'w'.)

The difficulties with this view can be broken into three categories formal difficulties, difficulties with the interpretation of 'Q', and difficulties with mass terms denoting abstract entities.

I said before that Parsons' 'Q' is similar to Moravcsik's '$<_{sp}$'. We saw above that under Moravcsik's interpretation of such sentences as '$x<_{sp}y$' we had to look to the descriptions 'x' and 'y' in order to determine the truth of such sentences – i.e., the positions occupied by 'x' in 'y' there are not purely referential. And so it is in Parsons' proposal: in 'xQy' we have to look to the descriptions 'x' and 'y' in order to determine the sentences' truth value (a fact implied by Parsons p. 366fn – quoted above – but not remarked upon). And surely Moravcsik's restriction on adequate semantics for mass terms is correct: we must be able to compute the denotation of complex expressions from the denotation of the simpler expressions contained therein (e.g., we must be able to give Tarski-type truth definitions for sentences). It is not obvious that this can be done in Parsons' non-extensional language.

Secondly, and related to the first, how is 'Q' to be understood? We saw above that attempts to introduce a whole collection of predicates like 'batch of furniture', 'vein of gold', 'nugget of gold', 'shipment of sugar', etc., led to problems of explaining how terms with a mass-like extension can combine with terms that have sets as their denotation. It is not clear that we can sidestep this problem by introducing 'Q' as a primitive. Does 'Q' have different meanings depending upon whether we are talking of 'gold', 'sugar' or 'furniture'? Does it have different meanings depending on whether we are talking of batches, veins, shipments or nuggets? It seems that what we have gained in ability to meet the "analyticity" and "deducibility" conditions we have lost in explanatory power.[4]

Thirdly, the criticisms of the interpretation of mass terms as denoting *abstract* entities. What are we to say of such sentences as 'gold is yellow'? We cannot attribute yellowness to an abstract entity – we must instead construe this as an assertion about quantities of Gold. Generally, what seem to be direct attributions to a *thing* (viz., the *thing* denoted by a mass *name*) turn out to be indirect attributions to quantities of that thing. Moravcsik says that, intuitively, the substance Red Ink should be a part of the substance Ink; but since these substances are abstract entities in Parsons' system, this cannot be so. The relation in question will have to be put: all quantities of one are quantities of the other. This is different from the case where we have two *predicates*: in that case it *is* permissible to look to the physical objects and show that all things that satisfy the one predicate also satisfy the other (e.g., 'white man' and 'man'). But here we do not have properties – we have *things*, and the relation should be that one is a part of the other. If Red Ink is not part of Ink, it is hard to see why 'Red ink is ink' is analytic. That is, I grant that 'All quantities of red ink are ink' is symbolized by Parsons in such a way as to be analytic; still the intuitive understanding of the semantics does not make Red Ink a part of Ink. Hence, the semantics gives us no reason to believe that 'Red Ink is Ink' is necessarily true; so it seems improper for it to be symbolized in such a way as to be analytic. I.e., it would seem that 'Red Ink is Ink' cannot be adequately characterized as 'All quantities of red ink are ink'. (This argument is adapted from Aristotle's criticism of Plato's theory of forms, *Meta.* B6). We could put this objection: in sentences like 'Red ink is ink' we are not talking about quantities, and so Parsons' symbolism involves a violation of our condition 4, the "aboutness" condition. Parsons himself points out that in sentences like 'Most gold is unmined' we are not talking about quantities (pp. 371–373). It's not clear that 'Most quantities of gold are unmined' even makes sense, given an indefinite number of ways of counting quantities. And if we do agree on a way, 'Most gold is unmined' can be true while 'Most quantities of gold' is false – as if all the unmined gold is in one big nugget. Parsons avoids the problem here by (a) claiming that he is not interested in 'most' quantifiers, only 'all' and 'some', and (b) with 'all and 'some' the truth-values are the same, and (c) he is only interested in the "truth-value" condition, not the "aboutness" condition. It seems to me, though, that the "aboutness" condition is an important one, both in its own right and in its implications for the "analyticity" condition (see above). An artificial language just cannot be adequate if it talks about one group of things while the natural language talks about a different group.

Finally, whatever advantages Parsons' language has, it is not the *basic* explanation of the denotation of mass terms. In his informal explanation of 'Q' (quoted above) he had said: "If it is true to say of an object... that 'it is gold', then the matter making it up will be *a quantity of gold*". For all the world, it looks as if we here have a notion more basic than 'xQg' – namely, that 'x is gold' is true. But if this is so, then there is a more straightforward explanation of mass terms than the one given by 'Q'. This one will be studied in the next section.

V. MASS NOUNS AS PREDICATES

When confronted with a sentence like 'Water is wet', the first impulse of a student who has completed an elementary course in logic is to translate it as

$$(x)\,(\text{Water}\ x \supset \text{Wet}\ x)$$

– i.e., to translate 'water' as a predicate. Presumably, this impulse stems from the instructor's recommendation to translate 'Men are mortal' as

$$(x)\ (\text{Man})\ x \supset \text{Mortal}\ x).$$

It is, however, easy to dissuade the student. First one points to the dissimilarities in the two cases. 'Men' is obviously plural and takes the plural 'are', while 'water' seems non-plural since it takes the singular 'is'. We can give a clear sense to the phrase 'For all x, if x is a man...', because we have an understanding of what it is to be *one* man (or a *distinct* man, or the *same* man, *etc.*); but in the case of water we do not have an analogous understanding. In 'For all x, if x is water...' it is difficult to give a clear meaning to what 'x' is. And if we do attempt to give a clear meaning to such locutions, it seems to involve a change in sense. For example, we might try to restate the quantifier phrase as 'For all x, if x is *a* water...'. But under the most normal understanding, "*a* water" is a certain *kind* of water; and then the sentence would be equivalent to 'All kinds of water are wet'. And surely this should not be so.

Once that student is in doubt about the adequacy of his translation, the teacher can give some arguments to show that the general attempt to force mass nouns into the mold of predicates is mistaken.[5] (1) If we treat mass nouns as predicates, then it is not clear what these predicates should be true of (there may be many answers: 'My ring is gold' suggests physical objects, 'The element with atomic number 79 is gold' suggests elements in the chemists' sense, and 'The particular bit of matter which makes up my ring is gold' suggests matter). (2) Demonstrating the deducibility of arguments like '*X* is made of gold, Gold is the element with atomic number 79, *ergo X* is made of the element with atomic number 79' depends on 'gold' being a name in the canonical notation, not a predicate.

By now the bright student is puzzled. If 'water' is not a predicate but rather a name, what sense are we to make of the phrase 'all water'? Further, if 'water' is a name what is 'dirty water'? If it is a name does it have internal structure? The various attempts to construe mass terms as names (of mereological entities, of sets, or of abstract entities) have all met with serious difficulties. It seems that the only option left is that the student is right: mass nouns are predicates. Hence, I shall attempt to answer the difficulties raised by this identification.

Let's start by adopting the notion of *property* given by Kripke (1963). It is a function on possible worlds to classes: the property indicated by the predicate ϕ is the function from possible worlds to the set of ϕ's in each world.[6] In the non-mass case this is fairly clear: 'pig' indicates a function from each possible world to the set of pigs in that world. But things are not so clear in the mass case. 'Water' does not pick out the class consisting of water in each possible world, unless we give it a special sense. For, as it is, it seems to suggest "water as opposed to milk, honey etc."

Consider sentences like 'Pigs are pink'. In such sentences we can always paraphrase the (implicit) quantification as 'Anything that is *a* pig...'. The analogue of this in the mass case – as in 'Water is wet' – is 'Anything that is *sm* water...', where we have a use of '*sm*', the indefinite article appropriate to mass nouns. In any case when we wish to speak of some physical object (say this puddle) of which the predicate 'water' is true, we can paraphrase it as 'This puddle is *sm* water'. Generally, when we are speaking of the *extension* of the mass term '*M*', we can paraphrase it '*sm M*'.

Recall now the first argument against treating mass terms as predicates – that we cannot specify what it is that (say) 'is *sm* water' if true of, other than simply to say that it is true of whatever is *sm* water. However, when put this way, the objection loses whatever force it once had. Compare it with: we cannot specify that (say) 'is a man' is true of other than simply to say it is true of whatever is a man. And surely this objection is off base – perhaps it is an interesting philosophical mater to find out what being a man amount to, but it is absolutely clear that the philosopher of language need not decide such a matter before he says 'is a man' is true of whatever is a man. And is merely this last that we need do in giving a semantics for a language. This is perhaps a critical mark of predicates as opposed to names – with a name it is essential for the semantics to assign it a denotation. With a predicate, however, we need merely indicate what things it is true of. It was in the inadequacies of satisfactorily explaining what mass nouns allegedly *named*, that enabled us to show the deficiencies in the previously-discussed proposals.

"But still," our detractor might continue, "'is *sm* gold' is true of *so* many different sorts of things – nuggets, flakes, veins, watches, rings, etc. – that it must be the case that we need some further information". The first answer to this is to point out that watches and rings are *made of* gold; nuggets, veins, etc., are not. Secondly, an analogous objection could be made in the non-mass case: 'is an animal' is true of many different things – species ("The camel is an animal"), breeds, individuals – that we must need further information. But surely it is pointless to make this objection here: 'animal' individuates its reference into individuals; the fact that other things can also be called 'animal' is irrelevant. 'Gold' individuates in its own way (picks out a certain stuff), and the fact that other things (nuggets, veins) can be called 'gold' is irrelevant.

There are other advantages in interpreting certain terms as predicates rather than as names. Aristotle long ago pointed out that if we interpreted such terms as 'man' and 'animal' as naming objects (Forms) which are distinct and not part of one another, then the most that can be said of the relation between the two is that anything which "partakes of" the one also "partakes of" the other. There is nothing we can add which will make 'All men are animals' be necessarily true. This is because when we talk of two *objects*, *X* and *Y*, we have to have the relation be *part of* in order for 'All *X* is *Y*' to be necessarily true. Aristotle points out that such is not the case with predicates – here one looks to other criteria, such as whether the extension of '*X*' must be included in the extension of '*Y*'. And the same seems to be the case with mass nouns: we want to avoid treating them as names so that 'All red ink is ink' can straightforwardly be shown analytic by appeal to the extensions of 'ink' and 'red ink'.

We want to give a rough-and-ready method of distinguishing extensional from non-extensional uses of mass terms. If '*M*' is a mass term and is used extensionally when not in subject position or when after an explicit quantifier (but then grammatical considerations may force a change in the form of the quantifier: 'all' to 'any', etc.), then '*M*' can usually be paraphrased by '(is) *sm M*'. Thus 'This puddle is water' becomes 'This puddle is *sm* water', 'John is eating cake' becomes 'John is eating *sm* cake' which in turn becomes 'There is something which John is eating and that is *sm* cake', 'All water is liquid' becomes 'Anything which is *sm* water is liquid' (there are other ways to paraphrase this). When '*M*' occurs without a quantifier in subject position, it most often is paraphrased by 'Anything which is *sm M*', as when 'Water is wet' becomes 'Anything which is *sm* water is wet'. There are cases though, where an unquantified mass term in subject position is existential in its meaning: 'Water is leaking through the crack' becomes 'Something which is *sm* water is leaking through the crack' or when 'Water is found on Mars' becomes 'Something which is *sm* water is found on Mars' (note the interplay at the quantifier 'some' with the article '*sm*').[7]

When these attempted paraphrases are not correct, we are not talking extensionally. The second argument given above against identifying mass nouns with predicates contains such a use. In 'The element with atomic number 79 is gold', we cannot correctly paraphrase it as 'The element with atomic number 79 is *sm* gold', for the former is true but the latter false (or meaningless). Rather what is being asserted is that in the actual world, two properties are true of the same entities. A paraphrase might be 'Anything which is (entirely) made of the element with atomic number 79 is *sm* gold'. Thus we could demonstrate the deducibility of '*X* is made of gold, The element with atomic number 79 is gold, *ergo x* is made of the element with atomic number 79' without requiring mass nouns to be names. However, this paraphrase has the disadvantage that it does not imply 'Gold is the element with atomic number 79' as the original did. Perhaps we would want to handle this as a case of predicate identity, but only identity in this possible world. Even if this line is taken, it is not the same as introducing abstract objects in Parsons' sense; rather it is resorting to second order logic.

Complex mass terms can be handled in the same way: 'Dirty water is bad to drink' can be paraphrased 'Anything which is *sm* dirty water is bad to drink'. Now consider sentences such as 'Water is a liquid': this is clearly a case of predicating the second-level predicate 'is a liquid' of an ordinary predicate 'water'. (This is justified by noting the anomaly of 'Anything which is *sm* water is a liquid'. Of course one must distinguish 'is a liquid' from 'is liquid'). We can also form such sentences as 'Dirty water is a liquid', which again is a case of second-level predication. The proposal put forth by Montague (1973), which is in many ways similar to the one advocated here, differs on this point. As Montague notes, his theory implies that complex mass phrases in subject positions *must* be taken extensionally; i.e., it is always the case that we are talking about the (physical) things of which (say) 'dirty water' is true. Or, as we can put it, it is *always* permitted to put 'is *sm* dirty water' in its place. But this makes such sentences as 'Dirty water is a liquid', 'Salt water is a liquid', etc., ill-formed. Surely this is false: in English such sentences are true; to preserve our "truth-value sameness" condition their translations must also be true, not meaningless, in any adequate artificial language.

VI. EPILOGUE

I think I have adequately answered the difficulties raised by the identification of mass terms with predicates, and also have shown what is wrong with the other alternatives. But there may still be the question: "Just how different are these proposals? Especially, is there really all that much difference between Cartwright's proposal and the extensional part of yours? Is there really all that much difference between Parsons' proposal and yours?" The answer is "no". If one understands Cartwright in the "charitable" way mentioned, that just *is* to understand mass terms as predicates restricted to one (the actual) possible world. The difference is that predicates are *not* to be restricted to the actual world: they express functions whose domain is the set of all possible worlds.[8] The difference with Parsons' view is merely this: predicates as opposed to names. Of course Parsons' 'xQm' (where 'm' is a mass term) will be true of exactly the same things as 'x is *sm* M' is. The problem with names is that a semantics must state *what* they name; and if one is going to represent predication by 'Q' one is obliged to give an account of 'Q'.

These are the points of difference. One might think that there are many more points of similarity than difference, especially considering how different the proposals appear on the surface. But, then, insofar as we are all correct to some degree or other, that there are large areas of agreement was to be expected.

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NOTES

* This paper is a summary of (a portion of) my dissertation *Some Problems of Non-Singular Reference: A Logic for Mass, Sortal and Adverbial Terms* (UCLA, 1971). I would like to thank the members of my committee for their help: Keith Donnellan, Montgomery Furth, Barbara Hall Partee, and John Perry. This paper was also read at the Canadian Philosophical Association meetings in Montreal, 1972. I would like to thank my commentator, Henry Laycock, for his insights. The non-existence of many mistakes is due to the (necessarily anonymous) referee. I thank him/her.
Added in proof. This paper was completed before the publication of J. Hintikka, J. M. E. Moravcsik, and P. Suppes (eds.), *Approaches to Natural Language*, and thus before the publication of Moravcsik's and Montague's articles on mass nouns (see bibliography). In the preparation of this paper I had access only to the versions of their papers as presented at the workshop in Stanford, 1970. There are a number of differences between the two versions, especially in Moravcsik; however, the main objections I wish to level are applicable to both versions. One should also see, in this volume, the responses to Moravcsik by Cheng and Grandy (who gives an account which, in some ways, resembles mine), and also Moravcsik's reply.

[1] Actually it is *senses* of nouns or noun phrases (or something like that) which are mass. Consider 'chicken'.

[2] In *W & O* see pp. 97–98 and p. 101. In his review of Geach see p. 102. In Strawson see p. 242. Of course, Quine, unlike Clarke and Strawson, only recommends this for "predicate occurrences" and for complexes formed by a demonstrative plus mass terms, not for "subject occurrences".

[2a] H. Laycock 'Some Questions of Ontology', *Phil. Rev.* **81** (1972), 3, and J. Bacon 'Do Generic Descriptions Denote?', *Mind* **82** (1973), 331; both appear to subscribe to this view of mass terms.

[3] The example is from Montague (1973).

[4] The criticism is from Moravcsik.

[5] These arguments are from Parsons, p. 364. Presumably Moravcsik and possibly Quine would also assent to their correctness.
[6] For a further development of this notion of property, see the works of Richard Montague.
[7] Apparent definite descriptions are discussed in Cartwright "H", p. 481.
[8] And anyway the "charitable" view may not be Cartwright's at all.

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