Truth and Mass Terms

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TRUTH AND MASS TERMS *

MASS terms have long figured prominently in scientific and conversational descriptions of the world. But the formal organization of sentences containing them has not been well understood. In this paper I discuss the semantical role of mass terms in English—the role that they play in a theory of truth for our natural language.[1]

I. MASS TERMS: GRAMMATICAL AND SEMANTICAL CHARACTERISTICS

There is no generally accepted criterion for determining which terms are the mass terms. Agreement centers on a group of nouns—like 'water', 'gold', 'feldspar', 'snow', 'stuff', 'cancer', 'furniture', 'wood', 'helium', 'grass', 'hardware'. Under the relevant reading, these nouns are concrete in the sense that they clearly apply to entities that have spatiotemporal location. More distinctively, they resist pluralization,[2] the indefinite article, and phrases like 'how many' and 'quite numerous'. On the other hand, they are hospitable to modification by phrases like 'how much' and 'very little'.

Concrete mass nouns are broadly distinguishable from concrete count nouns—nouns like 'shoe', 'ball', 'molecule', 'puddle'. Count nouns take the listed grammatical modifications that mass nouns resist, and resist those which mass nouns take. It has often been pointed out that a large class of words are ambiguous between the

* Earlier versions of this paper were discarded and improved upon in response to criticisms from Gilbert Harman, Adam Morton, and John Wallace. A fragmentary ancestor was read to members of the Duke University and the University of North Carolina philosophy departments in January 1971. The present paper has been bettered as a result.

[1] This conception of the task at hand is owed to Donald Davidson. Cf. "Truth and Meaning," *Synthese*, XVII, 3 (September, 1967): 304–323. My assumption that we speak a common language is overbold in the larger context of a theory of interpersonal linguistic interpretation, but for present purposes it is harmless.

[2] Exceptions like 'potatoes'—as in, 'I had potatoes for breakfast this morning'—are degenerately plural. My utterance can be true even if my breakfast consisted of only one potato. Intuitions may waver with 'peas' and 'beans'.

concrete-mass-noun and various count-noun interpretations. Thus: 'apple', 'fish', 'land', 'water'.

In fact, *any* noun that has a mass-term interpretation has another reading under which it may take all the grammatical paraphernalia of count nouns (pluralization, indefinite article, and so forth). Thus in 'How many feldspars have geologists distinguished?' the noun 'feldspars' can be parsed as 'kinds of feldspar'. In this case it is not a *concrete* count noun, but it has most of the grammatical co-occurrence properties of concrete count nouns. In general, any noun with a mass-term reading may also take this "kind of" reading. For conversational purposes, a single proper interpretation of these nouns is usually determined in the context of use. For theoretical purposes, I shall assume that the sentences to be analyzed by a truth theory will be indexed to distinguish the different readings.

In addition to their co-occurrence properties, concrete mass nouns are distinctive—and distinguished from concrete count nouns—in having the semantical property of referring cumulatively. Any sum of parts that are water is water. More generally, any concrete mass noun will plug into the schema:

Any sum of parts that are ___ is ___.

These rough grammatical and semantical criteria for distinguishing concrete mass nouns might be used to extend the class of mass terms. Most of the grammatical criteria for concrete mass nouns apply to a class of nouns which are not clearly concrete: 'information', 'merit' (as in 'The plan has little merit'), 'color' (as in 'He doesn't have much color in his face'). Moreover, these nouns contrast with a class of "abstract" nouns which satisfy the grammatical criteria for count nouns: 'objection', 'merit' (as in 'There are numerous merits to the proposal'), 'color' (as in 'The painting contains three basic colors'). On the other hand, "abstract mass nouns" do not appear to satisfy the semantical criterion that concrete mass nouns satisfy. Mereological concepts simply do not have any straightforward application to these nouns. For this reason one might hesitate to include them in the category of mass terms.

Many adjectives fulfill the semantical criteria that distinguish mass nouns. Any sum of parts that are red (hot, ductile) is red (hot, ductile). There are a few adjectives—mainly those having to do with shape, like 'spherical'—which seem to be analogous to count nouns in referring individually but not cumulatively. "Mass adjectives," of course, do not fulfill the grammatical criteria that mass nouns do. In fact, I know of no interesting co-occurrence criteria for "mass adjectives." It has been suggested that "count adjectives" like 'spherical' are not admitted as modifiers of mass nouns (*'spherical water'). But this does not seem to be generally true: 'There is some cylindrically shaped marble on the artist's workbench', 'Footwear is foot-shaped'.

It may be that criteria can be clarified in order to admit adjectives or abstract nouns into the class of mass terms. But to be assured of a background of agreement, I will aim my remarks at the clearest examples of mass terms—concrete mass nouns. I devote the next two sections to rival views of the semantical role of mass terms. In the final two sections I defend my own.[3]

II. QUINE'S MIXED VIEW

Quine has held that mass terms play one of two semantical roles depending on sentential context (*loc. cit.*). In subject position before the copula, he holds them to be singular terms, presumably individual constants. For example, in the sentence

(1) Snow is white.

'snow' would on his view be a singular term designating the scattered totality of the world's snow. Mass terms as singular terms are supposed generally to plug into the schema

'___' designates the world's ___.

In sentential contexts where mass terms appear after the copula, Quine holds that they play the role of general terms, predicates. Thus in

(2) This stuff is snow.

'snow' is a general term embedded in the predicate 'is snow', a predicate true of the world's snow and every part thereof down to some appropriate minimum constituent.

There is much that is intuitive about Quine's view. Before the copula in subject position, mass terms do seem to be "referring expressions" purportedly picking out something for the sentence to be about. Grammatically they are similar to singular terms in not taking indefinite articles or plural forms. And although some philosophers have found the Goodmanian notion of a scattered object unsettling, it does not seem especially inappropriate in the present case. As for mass terms occurring after the copula, Quine's account

[3] The organization of this section was influenced by J. M. E. Moravcsik, "The Problem of the Semantics of Mass Terms in English," (unpublished) and W. V. O. Quine, *Word and Object* (Cambridge, Mass.: MIT Press, 1960), pp. 90–100. Moravcsik advocates including abstract nouns among mass terms, in "Subcategorization and Abstract Terms," *Foundations of Language*, VI, 4 (November 1970): 473–487. Quine supports inclusion of adjectives in *loc. cit.* The term 'cumulative reference' and the schema are his.

yields an attractively unitary interpretation of 'is' according to which 'is snow' is treated on a semantical par with 'is red' and 'is a man'.

Despite its plausibility, however, Quine's theory is unsatisfactory. One difficulty with it is that it is incomplete. It does not cover mass terms that occur neither before nor after a copula. Thus consider the sentence

(3) Phil threw snow on Bill.

It would seem natural and intuitive to extend Quine's theory to handle 'snow' in this sentence as a singular term. Ignoring tense, the sentence might be roughly formalized[4] as

$$\text{Threw-on } (p, s, b)$$

The trouble with this move is that, unless Phil is the diabolical supersnowballer, the analysis will make the sentence come out false even if Phil did throw snow on Bill.

It is not difficult to see how to extrapolate Quine's theory to account for (3). Clearly 'snow' might be paraphrased as 'some snow'. 'Snow' might then be treated as a predicate attached to an existentially quantified variable. But it should be emphasized that any account that hinges on the appearance of a copula in the sentence to be analyzed will inevitably be incomplete.[5]

There is another, more serious, problem with Quine's theory. Quine says that mass terms in subject position do not differ from singular terms like 'Mama' or 'Agnes'. For purposes of deductive argument Quine sometimes treats proper names like 'Mama' and 'Agnes' as individual constants, and doing so seems to have no ill effects in formalizing intuitively valid deductions. But the practice leads to problems in the case of mass terms. Consider the intuitively valid argument

(a) Snow is white.
(b) This stuff is snow.
∴ (c) This (same) stuff is white.

Treating 'snow' in the first premise as an individual constant (and construing, for present purposes, the demonstrative 'this' as an

[4] Actually the formalization of the verb is defective, as is that of the proper names. But I leave these matters aside.

[5] One might try to defend Quine's remarks by pointing out that one can reformulate all English sentences that contain mass terms qua general terms into other English sentences that contain copulas that precede the mass terms. But if Quine's remarks are construed as directed toward the reformulations, they are uninformative. For in order to carry out the reformulations correctly, one must already know the semantical role of the mass term in the unregenerate sentences.

operator), we have

$$Ws$$
$$S_n(\imath x)S_t(x)$$
$$\therefore W(\imath x)S_t(x)$$

which is, of course, invalid. The problem is that the formalization obscures the logical relation between 'snow' occurring in subject position in the first premise and 'snow' occurring in predicate position in the second premise of (a)-(b)-(c).[6]

The point to be learned from this argument is, I think, that one must treat mass terms as being either predicates or individual constants but not both, on pain of failing to account for the logical relations binding different sentential occurrences together. In and of itself this point is compatible with Quine's claim that mass terms are singular terms before the copula and general terms afterward. Before the copula they could be analyzed as implicitly complex singular terms containing the mass term as predicate. Afterward, they could be interpreted as predicates unadorned.

But this position raises problems of its own. These emerge when one tries to choose an appropriate complex singular term for use before the copula in analyses of sentences like (a). One cannot use the expression '$(\imath x)(\text{Snow}(x))$' as the singular term. For, given the fact that after the copula the general term 'snow' applies to more than one object, the iota-formed singular term is improper. One might then introduce a new primitive to form the complex singular term. But doing this would make it impossible to give a straightforward analysis that validates argument (a)-(b)-(c). One would need an additional premise connecting the new primitive with the predicate 'is white'. And intuitively, (a)-(b)-(c) needs no additional premises in order to be valid. We shall return to these matters in section V.

III. PARSONS' INDIVIDUAL-CONSTANT VIEW

In a recent article Terence Parsons analyzes all occurrences of mass terms as individual constants.[7] The analysis depends on the introduction of three primitives: two two-place predicates—read, "is constituted of" and "is a quantity of"—and one substance-abstraction operator—'σ'. Let us see how these primitives are used.

[6] A similar argument can be made against Quine's treatment of color adjectives like 'red' as singular terms when they modify mass nouns and as general terms when they follow the copula. Cf. *Word and Object*, pp. 104–105.

[7] "An Analysis of Mass Terms and Amount Terms," *Foundations of Language*, VI, 3 (August 1970): 362–388.

Parsons' analysis focuses on the following representative sentences:

(4) My ring is gold.
(5) The element with atomic number 79 is gold.
(6) The particular bit of matter which makes up my ring is gold.
(7) Blue styrofoam is styrofoam.
(8) Water is widespread.
(9) Muddy water is widespread.

His analyses are:

(4′) rCg
My ring is constituted of the substance gold.

(5′) $e = g$
The element with the atomic number 79 is identical with the substance gold.

(6′) mQg
The bit of matter which makes up my ring is a quantity of gold.

Parsons' 'r', 'e', and 'm' are to be regarded as abbreviations for complex descriptions, whereas 'g' abbreviates an individual constant.

(7′) $(x)(Bx \ \& \ xQs \rightarrow xQs)$
Every quantity of styrofoam which is blue is a quantity of styrofoam.[8]

(8′) Sw
Water is widespread.

or

$S\sigma x[xQw]$

The substance which has as quantities all and only quantities of water is widespread.

(9′) $S\sigma x[Mx \ \& \ xQw]$
The substance which has as quantities all and only quantities of water which are muddy is widespread.

Parsons introduces the substance-abstraction operator to account for complex descriptions of substances, such as that in (9). He regards 'water' in (8) as tantamount to 'the substance which has as quantities all and only quantities of water'. Hence the alternative analyses in (8′). Similarly 'g' in all its occurrences could be replaced by the substance-abstraction expression '$\sigma x[xQg]$'.

The ontology Parsons ascribes to this ideology includes the terms 'physical object', 'bit of matter', and 'substance'. The last two of

[8] Parsons (370–373) finds (7) ambiguous between this interpretation and two others: 'Some blue styrofoam is styrofoam' and 'Most blue styrofoam is styrofoam'. I do not find (7) ambiguous, but Parsons' alternative readings are sentences requiring analyses in their own right. The theory I shall offer in sections IV and V will handle Parsons' "some" sentence easily enough. I shall avoid discussing his "most" sentence because the problem of indefinite quantifiers (other than the existential quantifier) needs special attention.

these are intended to apply to ontologically distinct sorts of entity.[9] Mass terms name substances on his view, and substances are composed of bits of matter. But a substance (salt, for example) is an abstract object and is not identical with the sum of bits of matter that coincide with it spatiotemporally.

Parsons' argument for this remarkable conclusion is essentially as follows: whereas sums of bits of matter are identical if and only if they coincide spatiotemporally, a substance like salt is not identical with any hypothetical sum of bits of matter that coincides with it spatiotemporally. (Call this sum "*m*.") For although the predicate '*x* is a quantity of *m*' is true of some given sodium ion, the result of substituting 'salt' for '*m*' in the same predicate is false of the same ion.

Since the conclusion of the argument—that 'salt' names an abstract object—flies in the face of a host of truisms ("salt occupies space"), it is unattractive. Of course, one might try to save these truisms by giving them special semantical explications. But then one would have to justify a distinction between the interpretations of predicates like 'occupies space' as concatenated with 'salt' and as concatenated with 'this lemon'. I see no grounds for such a distinction. And even if apparent grounds existed, the semantical theory that would result would be more complicated than the theory Parsons presents.

Fortunately, the unattractive conclusion does not follow from the argument. Nothing Parsons says prevents one from regarding salt as the sum of sodium chloride molecules.

But Parsons' argument has a more interesting flaw. One cannot give a natural-language locution just any old formalization; and treating 'is a quantity of' as a two-place relational predicate—on doing which the argument depends—is dubious. In many occurrences the phrase appears to work like an indefinite article. For example, '*x* is a quantity of salt' seems to be tantamount to

(i) $S(x)$
   x is some salt.

A defect of Parsons' analysis of '*x* is a quantity of salt' is that it cannot exhibit formally the move from this phrase to (i), without claiming that 'some' in (i) should itself be parsed as the two-place predicate 'is a quantity of'. Such a claim not only introduces needless complication, but also controverts independent grammatical

[9] *Ibid.*, pp. 376–378. Actually, Parsons suggests that all three terms may apply to ontologically distinct entities. This suggestion raises issues we need not confront here. Further discussion of these issues occurs in section IV and in a forthcoming paper, "Mass Terms, Count Nouns, and Change."

evidence that 'some' in such contexts is an article. If (i) itself is the analysis, this inference is, of course, trivially validated. The inference can perhaps be more plausibly exhibited by treating 'x is a quantity of salt' as

(ii) $Q(x)$ & $S(x)$
x is a quantity and x is some salt.

where 'quantity' applies to a highly general sort of physical object.[10] In occurrences of the phrase 'is a quantity of' which give the strong appearance of being followed by a singular term, correct analyses become more problematic. Discussion of these would take us too far afield. But the case that such occurrences force treatment of 'is a quantity of' as a single two-place predicate has not been, and I think cannot be, established. Unless the case is established, the argument against identifying substances and bits of matter spatiotemporally coincident with them fails.

The principle function of the primitive 'Q' ('is a quantity of') in Parsons' theory is to divide the reference of mass terms. This is borne out by the fact that, in his paraphrases, the phrase 'a quantity of' is everywhere replaceable by 'some'. Our discussion in the preceding paragraphs, however, reveals that the reference of mass terms is already intuitively divided. Parsons' explication of 'is a quantity of' relies on this fact. According to this explication, something is a quantity of salt just in case it is true to say of it that it "is salt" (367). 'Salt', in turn, applies not only to a totality, but to salt molecules and combinations of them. This suggests that treating mass terms as individual constants, naming a single object at every occurrence, ignores evidence provided by our intuitions about our language. It is simpler and more intuitive to treat them as predicates.

How have Parsons' primitives fared in this discussion? We have just given reason to dispense with 'Q'. Scuttling the view that mass terms designate abstract objects left us with no reason to retain the substance-abstraction operator. The primitive 'C' ('is constituted of') remains. Although 'C' is, I think, a more useful and less misleading primitive than either of the other two, it is not indispensable in an analysis of mass terms. Justification of this claim, however, would bloat the present essay to unreasonably corpulent proportions. For now we shall remain uncommitted to an analysis of (4).[11]

[10] This notion of quantity is discussed by Helen Morris Cartwright in "Quantities," *Philosophical Review*, LXXIX, 1 (January 1970): 25–42. For evidence that 'some' is an article, see H. A. Gleason Jr., *An Introduction to Descriptive Linguistics* (New York: publisher 1961), pp. 224–226; and Cartwright, "Heraclitus and the Bath Water," *Philosophical Review*, LXXIV, 4 (October 1965): 468–472.

[11] Further discussion of these issues will be given in "Mass Terms, Count Nouns, and Change."

In the following two sections I will outline the beginning of a theory which is simpler than Parsons', as regards both ontology and terminology, and which appears to agree better with the linguistic intuitions of native speakers. I will begin in section IV by discussing some general questions surrounding the treatment of mass terms as predicates. Then in section V I will show how the approach deals with some representative sentences containing mass terms.

IV. MASS TERMS AS PREDICATES

To treat mass terms as playing the role of predicates in a truth theory for English is to regard them as general terms in English.[12] Of course, general terms in English do not correlate one-one with predicates in a theory of truth. In some sentences, like 'John is red' and 'He is a dog', a general term may be preceded by a copula or by a copula and an article. In such cases the whole phrase will be analyzed as a noncomplex predicate. In other sentences, like 'Sheep are animals', a general term ('sheep') need not be analyzed as playing the truth-theoretic role only of a predicate. For the plural form of the copula 'are' signals an implicit universal quantifier. In cases such as these, it is theoretically uninteresting—at least, from a purely truth-theoretic point of view—to try to determine match-ups between words in natural language and logical parts of speech in one's analysis. For the general case, match-ups become interesting only at the level of whole sentences; and these match-ups are, of course, not one-one either. Despite the lack of a general one-one mapping between predicates and general terms, it is perhaps true to say that, wherever there is a general term in English, there is a corresponding predicate in an adequate truth theory.

A sufficient condition for a word's being a predicate, or general term, is that apart from special context it be truly applicable to (or true of) each of a plural number of objects. This condition coupled with the intuitive fact that almost all mass terms are truly applicable to numerous objects (and thus divide their reference) is strong intuitive ground for a predicate analysis of mass terms.

There has been a tendency among philosophers, however, to doubt that mass terms are general terms or predicates. This tendency, I think, stems largely from the belief that count nouns are the paradigmatic examples of general terms and that since mass terms differ so markedly from count nouns, they cannot be considered general terms. Clearly this consideration by itself is no argument, and the more specific discussions that have been motivated by it

[12] This criteriological link between predicates in quantification theory and general terms in natural languages has been fruitfully pressed by Quine. Cf. *Word and Object*, pp. 90–91, 95–97.

have not been much stronger. But given the persistence of the worry about treating mass terms as predicates or general terms, we would do well to confront it directly.

One expression of the worry has been the suggestion that, wherever a mass term appears to divide its reference, it is elliptical for some phrase that includes a count noun—as in 'portions of snow', 'clod of earth', 'globules of fat'. This suggestion might be seen as supported by the frequently voiced claim that we do not associate "criteria for individuation" with mass terms:

> The *general* question of the criteria of distinctness and identity of individual instances of snow or gold cannot be raised or, if raised, be satisfactorily answered. We have to wait until we know whether we are talking of *veins*, *pieces* or *quantities* of gold or of *falls*, *drifts or expanses* of snow.[13]

From this sort of claim one might conclude that count nouns like 'veins', 'pieces', 'expanses', in effect divide the reference of mass terms, whereas mass terms themselves designate just one object.

The key to evaluating this reasoning lies in the interpretation of the phrases 'criteria of individuation' and 'criteria of distinctness and identity'. If the claim is that we are barred by grammar from asking or answering questions of the form

Is x a single *mt*?

where '*mt*' stands in for any mass term, then the claim is unexceptionable. But this fact about grammar need not be taken to show that mass terms do not divide their reference. It shows at most that we do not associate with a mass term a general method for matching objects to which the term applies with successive natural numbers. It should perhaps be noted that we also do not associate general count criteria with the word 'quantity', which has several times been proposed as the all-purpose general term that "individuates" objects for mass terms. Grammar allows us to talk of (plural) quantities of soap. But we are not any better prepared to count the objects among which 'quantity of soap' divides its reference than we are to count the objects among which 'soap' (as mass term) divides *its* reference.

There is a second way to interpret the above claim quoted from Strawson. That is to read it as saying (a) that we have no grammatical sentences that express identity or distinctness of "instances" of snow or gold, except those in which phrases containing count nouns are adjoined to mass terms, and (b) that even if grammar did allow

[13] P. F. Strawson, "Particular and General," *Proceedings of the Aristotelian Society*, LIV (1953/4): 242. Although Strawson appears to assume that mass terms are individual constants, he should not necessarily be saddled with the reasoning I am reconstructing.

such sentences, we would have no general understanding of the conditions under which they would be true. Under this interpretation the claim is false. There are many grammatical sentences which express identity or distinctness of the things among which mass terms divide their reference:

> This snow is not the same as that snow.
>
> The gold that now composes this earring is the same as the gold that lay in an irregularly shaped lump on the artist's table a month ago.
>
> The trash that Alfred keeps throwing over his back fence and finding again in his yard is the same trash as the trash that Bertrand keeps throwing over *his* back fence and finding again in *his* yard.

In order to understand these sentences there is no need to interpolate count nouns before the mass terms 'snow', 'gold' and 'trash'. Nor is it true that these terms must be read as taking on special non-mass-term senses (e.g., 'kind of snow'). Furthermore, it is patently false that we do not have a general grasp of the conditions under which sentences such as these are true. Intuitively there is no more problem in understanding

> (i) x is not the same snow as y.

or

> (ii) x is the same trash as y.

than there is in understanding

> (iii) x is not the same shoe as y.

or

> (iv) x is the same star as y.

Moreover, we have no more difficulty in confirming and disconfirming sentences of the form of (i) and (ii) than sentences of the form of (iii) and (iv).

Given the grammaticality of sentences like those cited above and given the intuitive clarity of their truth conditions, there is no reason to think that count nouns like 'expanse', 'lump', 'batch', must be interpolated to divide the reference of mass terms. Sentences of the form of (i) testify to the fact that mass terms divide their own references.

Many people have intuitive compunctions against describing the like of the trash which Alfred kept throwing over his back fence as a physical object. Such people are apt to be willing to describe some of the *pieces* that make up the trash as physical objects; but the whole, they want to say, is a batch or aggregate of physical objects. These intuitive tendencies may have led in some cases to aberrant claims that physical objects and inchoate conglomerates of them are ontologically distinct. But a slippery-slope argument should persuade one that compunctions against including such conglomerates among the physical objects are not theoretically well founded. The more compact, enduring, and interesting the conglomerate and the less perceptually distinguishable its constituents, the more willing these people become to bestow on it the term 'physical object'. I see no principled dividing line in this continuum. Hence there seems no reason not to stretch the already elastic term 'physical object' to apply to such items as Alfred and Bertrand's trash. In so doing we place the entities among which ordinary mass terms divide their references in the same ontological category with the entities among which ordinary count nouns divide their references. And we quantify over objects that are water just as readily as over objects that are muffins (or objects that are green).

The foregoing reflections raise a puzzle. Ordinary usage seems to resist one's counting the objects which a mass term is true of. Yet we can quantify over these objects ('Alfred's trash exists') and express identity and difference between them. Given quantifiers, negation and identity, the resources of quantification theory enable us to divide the totality of the world's trash into an indefinitely large number of parts—in effect to count the objects the mass term 'trash' is true of:

$$\text{(C)}\ (\exists x_1)\ldots(\exists x_n)(\text{Trash}(x_1)\ldots\text{Trash}\ (x_n)\ \&\ x_1 \neq x_2\ \&\ \ldots\ \&\ x_{n\text{-}1} \neq x_n \\ \&\ (y)\ (\text{Trash}(y) \rightarrow y = x_1 \vee\ \ldots\ \vee y = x_n))^{14}$$

Thus our formalization seems to commit us to being capable of counting "trashes," whereas the English being formalized seems to bar us from doing so. The situation is not really so drastic as it might first appear. There are grammatical phrases in English that express (C)—not 'there are *n* trashes', but 'there are *n* things (objects) which are trash'. These expressions are unusual perhaps, but not ungrammatical. Still it is curious that English grammar lets us attach quantifiers and expressions of identity and difference to mass terms and yet prevents pluralization and the indefinite article.

The explanation is, I think, largely pragmatic. We have found it convenient not to bother about distinguishing countable "units" of objects that mass terms are true of. The fact that mass terms add as well as divide their references has much to do with this. An object of which a mass term is true often consists of parts that also satisfy the mass term. Frequently it is useful to talk of identity or difference

[14] I am indebted here to John Wallace.

between such objects when they are conveniently distinguishable in a given conversational context. But, typically, in the same context the parts of these objects which also satisfy the given mass term are not conveniently or relevantly distinguishable. For this reason counting the objects that satisfy a mass term is often not useful. Thus in the presence of two spatially separated clumps of snow, I might say,

> The snow on the table which I got from the front yard is not the same snow as the snow on the table which Karl is pointing at.

Although only two objects satisfying the general term 'snow' are easily distinguished, there are numerous other objects in the context which satisfy the term, namely the parts of each clump (down roughly to the crystals). Thus it is false to say there are (exactly) two objects which are snow on the table, but useless, irrelevant, and hence misleading to say that there are thousands. If a count is needed, count nouns specially suited to the purpose ('clump', 'lump', 'expanse', 'mass', 'heap', 'batch', 'bit', 'quantity', 'volume', 'piece', 'portion') are introduced to isolate the contextually relevant objects that satisfy the mass term. Some of these nouns are count nouns only by the grammatical criteria presented in section I. Thus, on the relevant reading, 'quantity of ___', 'volume of ___', 'portion of ___' (where a mass term fills the blank), can all be plugged into the schema:

(N) Any sum of parts which are ____s of _ _ _ is a ____ of _ _ _.

For example,

> Any sum of parts which are portions of water is a portion of water.

Noun phrases such as these seem tailor-made to cover our grammatical embarassment over questions regarding the number of objects that satisfy a given mass term. They give us the grammatical resources to pluralize and count. Yet they are semantically flexible enough to take any object that satisfies a mass term—regardless of shape, size, duration, texture, or spread—as a countable "unit." The other nouns listed ('clump', 'lump', 'expanse', 'mass', 'heap', 'batch', 'bit', 'piece') also serve the purpose of covering our grammatical embarrassment in certain contexts. In addition, these nouns indicate special spatial distributions, sizes, or textural consistencies which help us in conversational contexts to isolate the relevant objects that satisfy a given mass term.

On the relevant readings, then, nouns like 'quantity' and 'portion' seem to be grammatical lackeys for mass terms, sometimes with no independent semantical status: 'is a quantity of salt' (on one reading at least) is equivalent to 'is some salt'. The remaining "helping nouns" have staked out their own semantical function. But they also are not essential to dividing the reference of mass terms; rather they clarify which divisions are relevant in a given context.

Most mass terms are true of objects that are more or less continuous so far as our unaided senses are concerned. Frequently this is the reason why it is inconvenient or irrelevant to distinguish those parts of an object satisfying a mass term which themselves satisfy the mass term. Moreover, the practical inconveniences of distinguishing countable "units" are aggravated by the fact that continuous stuffs come in different shapes and sizes. And they change shapes and sizes from time to time, often in seemingly irregular ways. Those mass terms which are not true of roughly continuous stuffs ('hardware', 'sports apparel', 'furniture', 'fruit', 'clothing', 'apparatus') are found useful because they enable us to talk generally—often vaguely—of aggregates without having to bother about countable units.

There are no impassable conceptual barriers against laying down, for most ordinary mass terms, criteria for counting objects of which they are true. (I skirt here esoteric questions about the likes of 'energy'.)

In many cases, a science has given us the bases for perfectly clear count criteria. Thus, for example, we could associate the following criterion with the term 'gold': something is "a gold" if and only if it is an atom with atomic weight 196.97 or an aggregate consisting of any combination of such atoms (parts of atoms would not be counted). Ordinary usage is, of course, relatively flexible in its application criteria. For example, we often call an object 'gold' even if it does not consist entirely of gold atoms, just as we often call an object 'round' even if it is not exactly round. This flexibility could either be retained in or eliminated from our count criterion. In the cases of other mass terms less associated with natural sciences ('trash', 'gravel', 'clothing'), establishing such criteria would be more arbitrary, but nonetheless possible. It is apparent, though, that converting the grammar of mass terms into that of count nouns would in neither case serve any practical purpose. Grammar bars pluralization of mass terms because pluralization is useless.[15]

[15] One feature of the relation between mass terms and count nouns which I have neglected is our tendency to associate criteria of measurement with mass terms in lieu of count criteria. This feature is given valuable discussion in Helen Morris Cartwright's "Quantities," *op. cit.*

V. FIRST APPLICATIONS OF THE PREDICATE VIEW

It is now incumbent on us to show how our predicate approach handles some representative sentences containing mass terms. The analyses of most of the sentences we have discussed in the course of this paper are appealingly simple:

(1) ('Snow is white') goes into

(1″) $(x)(\text{Snow}(x) \rightarrow \text{White}(x))$

(2) ('This stuff is snow') reads

(2″) Snow(this stuff)

(3) ('Phil threw snow on Bill') receives the analysis:

(3″) $(\exists x)(\text{Snow}(x)\ \&\ \text{Threw-on}(\text{Phil}, x, \text{Bill}))$

The reading of (6) will be analogous to our treatment of (2). It should be clear that our analyses of (1) and (2) validate the natural-language argument (a)-(b)-(c) of section II.

As noted at the end of section IV, the application criteria of most mass terms is vague. This vagueness will affect the interpretation of sentences like (1). Consider, for example, the sentence 'Gold is ductile'. Suppose we decide that gold atoms are gold. Then either we must give the predicate 'is ductile' a special theoretical interpretation whereby objects which are gold and which cannot themselves be drawn into wires are counted ductile, or we must count the sentence true only for solid, macro-gold, and strictly speaking false. A third alternative would be to limit the application of 'gold' to objects that are literally ductile.

This third way accords poorly with the language of chemistry books, which have occasion to speak of gold in a liquid or gaseous state—or gold in its atomic form. The reinterpretation of the predicate 'is ductile' also seems unnatural: in order to delimit their range of applicability, predicates like 'is malleable' and 'is ductile' are commonly said to represent "physical properties" (as opposed to "atomic properties"). Thus it would seem most natural to count sentences like 'Gold is ductile' true only in a limited domain. But any of the theoretical alternatives is compatible with our analysis (1″). (In the preceding we have, of course, been ignoring other readings of our sentence, such as 'Most gold is ductile'.)

(7) ('Blue styrofoam is styrofoam') is interpreted as

(7″) $(x)(\text{Blue}(x)\ \&\ \text{Styrofoam}(x) \rightarrow \text{Styrofoam}(x))$

It has been said that such phrases as 'all blue styrofoam' cannot be analyzed as 'all objects which are blue and which are styrofoam'. The objection goes roughly as follows:

> An object (say, a toy raft) which is blue and which is styrofoam may be made of green styrofoam which is *painted* blue. Thus the object (the raft) is blue, but the styrofoam is green. Now suppose that all blue styrofoam is coarse, while green styrofoam is not. Then 'All blue styrofoam is coarse' is true. But its purported analysis, 'All objects which are blue and which are styrofoam are coarse' is false. For the raft is blue and is styrofoam but is not coarse. Hence the analysis is mistaken.[16]

The objection assumes that the verb 'to be' functions as a copula in

(i) The raft is styrofoam.

as well as in

(ii) All objects which are blue and which are styrofoam are coarse.

(which must be taken as having the form of (7″) with 'coarse' substituted for the second occurrence of 'Styrofoam'). But there are good reasons for thinking that the 'is' in (i) is not the copula. Suppose (i) is read as

(iii) Styrofoam(this raft).

If (iii) is true, then there is some styrofoam with which the raft is identical. Presumably this is the styrofoam that makes up the raft. But if the styrofoam is identical with the raft, it must come into being and pass out of existence at the same time. But a raft will often be "outlived" by its constituent styrofoam—for example, if the raft is cut into small pieces. So the styrofoam and the raft are not identical. The proper response to this argument, I think, is to hold that the 'is' in (i) is not the copula, but rather the 'is' of constitution or, better, of spatial coincidence.[17] But any such reformulation of (i) blocks the argument against analyzing (7) as (7″). A more perspicuous reading of (7″) than the reading against which the argument is directed is: 'For any x, if x is blue and x is some styrofoam, then x is some styrofoam.'

[16] The objection is adapted from Parsons, "An Analysis of Mass Terms and Amount Terms," p. 371. But it is taken out of the immediate context of his discussion, which assumes that mass terms are individual constants. So it should not be attributed to him.

[17] Arguments like this one are given by David Wiggins in *Identity and Spatio-Temporal Continuity* (Oxford: Basil Blackwell, 1967), pp. 10–13. I think that these arguments, though strong, are not decisive against the view that 'is' is the copula in sentences like (i). But I believe that the conclusion is nevertheless correct. (Cf. fn 11.)

We now turn to (8) ('Water is widespread') and (9) ('Muddy water is widespread'). It is well known that 'widespread' is one of a relatively small group of predicates that do not divide their reference in the usual way—if they do so at all. They cause a problem in analyzing pluralized count nouns as well as certain occurrences of mass terms. Take, for example, the sentence 'Lions are widespread'. Clearly 'Everything that is a lion is widespread' will not do. Usually classes are invoked at this point; and the analysis reads, 'The class of lions is widespread'. This does not seem very satisfying either, for reasons mentioned earlier in another context (section III): Classes are not spread out through space—only concrete objects are; and the usual lecture about how things work out in deep structure where they do not appear to in surface structure seems ad hoc, poorly motivated, and conducive to complication. I do not, however, wish to argue here for any given analysis of 'Lions are widespread'.

In the case of (8) and (9) we have a reasonably intuitive provisional interpretation, though it will force us to introduce a primitive. (8) may be formalized:

$$(8'') \text{ Widespread}(\imath y)((z)(y \text{ overlaps } z \rightleftarrows (\exists x)(\text{Water}(x) \;\&\; x \text{ overlaps } z)))$$

and (9):

$$(9'') \text{ Widespread}(\imath y)((z)(y \text{ overlaps } z \rightleftarrows (\exists x)(\text{Water}(x) \;\&\; \text{Muddy}(x) \;\&\; x \text{ overlaps } z)))$$

These may be read 'The sum (or totality) of all water is widespread' and 'The sum of all muddy water is widespread'.[18]

The primitive from the calculus of individuals facilitates analysis of another group of sentences represented by

(5) The element with atomic number 79 is gold.

and

(10) Water is the liquid that covers two-thirds of the face of the earth.

[18] The "overlaps" primitive is borrowed from the calculus of individuals as set out in Nelson Goodman, *The Structure of Appearance* (New York: Bobbs-Merrill, 1951), ch. II, esp. pp. 51–52. The calculus was first published in Henry S. Leonard and Nelson Goodman, "The Calculus of Individuals and Its Uses," *Journal of Symbolic Logic*, V, 2 (June 1940): 45–55. One might use the "overlaps" primitive to analyze not only (8) and (9) but also sentences like 'Lions are widespread'. Although it does not explicate the plural, this analysis is preferable to that in terms of classes. From a conversation with Richard Grandy there emerged the hypothesis that "widespread" sentences, containing both count nouns and mass terms, might be treated on an analogy with sentences—like 'Birds are numerous (many)', of perhaps 'Assassinations are frequent'—which appear to involve a restricted quantifier. This hypothesis is probably worth working on. But it appears to me doubtful that an analysis along these lines will be more economical and intuitive than the analysis here offered. Actually, I think that our use of 'overlaps' can be improved upon. But the needed refinements are well beyond the scope of this piece.

The readings are

$$(5'')\ \text{ean } 79 = ((\imath y)(z)(y \text{ overlaps } z \rightleftarrows (\exists x)(\text{Gold}(x) \& x \text{ overlaps } z)))$$

and

$$(10'')\ (\imath y)((z)(y \text{ overlaps } z \rightleftarrows (\exists x)(\text{Water}(x)\ \&\ x \text{ overlaps } z))) = \text{lce } 2/3$$

('ean 79' and 'lce 2/3' abbreviate the analyses of the respective definite descriptions.) The 'is' in (10) and (5) is intuitively the sign of identity. If one allows singular terms in one's truth-theoretic analysis (and I do), one needs a singular term on the left side of the identity sign. Using '$(\imath x)(\text{Water}(x))$' in the analysis of (10) does not fill the bill, since there is no unique object which is water. Our sum primitive seems to supply an appropriate solution, at least provisionally.

The analyses of (10) and (5) raise the question of whether analogous treatments could be applied to sentences like (1) ('Snow is white'). Thus

$$(1''')\ \text{White}(\imath y)((z)(y \text{ overlaps } z \rightleftarrows (\exists x)(\text{Snow}(x)\ \&\ x \text{ overlaps } z)))$$

Such analyses would confirm at least one aspect of Quine's theory: before the copula mass terms function as singular terms. But, as noted in section II, the argument (a)-(b)-(c) would not go through without a supplementary principle connecting the predicate 'is white' with the sum primitive. Since most speakers find (a)-(b)-(c) valid and since the quantifier approach (1″) accounts for their intuitions more simply, (1‴) is not a plausible *replacement* for (1″).[19]

Some speakers, however, may find (1) ambiguous in such a way as to allow (1‴) as an additional interpretation. There is no reason why such a possibility should be excluded a priori. I have found, however, that relatively few people (and most of them Quine readers) seem to think that (1‴) is a plausible interpretation of the sentence (1), as it occurs in their idiolects.

Even in cases where the mass term may be persuasively analyzed as denoting a sum or totality—as in (8), (10), (5), and perhaps one reading of (1)— the mass term should still be analyzed as embedded in a complex singular term rather than as a logically simple individual constant. This is because mass terms may take attributive modifiers, as in (9). If the logical relation between modified and unmodified occurrences is to be preserved, the mass term in unmodified occurrences cannot be read as a logically simple singular term. Thus

[19] Grandy has suggested another reason for preferring (1″) to (1‴). The latter analysis would make sentences like 'Water is enormous' obviously true. But they are not.

if 'snow' and 'muddy snow' are interpreted as singular terms denoting totalities, one should be able to read off from one's analysis that muddy snow bears some obvious relation to snow: for example, the "is a part of" relation. Such a relation can be exhibited in the calculus of individuals. It cannot be exhibited if 'snow' is treated as an individual constant.

One cannot show such sentences as 'Muddy snow is muddy' to be logical truths if 'Muddy snow' is formalized with the "overlaps" primitive. One can see this intuitively by noting that, although the totality of all the muddy snow is muddy, the totality of all the hexagonally shaped gold is not (or need not be) hexagonally shaped. Since 'Muddy snow is muddy' is intuitively valid, the quantified analysis, '$(x)(S(x)\ \&\ M(x) \rightarrow M(x))$', is the correct one. Note that from 'Muddy snow is widespread' we do not deduce that snow is widespread.

I have now shown how our theory handles some representative sentences containing mass terms. These sentences, however, do not by themselves provide a thorough test of the theory. Some of the most interesting questions about mass terms arise in discussion of the relations between mass terms, count nouns, and change. But adequate discussion of these questions requires more space than I can devote in this paper.

Before closing I wish to canvass briefly the chances of improving the theory I have presented. One sort of improvement would consist of eliminating the primitive we borrowed from the calculus of individuals. That primitive has so far been invoked at two points. First, we used it to account for sentences like (8) and (9) which contain predicates such as 'widespread'. If one could devise a treatment of count-noun sentences containing this sort of predicate which dispensed with the class-abstraction operator, one might well be able to extend the treatment to the analogous mass-term sentences and dispense with the "sum" primitive (cf. fn 18).

The other point at which we invoked our primitive was in interpreting sentences like (5) and (10) in which mass terms seem clearly to function as singular terms. It seems likely that jettisoning a primitive in these cases would be preceded by a wholesale elimination of singular terms. To many, this is desirable in any case. But without using *some* special primitive it is difficult to see how to use the Russell method to analyze sentences like (10). The most straightforward application of the method would yield something like:

$$\text{(R)}\quad (x)(\text{Water}(x) \rightleftarrows (\exists y)((z)(\text{A liquid that covers the earth}(z) \rightleftarrows y = z)\ \&\ x = y))$$

But (R) entails that there is at most one object which is water. And that is false. One might try

(R′) $(\exists y)(\text{Water}(y)\ \&\ y =$ the liquid that covers the earth)

Here the remaining singular term could be russellized out without encountering the previous objection. But the analysis is wrong because it does not entail, as it should,

> Whatever is constituted of water is constituted of the liquid that covers the earth.

Further tinkering may yield more reasonable analyses, but I have found it difficult to envision one which does not resort to some primitive or other. Thus it appears, for the present anyway, that our sum primitive earns its keep.

I have defended the view that mass terms at all occurrences should be represented as predicates in a theory of truth for English. These predicates should be given the same sort of satisfaction axioms any other ground-level predicates are given. The approach I have proposed uses one primitive and quantifies only over physical objects. But we have not yet applied our approach to some of the most interesting sentential occurrences of mass terms. And even now, it is evident that our account is so intricately related to accounts of other constructions that it cannot be vouched safe until accounts of these —and perhaps all the constructions in the language—are given.

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BOOK REVIEWS

Theory and Experience, edited by LAWRENCE FOSTER and J. W. SWANSON. Amherst: University of Massachusetts Press, 1970. 160 p. $8.50.

This volume is a collection of papers read in a public lecture series at the University of Massachusetts at Amherst during 1968/9, but, unlike most collections of public lectures, it comprises essays that are reasonably close in the problems they consider. Of course even the best organized of such collections leave puzzles as to how various of the essays are related. For example, here it is tantalizing to compare the approaches in the contributions of Quine and Chisholm. Chisholm's essay "On the Nature of Empirical Evidence" is an attempt to set out what he takes to be the basic concepts of epistemic logic and to apply these concepts to problems about knowledge, evidence, and evidential support. Quine's "Grades of Theoreticity" explores how much of our conceptual