

SYNTHESE LANGUAGE LIBRARY

TEXTS AND STUDIES IN
LINGUISTICS AND PHILOSOPHY

Managing Editors:

JAAKKO HINTIKKA, *Academy of Finland, Stanford University
and Florida State University*

STANLEY PETERS, *The University of Texas at Austin*

Editorial Board:

EMMON BACH, *University of Massachusetts at Amherst*

JOAN BRESNAN, *Massachusetts Institute of Technology*

JOHN LYONS, *University of Sussex*

JULIUS M. E. MORAVCSIK, *Stanford University*

PATRICK SUPPES, *Stanford University*

DANA SCOTT, *Oxford University*

VOLUME 7

DAVID R. DOWTY

WORD MEANING
AND
MONTAGUE GRAMMAR

*The Semantics of Verbs and Times in
Generative Semantics and in Montague's PTQ*



D. REIDEL PUBLISHING COMPANY

DORDRECHT : HOLLAND/BOSTON : U.S.A.

LONDON : ENGLAND

of *go*), and I am not aware of any other verb whose idioms have the striking number of causative parallels that *come* idioms do. Of course a grammar might contain both kinds of rules – a general relexicalization rule for [CAUSE *come* α], but completely separate rules for lexicalizing *go* and *send* and all idioms in which these morphemes appear. Yet there are still problems. As Binnick notes, there are also quite a few idioms with *come* that are not paralleled by *bring* idioms, such as *come clean* “reveal the full truth,” *come by* “get, obtain,” etc. Though such cases might be handled by restricting α in the lexicalization of [CAUSE *come* α],³ other kinds of cases will be more recalcitrant.

As example (8) illustrated (*The metal was hard, The metal hardened, John hardened the metal*), *hard* is an adjective that has phonologically regular inchoative and causative verbal forms, thus presumably these should be accounted for by a general relexicalization rule. But as Lakoff noted (1965), when *hard* has the meaning “difficult” instead of the meaning “physically rigid or impenetrable”, the inchoative and causative forms are not possible:

- (18) The problems in this textbook are hard.
- (19) a. The problems in this textbook get hard (harder) in the later chapters.
b. *The problems in this textbook harden in the later chapters.
- (20) a. The author of the textbook made the problems hard (harder) in the later chapters.
b. *The author of the textbook hardened the problems in the later chapters.

This is the opposite of the Binnick cases – here it is the meaning and not the phonological form that determines whether lexicalization of causative and inchoative takes place. Yet for the other meaning of *hard*, we clearly do want to say that it falls under the phonologically-determined general pattern for English regular causatives and inchoatives, and if the phonological form is all that is at stake for that rule, then there would seem to be no way of excluding the relexicalization rule from applying to *hard* meaning “difficult.” I don’t know how many cases like *hard* there will be in which morphological and semantic criteria for lexicalization are in conflict,⁴ but even a few such cases cast doubt on the claim that all lexicalization rules can be successfully formulated either completely in terms of meaning or else via relexicalization rules. (One could of course reply that there are homonyms *hard*₁ and *hard*₂ and that only one of these undergoes the general causative and inchoative

relexicalization rules. But if a relexicalization rule is sensitive to the distinction between homonyms, then it is unclear that it really describes a generalization stated entirely in terms of the form but not the meaning of a word.)

Of course, relexicalization rules would have to be provided with a means for handling exceptions quite apart from troublesome cases like *hard*. There are many exceptions in English to the causative and inchoative patterns illustrated for *cool* and *hard* (cf. Lakoff, 1965), as there are to the various nominalization patterns. The point of this discussion is merely to establish that the device of post-transformational lexical insertion does not, as is sometimes supposed, unequivocally eliminate the problem of “exceptions” to lexical transformations.

Generative semanticists were not unaware of these problems (cf. Gruber, 1967). McCawley has pointed out (personal communication) that in writing McCawley (1968a) he had in mind “the sort of complex dictionary entry introduced by Gruber, in which specific morphological realizations were indicated for optional adjuncts to a semantic item,” and “in addition, there is nothing to prevent general rules for the morphological realization of some of those items (e.g. BECOME → *-en*), with the general rules being overridden by any specific realizations given in particular dictionary entries.” (This suggestion, of course, involves a more complicated theory of grammar than I have been describing, since the application of a general lexical insertion transformation would be constrained by properties of certain other, specific lexical insertion transformations that happened to be in the grammar. However, I believe the details of a solution to this problem were not generally agreed upon, nor have they been worked out explicitly since.)

2.2. THE ARISTOTLE-RYLE-KENNY-VENDLER VERB CLASSIFICATION

In this section I will introduce a classification of verbs (or rather, of verb phrases) that developed in the philosophical literature as a result of a distinction made originally by Aristotle. This is not to deny that the distinctions have been recognized at one time or another by various linguists, but attempts at a comprehensive analysis of these classes have been restricted until recently to philosophers (cf. Comrie (1976) for linguistic references). The relevance of the verb classification at this point in the book is that the differences among the various classes will turn out to be explained, to a remarkable degree, by the hypothesis that one verb class differs from another in which of the abstract operators CAUSE, BECOME or other such operators appear

in the Logical Structure of all verbs of each class; that is, the classes differ systematically in the way exemplified by the logical structures of the three words *cool* in (7a), (7b) and (7c), or the structures underlying the words *dead*, *die* and *kill* in McCawley's analyses.

I have earlier referred to this classification (Dowty, 1972) by the term *verb aspect*. This is not a wholly appropriate term, since *aspect* in linguistic terminology is usually understood to refer to different inflectional affixes, tenses, or other syntactic "frames" that verbs can acquire (*aspect markers*), thereby distinguishing "different ways of viewing the internal temporal constituency of a situation" (Comrie, 1976, p. 3). The Slavic languages provide the best-known examples of aspectual affixes for verbs. *Aspect* is distinguished from *tense* from the point of view of semantics in that tenses (like the tense operators of standard tense logics) serve to relate the time of a situation described to the time of speaking (as in past, present and future tenses), whereas *aspect* markers serve to distinguish such things as whether the beginning, middle or end of an event is being referred to, whether the event is a single one or a repeated one, and whether the event is completed or possibly left incomplete. By this use of the term *aspect*, the only instances of pure aspect markers in English are the progressive "tense" and the habitual quasi-auxiliary *used to* (phonetically ['yustə]), as in *I used to go to the movies on Saturday*. However, it is recognized that in all languages, semantic differences inherent in the meanings of verbs themselves cause them to have differing interpretations when combined with these aspect markers, and that certain of these kinds of verbs are restricted in the aspect markers and time adverbials they may occur with (Comrie, 1976, Chapter 2). It is because of this intricate interaction between classes of verbs and true aspect markers that the term *aspect* is justified in a wider sense to apply to the problem of understanding these classes of verbs as well, and it turns out to be this same classification of verbs which is the subject of the Aristotelian categorization. If it is necessary to distinguish the two uses of *aspect*, we can (following Johnson, 1977) distinguish the *aspectual class* of a verb (the Aristotelian class to which the basic verb belongs) from the *aspectual form* of the verb (the particular aspect marker or markers it occurs with in a given sentence).

2.2.1. *The Development of the Verb Classification*

It is Aristotle who is generally credited with the observation that the meanings of some verbs necessarily involve an "end" or "result" in a way that other verbs do not. In the *Metaphysics* 1048b, he distinguished between *kineseis*

(translated "movements") and *energiai* ("actualities"), a distinction which corresponds roughly to the distinction we shall be making between accomplishments and activities/states. However, Aristotle elsewhere made the distinctions differently and with different terms; couched in metaphysical discussions of the potential and the actual, these contrasts seem barely relevant to natural language semantics and perhaps even contradictory at times. Therefore the reader is referred to Kenny (1963: 173-183) for an exegesis of Aristotle and additional references. (Kenny also claims to have discovered in Aristotle's *De Anima* the distinction between states and activities.)

Despite these problems, several Oxford philosophers of this century have had a go at Aristotle's classes, and in ways that are increasingly relevant for linguistic methodology. The first of these was Gilbert Ryle, who in his book *The Concept of Mind* (Ryle, 1949, p. 149) coined the term *achievements* for the resultative verbs, to be distinguished from the irresultative *activities*. Achievements, such as *win*, *unearth*, *find*, *cure*, *convince*, *prove*, *cheat*, *unlock*, etc., are properly described as happening at a particular moment, while activities such as *keep (a secret)*, *hold (the enemy at bay)*, *kick*, *hunt*, and *listen*, may last throughout a long period of time. Ryle also noticed that achievements have a kind of semantic dichotomy that activities do not:

One big difference between the logical force of a task verb and that of a corresponding achievement verb is that in applying an achievement verb we are asserting that some state of affairs obtains over and above that which consists in the performance, if any, of the subservient task activity. For a runner to win, not only must he run but also his rivals must be at the tape later than he; for a doctor to effect a cure, his patient must both be treated and be well again . . . (Ryle, 1943, p. 150)

However, he also distinguished a sub-class of achievements which lack this dichotomy, "which are prefaced by no task performances." Ryle also supplied a test for these "purely lucky achievements" in the form of a list of adverbs which cannot co-occur with them:

. . . we can significantly say that someone has aimed in vain or successfully, but not that he has hit the target in vain or successfully; that he has treated his patient assiduously or unassiduously; but not that he has cured him assiduously or unassiduously; that he scanned the hedgerow slowly or rapidly, systematically or haphazardly, but not that he saw the nest slowly or rapidly, systematically or haphazardly. (Ryle, 1949, p. 151)

Additional test adverbs are *attentively*, *studiously*, *vigilantly*, *conscientiously*, and *pertinaciously*.

In *Action, Emotion and Will* (Kenny, 1963, pp. 171-186) Anthony Kenny brought more grammatical and logical criteria to bear on these classifications.

He observed that if ϕ is a *performance verb* (his term for the class that corresponds to Ryle's achievements) "A is (now) ϕ ing" implies "A has not (yet) ϕ ed." If a man is building a house, then he has not yet built it. But if ϕ is an activity verb, then "A is (now) ϕ ing" entails "A has ϕ ed." If I am living in Rome, then I already have lived in Rome. While Kenny apparently did not appreciate Ryle's distinction between achievements with an associated task and purely lucky achievements,⁵ he did on the other hand make precise the distinction between *activities* and *states*. Activities and performances can occur in progressive tenses, states cannot: We say that a man is learning how to swim, but not that he is knowing how to swim. On the other hand, the simple present of activities and performances always has a frequentative or habitual meaning (*John listens to Mary, John builds houses*) in a way that the simple present of states does not; *John knows the answer* is not frequentative. (The rest of Kenny's tests are incorporated below.)

It was Zeno Vendler who first attempted to separate four distinct categories of verbs by their restrictions on time adverbials, tenses, and logical entailments (Vendler, 1967). He distinguished *states*, *activities*, *accomplishments* (which are Kenny's performatives, Ryle's "achievements with an associated task"), and *achievements* (which are Ryle's "purely lucky achievements" or "achievements without an associated task"). This terminology will be adopted throughout the present work. Examples of verbs from Vendler's four categories are listed below:

<i>States</i>	<i>Activities</i>	<i>Accomplishments</i>	<i>Achievements</i>
know	run	paint a picture	recognize
believe	walk	make a chair	spot
have	swim	deliver a sermon	find
desire	push a cart	draw a circle	lose
love	drive a car	push a cart	reach
		recover from illness	die

One of the things which seemed to bother Vendler was the question of how the four categories should be grouped together. He considered states and achievements to belong to one "genus" and activities and accomplishments to belong to another, on the basis of the fact that the first two categories lack progressive tenses while the second pair allow them. (We shall see that states and achievements also fail the tests for agency, unlike the other two classes.) Yet he also noticed that achievements and accomplishments share some properties (e.g., they take time adverbials with *in*, such as *in an hour*) which activities and states lack. What we will attempt to do in

the analysis that follows is not merely arrive at the most pleasing taxonomy of four or more categories of verbs, but to try to explain by the analysis given just why each of the categories or combinations of categories has the properties it does.

2.2.2. *States and Activities*

The distinction between states and activities (or actually between states on the one hand and activities and accomplishments on the other) is familiar to the linguist as the distinction *stative* vs. *non-stative*⁶ drawn by Lakoff in his thesis (Lakoff, 1965) and does not require extensive discussion here. The usual tests are as follows (*know* is a stative, *run* is an activity, and *build* is an accomplishment):

I. Only non-statives occur in the progressive:

- (21) a. *John is knowing the answer.
 b. John is running.
 c. John is building a house.

II. Only non-statives occur as complements of *force* and *persuade*:

- (22) a. *John forced Harry to know the answer.
 b. John persuaded Harry to run.
 c. John forced Harry to build a house.

III. Only non-statives can occur as imperatives:

- (23) a. *Know the answer!
 b. Run!
 c. Build a house!

IV. Only non-statives co-occur with the adverbs *deliberately*, *carefully*:

- (24) a. *John deliberately knew the answer.
 b. John ran carefully.
 c. John carefully built a house.

V. Only non-statives appear in Pseudo-cleft constructions:

- (25) a. *What John did was know the answer.
 b. What John did was run.
 c. What John did was build a house.

VI. As Kenny noted, when an activity or accomplishment occurs in the

simple present tense (or in any non-progressive tense), it has a frequentative (or habitual) interpretation in normal contexts. If (26b) and (26c) are not used in one of a few specialized contexts (e.g. used by an announcer at a sports event, appear as a stage direction, appear in a narrative in the historical present), then they are understood to involve more than one event of reciting a poem or running respectively. But (26a) does not involve more than one occasion of knowing the answer. (The third example is changed from *build a house* to *recite a poem*, because one cannot build the same house more than once, so the frequentative interpretation would be problematic.)

- (26) a. John knows the answer.
 b. John runs.
 c. John recites a poem.

(The behavior of achievements with respect to the stativity tests is complicated and will be discussed below.)

2.2.3. *Activities and Accomplishments*

Activities and accomplishments are distinguished by restrictions on the form of time adverbials they can take and by the entailments they have when various time adverbial phrases are present.

I. Whereas accomplishment verbs take adverbial prepositional phrases with *in* but only very marginally take adverbials with *for*, activity verbs allow only the *for*-phrases:

- (27) a. ?John painted a picture for an hour.
 b. John painted a picture in an hour.

- (28) a. John walked for an hour.
 b. (*)John walked in an hour.

II. Almost parallel semantically to the *for-an-hour* sentences and the *in-an-hour* sentences above are (29) and (30):

- (29) a. John spent an hour painting a picture.
 b. It took John an hour to paint a picture.

- (30) a. John spent an hour walking.
 b. (*)It took John an hour to walk.

(Though (30b) and perhaps even (28b) have acceptable readings, *an hour* in these readings does not describe the duration of John's action as it does in

(27b) and (29b), but rather seems to give the time that elapsed *before* John actually began to walk. The full explanation of these readings cannot be given until Chapter 7, however.)

III. The entailments of activity verbs with *for*-phrases differ from those of accomplishment verbs under the same conditions. If John walked for an hour, then, at any time during that hour it was true that John walked. But if John painted a picture for an hour, then it is not the case that he painted a picture at any time during that hour. This difference in entailment might be represented as in (31):

- (31) If ϕ is an activity verb, then $x \phi ed$ for y time entails that at any time during y , $x \phi ed$ was true. If ϕ is an accomplishment verb, then $x \phi ed$ for y time does not entail that $x \phi ed$ was true during any time within y at all.

IV. As Kenny noted, entailments from the progressive to the non-progressive tenses also distinguish activities from accomplishments:

- (32) If ϕ is an activity verb, then x is (now) ϕing entails that x has ϕed . If ϕ is an accomplishment verb, then x is (now) ϕing entails that x has not (yet) ϕed .

(This last test must be used with caution. It can be true that John is now building a house but also that he has already built a house, namely if he has already built a *different* house from the one he is now building. But the intent of Kenny's test is clear: we must give a "wide scope" reading to any quantifier occurring within ϕ to apply the test appropriately.)

V. A distinction in entailment also shows up if these two kinds of verbs appear as the complement of *stop*:

- (33) a. John stopped painting the picture.
 b. John stopped walking.

From (33b) we can conclude that John *did walk*, whereas from (33a) we are not entitled to conclude that John *did paint* a picture, but only that he *was painting* a picture (which he may or may not have finished).

VI. Only accomplishment verbs can normally occur as the complement of *finish*:

- (34) a. John finished painting a picture.
 b. *John finished walking.

VII. The adverb *almost* has different effects on activities and accomplishments:

- (35) a. John almost painted a picture.
b. John almost walked.

(35b) entails that John did not, in fact, walk, but (35a) seems to have two readings: (a) John had the intention of painting a picture but changed his mind and did nothing at all, or (b) John did begin work on the picture and he almost but not quite finished it. It is this second reading which is lacking in activity verbs.

Since I have used an intransitive verb *walk* to illustrate the activity class, it might be supposed that the presence or absence of an object accounts for the difference between the two classes. However, there are activity verbs which do take objects. For example, *push a cart* or *drive a car* can be substituted for *walk* in the above examples with the same results.

VIII. Another such difference in possible scope ambiguities between activities and accomplishments has been noticed by generative semanticists, e.g. Binnick (1969). Some accomplishments (specifically, those in which the result brought about is a non-permanent state of affairs) exhibit an ambiguity with *for*-phrases which activities never have:

- (36) a. The sheriff of Nottingham jailed Robin Hood for four years.
b. The sheriff of Nottingham rode a white horse for four years.

(36a), an accomplishment, is ambiguous between a repetitive reading (*four years* delimits the time over which the act of jailing repeatedly took place) and a reading in which *four years* delimits the duration of the result-state which the single act of jailing produced. (36b), an activity, has only the repetitive reading.

2.2.4. Achievements

Achievement verbs, Vendler's fourth class, can be distinguished by the following tests:

I. Although accomplishments allow both *for*-phrase and *in*-phrase time adverbials with equal success, achievements are generally quite strange with a *for*-phrase.

- (37) a. John noticed the painting in a few minutes.
b. ??John noticed the painting for a few minutes.

II. Predictably, the same goes for the *spend-an-hour/take-an-hour* distinction:

- (38) a. It took John a few minutes to notice the painting.
b. ??John spent a few minutes noticing the painting.

III. The entailments of achievements also differ from those of accomplishments. If *John painted a picture in an hour* is true, then it is true that John *was painting* a picture during that hour. But from the truth of (37a) it does not follow that John *was noticing* the painting throughout the period of a *few minutes*. Schematically,

- (39) If ϕ is an accomplishment verb, then $x \phi ed \text{ in } y \text{ time}$ entails $x \text{ was } \phi ing \text{ during } y \text{ time}$.
If ϕ is an achievement verb, then $x \phi ed \text{ in } y \text{ time}$ does not entail $x \text{ was } \phi ing \text{ during } y \text{ time}$.

IV. Unlike accomplishment verbs, achievements are generally unacceptable as complements of *finish*:

- (40) *John finished noticing the painting.

V. And unlike both accomplishments and activities, achievements are unacceptable as complements of *stop* (except in a habitual reading):

- (41) (*)John stopped noticing the painting.

VI. *Almost* does not produce the ambiguity with achievements that it produces with accomplishments; compare (42) with (35):

- (42) John almost noticed the painting.

VII. As Ryle observed, there is a class of adverbs which are semantically anomalous with achievement verbs:

- (43) ??John

}	attentively	}	discovered the solution
	studiously		detected an error
	vigilantly		found a penny
	conscientiously		reached Boston
	obediently		noticed the painting
	carefully		

Since the adverbs *deliberately*, *carefully* in stativity test IV are a subset of these adverbs, this test distinguishes states as well as achievements from the other categories.

TABLE I

Criterion	States	Activities	Accomplishments	Achievements
1. meets non-stative tests	no	yes	yes	??
2. has habitual interpretation in simple present tense:	no	yes	yes	yes
3. ϕ for an hour, spend an hour ϕ ing:	OK	OK	OK	bad
4. ϕ in an hour, take an hour to ϕ :	bad	bad	OK	OK
5. ϕ for an hour entails ϕ at all times in the hour:	yes	yes	no	d.n.a.
6. x is ϕ ing entails x has ϕ ed:	d.n.a.	yes	no	d.n.a. ⁸
7. complement of stop:	OK	OK	OK	bad
8. complement of finish:	bad	bad	OK	bad
9. ambiguity with almost:	no	no	yes	no
10. x ϕ ed in an hour entails x was ϕ ing during that hour:	d.n.a.	d.n.a.	yes	no
11. occurs with <i>studiously</i> , <i>attentively</i> , <i>carefully</i> , etc.	bad	OK	OK	bad

OK = the sentence is grammatical, semantically normal

bad = the sentence is ungrammatical, semantically anomalous

d.n.a. = the test does not apply to verbs of this class.

These criteria, many of which distinguish subsets of the four categories rather than determining a single category, can be perspicuously summarized in the form of a chart (Table I).

2.2.5. Lexical Ambiguity

At this point, a qualification must be made concerning this classification. Activities and accomplishments are supposedly distinguished by criteria 4, 5, 6, 8, and 9, but this is not always the case. Notice first that an activity verb describing movement behaves like an accomplishment verb if it occurs with either a locative of destination (Fillmore's *Goal* case) or with an adverb of extent, as in (44):

- (44) John walked { a mile.
to the park.

Now (44) meets all the requirements for an accomplishment:

- (45) a. John walked to the park in an hour.
b. It took John an hour to walk to the park.

(45a) and (45b) are well-formed and have the proper entailments for accomplishments. (46) is also grammatical:

- (46) John finished walking to the park.

(47) does not entail that John walked to the park (except on the habitual reading of course):

- (47) John was walking to the park.

Furthermore, it can be objected that even when a locative or extent phrase is not present it is possible to assign an accomplishment reading to an "activity" verb in the proper context. Thus if I know (and the addressee knows) that John is in the habit of swimming a specific distance every day (to prepare himself for a swimming race perhaps), then I can assert that today John swam in an hour, or that he finished swimming early, or that on Tuesday he stopped, but did not finish swimming. (The starred sentences (28b), (30b) and (34b) can likewise be grammatical in special contexts.)

This phenomenon is not limited to activity verbs of motion, of course. *Look at*, for example, is normally an activity, but it has a familiar "special sense" in which it is an accomplishment:

- (48) I haven't finished looking at your term paper yet, but I'll try to finish it tonight so we can discuss it tomorrow.

In fact, I have not been able to find a single activity verb which cannot have an accomplishment sense in at least some special context. *Look for* (*listen for*, etc.) would seem to be the most inherently irresultative of the activity verbs, but it is easy to find a context in which they are accomplishments: If a library has an established search procedure for books involving a definite number of prescribed steps, then one librarian can tell another that he finished looking for a certain book but never found it.

Furthermore, it may be supposed that those few examples which sound equally felicitous with *for* and *in* adverbials – e.g. Fillmore's (1971) example *He read a book for/in an hour* or *She combed her hair for/in five minutes*, an example pointed out to me by James McCawley – are all cases where a verb phrase can be read ambiguously as an activity or an accomplishment. In other words, *for* phrases may be restricted to activities exclusively, and

alleged "marginal" occurrences of *for*-phrases with accomplishments such as (27b) are in fact being read as activities.

If this claim is correct, then Vendler's attempt to classify surface verbs once and for all as activities or accomplishments is somewhat misguided. First, we have seen that not just verbs but in fact whole verb phrases must be taken into account to distinguish activities from accomplishments. (In a certain sense, even whole sentences are involved, as will be seen in the next section.) And second, the possibility of giving accomplishment "interpretations" to activity verbs in special contexts blurs the distinction even further. The problem of distinguishing between lexical verbs which *must* be accomplishments, those which *may* be accomplishments with the right time adverbs, and those which can be accomplishments only under special interpretations is an interesting and difficult one, involving as it does the thorny problems of polysemy versus homophony. These problems will not be completely sorted out until Chapters 6 and 7, but the nature of the distinction and its interaction with tenses and time adverbs can be examined in the meantime anyway. The term "activity verb" will be retained for the present to describe instances of particular verbs in particular sentences when those sentences have the appropriate surface syntactic features (according to the criteria in Table I) and an irresultative meaning when understood in their most typical (or otherwise specified) context.

2.2.6. *The Problem of Indefinite Plurals and Mass Nouns*

There is another, more serious problem for Vendler's classification. Accomplishment verbs which take direct objects unexpectedly behave like activities if an indefinite plural direct object or a mass-noun direct object is substituted for the definite (or indefinite singular) one:

- (49) a. John ate the bag of popcorn in an hour.
b. *John ate popcorn in an hour.
- (50) a. John built that house in a month.
b. *John built houses in a month.
- (51) a. It took an hour for John to eat the bag of popcorn.
b. *It took an hour for John to eat popcorn.
- (52) a. It took a month for John to build that house.
b. *It took a month for John to build houses.

- (53) a. John finished (eating) the bag of popcorn.
b. *John finished (eating) popcorn.
- (54) a. John finishing (building) the house.
b. *John finished building houses.

Unfortunately, this difficulty extends to achievement verbs as well. That is, *discover* and *meet*, achievement verbs, disallow the durative adverbials *for six weeks*, *all summer* in (55a) and (56a), as they should according to our criteria. But (55b) and (56b), with indefinites or mass nouns, are good:

- (55) a. *John discovered the buried treasure in his back yard for six weeks.
b. John discovered $\left\{ \begin{array}{l} \text{fleas on his dog} \\ \text{crabgrass in his yard} \end{array} \right\}$ for 6 weeks.
- (56) a. *John met an interesting person on the beach all summer.
b. John met interesting people on the beach all summer.

Furthermore, if an indefinite plural occurs even as subject of an achievement, the sentence is acceptable with durative adverbials:

- (57) a. *John discovered that quaint little village for years.
b. Tourists discovered that quaint little village for years.
- (58) a. *A gallon of water leaked through John's ceiling for six months.
b. Water leaked through John's ceiling for six months.

We can informally state a general principle to cover the cases (55)-(58).

- (59) If a sentence with an achievement verb contains a plural indefinite NP or mass noun NP (or if a sentence with an accomplishment verb contains such an NP as object), then it has the properties of a sentence with an activity verb.

How should principle (59) be incorporated into the grammar? Around 1967 most generative-transformational grammarians would probably have agreed how to do this. One would postulate syntactic features such as [\pm durative] and somehow state selectional restrictions, say, between verbs with these features and time adverbials like *for x time* and *in x time*.

In fact, an excellent and very thorough study of the phenomenon of aspect has already been done from this theoretical point of view (Verkuyl 1972) and it will be useful to consider it at this point. Verkuyl was acutely

aware of principle (59) (or at least aware of the data behind it, which is the same in Dutch as in English, and no doubt as in many if not all other languages⁹), and most of his work is devoted to finding a way of generating correctly sentences like (55)-(58). His main thesis is that the notions of durative and perfective aspect are not to be found in any one constituent in surface structure, but arise from the "composition" of certain constituents; hence his title *On the Compositional Nature of the Aspects*. I quote:

In chapter two the compositional nature of the aspects will be demonstrated with the help of a number of outwardly diverse sentences, all of which allow for the same generalizations regarding the position of durational adverbials. The durative and non-durative aspects in these sentences appear to be composed of a verbal sub-category on the one hand and a configuration of categories of a nominal nature on the other.

(Verkuyl, 1972, p. iv)

This conclusion leads him to propose, for example, that VP nodes should be sub-categorized as *durative* and *non-durative*, the first of which can be expanded as in (60), (61), and (62). Non-durative VPs can be expanded as (63) but not (64); the structure (64), which would correspond to the ungrammatical (49b) or (54), is excluded by the phrase structure rules (Verkuyl, 1972, p. 54):

(60) [VP_{dur.} [V AGENTIVE] + [NP INDEF. PL.]]

(61) [VP_{dur.} [V NON-AGENTIVE] + [NP INDEF. PL.]]

(62) [VP_{dur.} [V NON-AGENTIVE] + [NP INDEF. SG.]]

(63) [VP_{non-dur.} [V AGENTIVE] + [NP INDEF. SG.]]

(64) *[VP_{non-dur.} [V AGENTIVE] + [NP INDEF. PL.]]

Actually Verkuyl later concludes (Verkuyl, 1972, pp. 107ff.) that the sub-categorization with respect to aspect must take place at an even higher node than the VP since information outside the VP, e.g. in (57)-(58), must be taken into account.

Verkuyl's solution seems to produce all the good sentences without producing any of the bad ones; yet I think many linguists today would not be totally satisfied with this kind of solution, and for good reasons. In the first place, Verkuyl's analysis does absolutely nothing toward explaining why the structure (64) is ungrammatical while the others are not. Using his formalism and categories, it would be just as simple to write a grammar in which (60) or (61) or (62) would be blocked while (64) would be generated. Yet I doubt that there is any language in which this would be the case.

In the second place, I believe it would be agreed that the distinction between durative and perfective aspect is a semantic notion at least as much as it is a syntactic notion. What all accomplishments (including activity verbs in the "special interpretation" discussed earlier) have in common (as Ryle and Kenny noted) is the notion of a specific goal or task to be accomplished: in some cases it is a specific distance which is traversed or a specific location which the subject (and/or object) ends up at. In other cases it is the creation or destruction of a specific direct object; in still others it is the new state which the object (or subject) comes to be in as a result of the subject's action. If these verbs occur in a simple past tense, then we understand the goal or task to be reached. If these verbs occur in the progressive, then we are not entitled to assume the same task to be accomplished, though we understand that the action the subject performed was the same kind as before. Surely a semantic analysis of these verbs must account for these meanings in terms of the very same notions of time reference, completion of action and definiteness or indefiniteness of object that Verkuyl has neatly explained away as co-occurrence restrictions. The effect of these restrictions would surely have to be reflected in the semantic component, hence duplicated in the grammar.

2.2.7. Examples of the Four Vendler Categories in Syntactic and Semantic Subcategories

I believe that a defect of previous studies of the Aristotelian verb classification has been that only a few examples from each category are discussed, possibly giving the reader (not to mention the authors) a somewhat skewed impression of what the full ranges of verb phrases singled out by the given tests actually consist of. To try to rectify this situation, I have inserted here an informal list of different kinds of verbs in each category, subcategorized by both semantic and syntactic properties. The semantic headings should not be taken too seriously; I simply intend these to bring some of the different kinds of verbs in each class to the reader's attention, and I do *not* claim that these are either exhaustive or mutually exclusive categories, and I do not necessarily attach any theoretical significance to them or the way I have arranged them.

Some verbs are aspectually ambiguous in ways that have been alluded to already and will be described further later on.

As the reader may notice, the syntactic tests given for distinguishing the four categories do not give totally consistent results for all examples below. In fact, consideration of some of them will force us to make some

revisions in the Vendler-Kenny classification (this revision will be made after interval semantics is introduced in Chapter 3). But for expository purposes, I retain Vendler's four categories here and in the rest of this chapter.

By the term *transitive* as applied to verbs and adjectives, I mean that a second noun phrase essential to the meaning follows the adjective or verb immediately (i.e. semantically a two-place relation is involved). By *two-place phrasal* I mean that a semantically essential noun phrase follows after a preposition. For example, *love* and *like* are transitive in *John loves Mary* and *John is like Mary*, but *listen* and *similar* are two-place phrasal in *John listens to Mary* and *John is similar to Mary*.

I. STATES (STATIVES)

A. Intransitive Adjectives

1. With individuals as subjects: *be tall, big, green, American, quadrilateral*.
2. With propositions as subjects: *be true, false, likely, doubtful*.

B. Intransitive Verbs

1. *exist, stink, itch, burn, live* (as in *Bird lives*).
2. "Pseudo-passives" that have no real active forms, with propositions as subjects: *be rumored, be (widely) believed*.

C. Transitive and Two-place phrasal adjectives

1. *like; similar, identical, related to NP* [These are the symmetric predicates of Lakoff and Peters 1969].
2. *proud, jealous, fond of NP*.

D. Transitive Verbs

1. Animate subjects: *love, hate, dislike, know, have*.
2. Symmetric predicates: *resemble, equal, be*.
3. With propositional object and propositional or human subject: *mean, prove, show, indicate, suggest, imply*.
4. Propositional subject: *involve, concern*.
5. Physical perception verbs [all are achievements as well as states] *see, hear, smell, taste, feel, perceive*.
6. Cognitive verbs with propositional objects [also achievements] *understand, know, believe, doubt, regret*.

7. "Psych-Movement" Verbs [propositional subject, human object; also achievements] *dismay, worry, please, surprise, astonish*.

8. Non-extensional Objects: *need, want, desire, fear*.

E. Two-place phrasal Verbs

1. Locatives

- a. *be in, on, around, under, at NP*.
- b. Pseudo-passives: *be located, be found at, on, around NP*.
- c. *sit, stand, rest, hang, lie, perch, adhere to, on, at, in NP*.
- d. Pseudo-motional locatives, predicated of roads, rivers, etc.: *run, flow, meander* (transitive: *cross*).

2. "Psych-movement" [May be transformational variant of D.7] *be pleased, astonished, dismayed at NP; like NP*.

II. ACTIVITIES

A. Adjectives [all adjectival and predicate nominal activities are volitional]

1. Intransitive: *be brave, greedy*.
2. Two-place phrasal: *be rude, nice, polite, obnoxious to NP*.

B. Predicate Nominals: *be a clown, hero, bastard, fool, stick-in-the-mud*.

C. Intransitive Verbs

1. Animate or inanimate subjects: *vibrate, rotate, hum, run, rumble, roll, squeak, roar*.
2. Cosmological: *thunder, rain, snow*.
3. Animate subjects: *cry, smile, walk, run, swim, talk, dance*.
4. Transitive absolute, or "object deletion" verbs: *smoke, eat, drink, play (music)*.

D. Transitive Verbs of movement: *drive, carry, push NP, raise the thermostat, dim the lights*

E. Two-place phrasal [though perhaps the prepositional phrase is a modifier] *sit, write, ride on, in NP*

F. Non-extensional Object [both transitive and two-place phrasal] *seek, listen for, look for, search for*

G. Physical Perception Verbs [transitive and two-place phrasal] *listen to, watch, taste, feel, smell* (the last three are also states and achievements).

H. Pseudo-three place idioms: *pay attention to, pay heed to, keep track of* NP.

I. "Aspectual" Complement Verbs: *keep, continue*.

III. ACHIEVEMENTS (May be coextensive with inchoatives)

A. Locatives

1. Transitive verb: *reach, leave, touch* NP (*touch* also stative and active).
2. Two-place phrasal verbs: *arrive at, land on, depart from, fall from* NP.

B. Change of Physical State (Absolute states; cf. 2.3.5 for distinctions between absolute and degree achievements)

1. Intransitives: *melt, freeze, die, be born* (Pseudo-passive), *molt, ignite, explode, collapse*.
2. Two-place phrasal: *turn into* a NOUN, *turn to* NOUN, *become* ADJ.

C. Change of Physical State (Degree state) ^{Atelic Dowty 1991:568}

1. Intransitive: *darken, warm, cool, sink, improve*. *dim the lights*
2. Phrasal: *become* ADJ-er.

D. "Aspectual" Complement Verbs

1. Infinitive complement: *begin, start, cease*.
2. Gerundive complement: *stop, resume, begin, start*.
3. With event nominal as subject: *end, stop, resume, start, begin*.

E. Possessive: *acquire, receive, get, lose*.

F. Cognitive (many both achievements and states)

1. Physical perception: *notice, spot, see, catch sight of, hear, taste, smell, feel, lose sight of*.
2. Abstract cognitive: *realize, recognize, understand, detect, find* (also accomplishment), *remember, forget*.

G. Change of State of Consciousness: *awaken, fall asleep*.

IV. ACCOMPLISHMENTS

A. Locatives

1. Transitive verb involving enclosure: *hide, cover, box, uncover, crate, shell* NP.
2. Two-place phrasal: *walk, swim, fly to* NP.
3. Two-place phrasal, can also be stative: *sit, lie, stand on* NP.
4. Pseudo-transitive motion verbs with extent NP – this NP is not a real direct object, as can be seen from absence of passive: **A mile was walked by John: walk a block, swim a mile*.
5. Two-place phrasal derived from activity verbs with locative result state: *drive, carry, push* NP to NP.
6. Two-place phrasal not derived from activity verbs: *put, place, set* NP into NP.
7. transitive with extent NP: *carry, push, drive* NP a mile, a block.

B. Intransitives that are not locatives [may be empty?]: *shape up, grow up* (fig.).

C. Transitive verbs of creation (*accusativus effectivus*)

1. [derived from activities] *draw* (a picture), *knit* (a sweater), *dig* (a hole).
2. [Not derived from activities] *make, build, create, construct, erect*.

D. Transitive Verbs of Destruction: *destroy, obliterate, raze* NP; *melt* (an icecube), *erase* (a word), *eat* (a sandwich).

E. Transitive Change of State: *kill, transmogrify, petrify* NP; *marry* NP to NP, *cook* (a turkey), *paint* (a house), *tan* (leather).

[Note that the same verb can be understood to express different semantic relationships to its object and thus belong to IV.D, IV.C, or IV.E accordingly. Cf. *paint a picture* (picture comes into existence) vs. *paint a house* (house undergoes change, but existed already). Also cf. *erase a word* (word ceases to exist) vs. *erase a blackboard* (blackboard undergoes change, but still exists).]

F. Creation of a "Performance Object"

1. Concrete Representation Created: *paint a landscape, photograph a senator, draw a unicorn, record a conversation, transcribe a lecture*. [Here something is created, but not literally]

the thing named by the object NP. Rather, a representation of that object is created, and the object itself does not undergo any change. Cf. *draw a picture* vs. *draw a unicorn*. Also, note *paint a picture* (IV.C) vs. *paint a house* (IV.E) vs. *paint a scene* (IV.F.1).]

2. Abstract "Performance Object" Created:

- a. "Agent Performance": *perform a sonata, recite a poem, sing a song, prove a theorem, produce a play.*
- b. "Experiencer Performance": [Here the subject of the sentence does not bring about the performance as in F.2a, but the phrase is an accomplishment by the syntactic tests just the same]. *listen to a symphony, watch a play, attend a course, read a book.* [Note that *listen to the sound of the waterfall* is an activity but *listen to the symphony* is an accomplishment.]
- c. unclassified: *play a game of chess, basketball.*

[It is hard to know whether *prove a theorem* and *sing a song* should be considered ambiguous. If the theorem is being proved or the song sung for the very first time, then the theorem or song is created, just as in *build a house*, though the object is abstract. But if a previously composed song is sung or a theorem in a textbook is proved, there is at most a "re-creation". Yet no strong ambiguity is felt. Also, should *read a poem* be taken as ambiguous between agent and experiencer performances, according as it is read aloud or not? Probably not. Again, these categories are only for expository purposes.]

G. Other syntactic types of accomplishments. [These are not subcategorized semantically, and I have not tried to determine how many of the above semantic types occur in each of these forms.]

1. *That*-complement verbs: *bring about that S.*
2. Infinitive-complement verbs: *make NP VP, cause NP to VP.*
3. Prepositional Phrase complements: see under Locatives above; also *turn NP into a NOUN, put NP to sleep, drive NP to drink, read oneself to sleep.*
4. Factitive (Adjective of Result): *hammer NP flat, wipe NP clean, wiggle NP loose.*
5. Factitive (Nominal of Result): *elect NP president, chairman, appoint NP chairman.*
6. Verb particle constructions: (i) Transitive: *take NP out, chase*

NP *away, turn NP off*; (ii): Intransitive: *go out, run away, sit down, dry out.* [As Bolinger (1971) points out, verb-particle constructions are almost invariably accomplishment verbs. In many cases, the particle makes no significant contribution to the meaning of the whole except to indicate unambiguously that an accomplishment is intended (cf. *clean the room* vs. *clean the room up*), so in a sense this particle is the closest thing English has to a marker of perfective aspect.]

2.3. AN ASPECT CALCULUS

2.3.1. *The Goal and Purpose of an Aspect Calculus*

In this section an explanatory hypothesis about the four Vendler categories will be explored (though actually more than four categories will result). This hypothesis is essentially that of Dowty (1972). The idea is that the different aspectual properties of the various kinds of verbs can be explained by postulating a single homogeneous class of predicates – *stative predicates* – plus three or four sentential operators and connectives. English stative verbs are supposed to correspond directly to these stative predicates in logical structure, while verbs of the other categories have logical structures that consist of one or more stative predicates embedded in complex sentences formed with these "aspectual" connectives and operators. These aspectual operators and connectives are treated as logical constants – a standard model-theoretic interpretation is to be given for each – and the stative predicates are non-logical constants.

This hypothesis, then, is essentially a reductionist analysis of the aspectual classes of verbs. The goal is for a puzzling diversity of kinds of verbs to be explained as combinations of an aspectually simple and unproblematic kind of verb – the stative – with an explicitly interpreted operator or operators. The success of this depends not only on the formal interpretation of the operators, but also on the assumption that statives are clearly understood and unproblematic. Intuitively, the notion of a stative predicate will seem clear. Statives can be judged true or false of an individual by reference to the state of the world at only a single movement of time (while other classes of verbs require "information" about more than one point in time and in some cases, from more than one possible world). To make this hypothesis into a substantive claim about possible versus impossible word meanings in a referential framework such as that of UG will require being more specific

about “true or false by reference to the state of the world at only a single moment of time”, but this problem will be deferred to section 2.4 below.

It seems to me that a goal of this kind can also be seen implicitly in the following passage from Lakoff (1972, pp. 615-616):

In the analyses offered above [certain lexical decomposition analyses – DRD], certain atomic predicates keep recurring: CAUSE, COME ABOUT, SAY, GOOD, BAD, BELIEVE, INTEND, RESPONSIBLE FOR, etc. These are all sentential operators, that is, predicates that take sentential complements. It seems clear that we would want these, or predicates like these, to function as atomic predicates in natural logic. Since these keep recurring in our analyses, it is quite possible that under the lexical decomposition hypothesis the list would end somewhere. That is, there would be only a finite number of atomic predicates in natural logic taking sentential complements. These would be universal, . . . Moreover, verbs like ‘kick’ and ‘scrub’ in [Sam kicked the door open] and [Sam scrubbed the floor clean] could be ruled out as sentential operators since they could be analyzed in terms of already existing operators, as in [Sam caused the door to come to be open, by kicking it] or [Sam caused the floor to come to be clean, by scrubbing it]. This seems to me to be an important claim. Kicking and scrubbing are two out of a potentially infinite number of human activities. Since the number of potential human activities and states is unlimited, natural logic will have to provide an open-ended number of atomic predicates corresponding to these states and activities. Hopefully, this can be limited to atomic predicates that do not take sentential complements . . . It seems to me that under the lexical decomposition hypothesis we have a fighting chance of limiting sentential operators to a finite number, fixed for all natural languages.

(The hypothesis I am considering here differs from Lakoff’s in two ways, however. I will suggest that states and activities might be reduced to non-logical predicates of the same sort, and I am not claiming that all words with ‘sentential complements’ can be analyzed in terms of fixed, language universal operators – I think this claim is probably false – but only that aspectual categories of verbs might possibly be reduced in this way.)

An important methodological assumption of this enterprise is that the appropriate syntactic distribution of these operators in logical structures, as well as the appropriate model-theoretic interpretation of them, can be adduced by careful attention to syntagmatic and paradigmatic contrasts and restrictions evidenced in the language itself. Though this methodology is highly characteristic of GS, I do not think it is one that linguists other than generative semanticists would repudiate; rather, most would merely deny that the conclusions reached in this way applied to a level of *syntactic* (as opposed to semantic) representation. I should be careful to add that I am not presupposing that the structuralist methodology is a wholly reliable one, much less that it is sufficient to discover all we need to know to

construct an adequate semantic theory of a natural language (as I think many linguists do assume without question). But I think it is a methodology worthy of further investigation, even in a referential theory like UG.

Ultimately, there will remain some features of the verb classes that cannot be attributed to any structurally-motivated operators I am able to devise (though adequate conditions on model-theoretic interpretations of the verbs involved can be stated precisely anyway). Nevertheless, I think the idea of a structurally motivated natural logic is important enough to justify the presentation of my 1972 aspect calculus before the revisions are introduced. I believe that much can be learned from the attempt to construct such a calculus, no matter whether the resulting analysis is stated entirely in terms of it or not.

In Chapter 4, the possibility of using this aspect calculus to “decompose” verbs via the translation relation will be considered. As I have mentioned that the translation procedure of UG is a theoretically unnecessary step, it may be wondered whether this aspect calculus can have any real significance in such a theory. I think in fact it can be significant. Stated in a way that does not presuppose a translation step, the claim the aspectual calculus makes about the Fregean interpretation $\langle B, G_\gamma, f \rangle_{\gamma \in \Gamma}$ for English (whether induced by translation, directly, or otherwise specified) is merely that there exists a finite set of functions $f_1 \dots f_n$ (which correspond to the interpretations of aspectual operators) and a set of objects A (which can be interpretations of stative predicates), such that for each verb α of English, the interpretation of α is equivalent to some composite function constructed out of (a finite number of) $f_1 \dots f_n$ and members of A , and that moreover, this way of specifying the interpretation of α is more economical, elegant, useful, insightful, (or whatever) than any other comparably explicit way of defining the interpretation of α .

2.3.2. *Statives, von Wright’s Logic of Change, and BECOME*

Classical propositional and predicate logic is said to deal with “timeless” states of affairs, propositions which are either true or false once and for all. The notion of a state of affairs being true over a certain period of time can, however, be accommodated in a straightforward way. One would need to add to the predicate logic only a set of variables and constants representing points in time, quantifiers for these time variables, and an operator representing the notion of a proposition being true *at* a time. A sentence containing a stative verb and a *for*-phrase time adverbial (e.g. (65)) could be represented logically as in (66), ignoring for the moment the past tense.

- (65) John loved Mary for three years.
 (66) $(\wedge t: t \in \text{three years}) AT(t, \text{John love Mary})$

Such formulas could be given a model-theoretic interpretation as follows: An appropriate semantic model for this system would include a set of times $t_1 \dots t_n$ with a transitive, asymmetrical relation defined on them (the "earlier than" relation). Interpretations of non-logical constants would be given relative to each time t , and thus formulas may be true or may be false, depending on which time they are evaluated at. Assuming that time adverbs like *three years* denote (contiguous) sets of these times and that we have some way of identifying the "stretch" of time which an adverb refers to, we can give truth conditions for formulas like (66) very simply: (66) would be true relative to some semantic model if the individuals *John* and *Mary* exist in all of the times in the interval *three years* and the sentence *John loves Mary* is true at all times in the interval. This, in fact, would be the only logical mechanism needed for a "Natural Logic" capable of handling statives and durational adverbials. (Though Montague's intensional logic does not contain variables and constants denoting times directly, evaluation of expressions relative to a time is of course part of the intensional semantics, and we will see later how means of referring to times directly can be introduced easily. Temporally-interpreted languages with expressions denoting times are of course not new in the tense logical literature; one might cite Prior's "B-series logic" (Prior, 1967, p. 38) and Rescher and Urquhart's "R-calculus" (Rescher and Urquhart, 1971, pp. 31-35) as antecedents. For simplicity of exposition, I will continue to assume in this section a simple, predicate-logic-like formal language with temporal interpretation, enlarging this language and its semantic apparatus as the need arises.)

A different solution would be required for events, however, since they are not literally true or false *for* a period of time or even at a point in time. Rather, events somehow "take place" *in* time. Some further logical concepts are therefore necessary to capture this notion.

Georg Henrik von Wright (1963; 1968) observed that an event, such as the closing of a door, is understood to have taken place at a certain time if one state – the state of the door's being open (or being not closed) – is replaced at that time by a second state – the state of the door's being closed. Von Wright claimed that this "change of state" definition of an event was generalizable: that *any* event can be defined as a change of state where the two states are of a particular form. Namely, one of the states is the negation

of the other. An event is a change from state p to state q , where $p = \neg q$ (or, to say the same thing, $q = \neg p$).

Von Wright devised a formal calculus of change-of-state which consists of classic propositional logic with the addition of a dyadic operator T (called "And Next"). In the T-calculus, all formulas can be reduced to one of four basic types. These are given in (67) along with their intuitive interpretations:

- (67) $\neg pTp$ "the state p comes about"
 $pT\neg p$ "the state p is destroyed, comes to an end"
 pTp "the state p remains, continues to obtain"
 $\neg pT\neg p$ "the state $\neg p$ remains" or "the state p fails to come about"

Consider now the relationship between Lakoff and McCawley's abstract verb BECOME (or COME ABOUT) and von Wright's analysis of events. The example *The soup cooled* bears the same relation to *The soup is cool* as *The door closed* bears to *The door is closed*. The first sentence can only be true if the soup's being not-cool was replaced, at the time referred to by that sentence, with the soup's being cool. The same will be true of all sentences analyzed by generative semanticists as containing the operator BECOME.

This observation suggests the possibility of defining BECOME sentences in terms of von Wright's logic of change. Moreover, the atomic predicates END (or STOP or whatever the inverse of BECOME is called) and REMAIN can also be defined in terms of von Wright's formulas:

- (68) BECOME (p) = def. $\neg pTp$
 END (p) = def. $pT\neg p$
 REMAIN (p) = def. pTp

Semantically, this claim is simply that one can utter truthfully a sentence like *The soup cooled* when one first observes that the soup is not cool, and thereafter that it is; the meaning of the sentence is that those two states of affairs were true in temporal succession, no more and no less. This analysis makes explicit the temporal relationship among the three pro-verbs and the simple statives.

Furthermore, this analysis would give a semantically correct account of the beginnings and endings of states and of activities such as *It started to rain*, *John stopped running*, *Harry just continued eating his ice cream*, etc. That is, the operators in (68) underlie a large number of individually lexicalized "aspectual" verbs like *begin* as well as the "disappearing" operators in *John cooled the soup*:

- (69) a. It started to snow.
 b. John came to believe that the earth is flat.
 c. John went crazy.
 d. John got drunk.
 e. John sat on the bench. (ambiguous between stative/inchoative)
 f. John lay on the sofa. (ambiguous between stative/inchoative)
 g. She went t' singing. (some dialects)

Von Wright did not provide a formal semantic treatment of his logic of change, though it is easy enough to construct one. However, there is no need to go through the intermediate step of defining structures with BECOME in terms of the logic of change and then defining truth conditions in terms of von Wright formulas: COME ABOUT, END, and REMAIN can simply be regarded as sentential operators in a "Natural Logic", and truth conditions can be defined directly in terms of these and the same kind of semantic model as was described above. If time is discrete in the model – that is, if for any moment there is a unique moment that most immediately follows it – then we can identify the set of times in the model with the set of positive and negative integers and zero, hence refer to the time immediately preceding a time t as $t - 1$, the time immediately following it as $t + 1$.

- (70) Where ϕ is any formula, and t is any time,
 BECOME ϕ is true at t iff ϕ is true at t and false at $t - 1$.
 END ϕ is true at t iff ϕ is false at t and true at $t - 1$.
 REMAIN ϕ is true at t iff ϕ is true at t and true at $t - 1$.

Alternatively, if time is taken to be dense in the model – if for any two moments no matter how close there is always another moment between the two (and hence an infinite number of moments between any two moments) – then the definitions could be reformulated along the following lines: BECOME ϕ would be true at t iff ϕ is true at t , ϕ is false at t' for some time t' earlier than t , and for all times t'' later than t' but earlier than t ϕ is also false at t'' . I presently know of no linguistic reasons why time should be considered dense rather than discrete or vice-versa, so I will leave the matter open here.

It has often been suggested in the literature on presupposition (e.g. Givón, 1972) that the implication of a "negated" earlier state with change-of-state verbs is a presupposition (or conventional implicature) rather than a part of the "assertion" of the verb. This claim is based on the judgment that sentences like (71)-(73) seem to commit the speaker to the view that the gates were closed just before 8 PM:

- (71) The gates didn't open at 8 PM.
 (72) Did the gates open at 8 PM?
 (73) It is possible that the gates opened at 8 PM.

Even more frequently discussed is the implicature of *John has stopped beating his wife* to the effect that John at one time beat his wife. (The aspectual complement verb *stop* would be analyzed on the present view with the operator END above.) If this claim is correct, then these initial state implicatures could be accommodated, I believe, in a treatment of conventional implicature such as that proposed by Karttunen and Peters, with implicatures generated by logical deep structures here rather than by English sentences.

Inchoative verbs derived from adjectives and "aspectual" complement verbs make up a major part of the class of achievement verbs. At this point we will take the further step of suggesting that *all* achievements have a logical structure consisting of BECOME plus an embedded clause.

The BECOME analysis seems to provide an intuitively satisfactory semantic account of the remaining achievement verbs. For example, *realize* (in its inchoative, not its stative sense) seems to be equivalent to "come to know (something which one did not know earlier)." *Forget* is its inverse, just as END is the inverse of COME ABOUT: *forget* is "come to not know (something which one did know earlier)". Likewise, *find* or *discover* is "come to have" or "come to know the location or existence of", with *lose* as the inverse. The locative achievements *arrive at* and *reach* are "come to be at (a place that one was not at just before)". Their inverses are *depart from* and *leave*.

This claim about achievement verbs embodies von Wright's position that all events correspond to a change of state of one form or another. As the analysis of accomplishment verbs suggested below also involves BECOME sentences, these change-of-state entailments are also treated as an essential part of the meaning of accomplishments. This seems to accord with Kenny's view of the essential characteristics of performances (his class that includes both achievements and accomplishments):

Performances are brought to an end by states. Any performance is describable in the form: "bringing it about that p ". Washing the dishes is bringing it about that the dishes are clean; learning French is bringing it about that I know French, walking to Rome is bringing it about that I am in Rome. In all of these cases, what is brought about is, by our criteria, a state: "is clean" "knows" "is in Rome" are all static verbs.

(Kenny, 1963, p. 177).

As I mentioned, the beginnings and endings of activities can also be achievements (and for that matter, be involved in accomplishments), so the sentence embedded directly under BECOME will not always contain just a stative verb, but may be an activity or even, as Kenny suggests, another performance:

A performance may be brought about no less than a state: if the policeman is forcing the prisoner to walk to the police-station, then the policeman is bringing it about that the prisoner is bringing it about that he is in the police-station. Thus in 'bringing it about that *p*', '*p*' may contain a performance verb instead of a static verb. But every performance must be ultimately the bringing about of a state or of an activity; otherwise we could have an action which consisted merely in bringing it about that it was being brought about that it was being brought about that . . . If the description of the action in this form is ever to be completed, it must contain either a perfective verb or an activity-verb. One performance differs from another in accordance with the differences between the states of affairs brought about: performances are specified by their ends.

(Kenny, 1963, pp. 177-178)

The independent syntactic evidence that might be cited for the analysis of achievements in terms of BECOME and an embedded sentence in generative semantics is of two kinds. First, simply the existence of a regular pattern of achievement verbs like *cool*, *harden*, etc. derived morphologically from stative adjectives might be considered evidence of a sort for this analysis, but acceptance of this pattern as evidence that *all* achievements have this structure depends on one's acceptance of the kind of "analytic leap" mentioned earlier which allows that a unit of meaning that is structurally distinguished in some words should be postulated as an independent part of the meanings of all words with similar overall meanings. Second, it can be argued that certain adverbs must have as their scope the embedded stative clause in an achievement verb, rather than the whole verb (i.e. the BECOME sentence). This second kind of evidence, which also applies to accomplishment verbs, would appear to be more significant than the first, and it will be discussed in detail in 5.6-5.8 below.

2.3.3. A Semantic Solution to the Problem of Indefinites and Mass Nouns

Finally, the BECOME analysis can be shown to exclude achievement verbs from the durative constructions (thus explaining the restriction on co-occurrence with *for*-phrases) except in just those cases where an indefinite plural or mass noun occurs in the sentence. This will be demonstrated by considering first what the model-theoretic interpretation of a deviant sentence like (74) would have to be.

- (74) *John discovered the buried treasure in his back yard for six weeks.

I again assume that the durative adverbial *for six weeks* is to be represented in terms of a quantified time expression and a two-place AT operator; that is "for all times *t* such that *t* is a member of the period *six weeks*, it was true at *t* that *p*." (We shall ignore the past tense once again.) Proposition *p* in this case is that expressed by the sentence "John discovered the buried treasure in his back yard." This embedded sentence, in turn, will be a BECOME sentence, and embedded in this will be a stative sentence to the effect that "John knows the existence of the buried treasure in his back yard." (This sentence does not have to be further analyzed for our present purposes.) This logical form is roughly represented in (75):

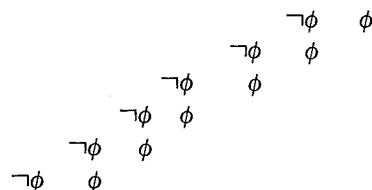
- (75) $(\Lambda t: t \in \text{six weeks}) AT(t, \text{BECOME } [John \text{ knows that } \dots])$

Now consider how the truth conditions for this logical structure would have to be satisfied in a model. The temporal quantifier entitles us to pick any arbitrary moment within the time period denoted by *six weeks*, say t_i , and it is asserted by the AT operator that the embedded sentence is true. This embedded sentence in turn is another tensed sentence, which asserts that one state of affairs, expressed by the sentence ϕ is true now (i.e. at t), and its negation, $\neg\phi$ was true at the previous moment, which in this instance is t_{i-1} . Let us represent the truth conditions in the model graphically by writing a horizontal series of t 's representing successive moments in time proceeding from left to right, all within the bounds of *six weeks*. Under each t we will list the sentences true at that time.

- (76) $\dots t_{i-3}, t_{i-2}, t_{i-1}, t_i, t_{i+1}, t_{i+2}, t_{i+3}, \dots$
 $\neg\phi \quad \phi$

This is all well and good so far, but suppose we now pick t_{i-1} as the arbitrary moment. Because this is still part of *six weeks*, the embedded BECOME sentence must also be true then, namely, ϕ at t_{i-1} and $\neg\phi$ at t_{i-2} . Thus we have arrived at a contradiction: both ϕ and $\neg\phi$ are true simultaneously at t_{i-1} . In fact, if we compute the truth conditions for all t 's in the interval *six weeks*, the contradiction will be present at each moment in the interval except the very last one. The graphic representation would look something like (76').

(76') ... $t_{i-3}, t_{i-2}, t_{i-1}, t_i, t_{i+1}, t_{i+2}, t_{i+3}, \dots$



Thus this analysis accounts for the semantic anomaly of (74), and I think it accounts for it in an intuitively satisfying way: to say that John has been "discovering" a certain fact (or the existence of a certain object) throughout a period of six weeks would seem to entail that he has repeatedly not known and then come to know the very same fact, which is obviously a contradiction (barring memory loss).

Now consider the cases where there is a plural indefinite or mass noun in a sentence with an achievement verb, e.g., (77)

(77) John discovered $\left\{ \begin{array}{l} \text{fleas on his dog} \\ \text{crabgrass in his yard} \end{array} \right\}$ for six weeks.

There may be reason to assume that indefinite plurals and mass nouns are to be logically represented as involving variables whose binding existential quantifier lies within the scope of the time quantifier of the surface sentence in which they arise. Notice that (77) can be given the pseudo-logical paraphrase (78a) but not (78b):

- (78) a. For six weeks John discovered there to be some x such that x is crabgrass and is in his yard.
 b. *There is some x such that x is crabgrass and for six weeks John discovered x to be in his yard.

(77) would have a logical structure like (79):

(79) $(\bigwedge t: t \in \text{six weeks})(\bigvee x)[AT(t, \text{BECOME } [John \text{ knows} \dots x \dots])]$

Consider how the truth conditions for (79) might be satisfied in a temporal model. (79) will be true if for each t_i in an interval of six weeks' duration, there is some value for x that makes the BECOME sentence true. Since the existential quantifier binding x is within the scope of the temporal universal quantifier, the value for x may differ from one t to the next and indeed will have to to avoid contradiction. If we let x_i denote some value for x that makes the BECOME sentence in (79) true and let f represent the propositional

function "John knows that x is in his yard" at each time, then the conditions under which (79) would be true can be represented schematically as follows:

(80) ... $t_{i-3}, t_{i-2}, t_{i-1}, t_i, t_{i+1}, t_{i+2}, \dots$
 $\neg f(x_1) f(x_1)$
 $\neg f(x_2) f(x_2)$
 $\neg f(x_3) f(x_3)$
 etc.

Again, the analysis makes an intuitively sound claim about (77): if John has been discovering fleas on his dog or crabgrass in his yard for six weeks, then he must have been discovering new patches of crabgrass or new fleas on his dog all the time, not the same one over and over again. }x

With achievement verbs it does not matter whether the indefinite or mass noun occurs as subject or as object. Since both of these would occur within the scope of BECOME (which is in turn within the scope of the adverb), any indefinite plural or mass noun in the sentence will allow achievements to be used durationally. Accomplishments will be analyzed in such a way that the direct object noun phrase falls within the scope of a BECOME sentence (as in McCawley's analysis of *kill*), hence indefinite plurals and mass terms in the direct object position of accomplishment verbs are predicted to pattern in the same way as the subjects and objects of achievements with respect to durational adverbials. It is therefore not necessary to postulate an elaborate system of syntactic restrictions as Verkuyl (1972) does to account for these distributional restrictions.

Two qualifications must be made about this treatment. First, it may be objected that even the grammatical sentence *John has been discovering crabgrass in his yard for six weeks* does not mean that John has come upon something new at literally every single moment in a six-week period. If we are to use the universal quantifier to represent durational adverbs like *for six weeks* in a natural logic at all, then the moments it quantifies over must be something like "relevant psychological moments" which are both vaguely specified and also contextually determined. Notice that when we utter a sentence like (81) we seldom feel it necessary to qualify it as in (82).

- (81) I've done nothing for the past hour except read this damn book.
 (82) Well, actually that's not true, there's the two and a half minutes that I went to the bathroom, and the two thirty-second periods I spent looking out the window, and all those fractions of seconds I was blinking ...

To see that the relevant moments in a durational adverb are contextually determined, note that (83) is not odd in the same way as (84):

- (83) John has been working in San Diego for the last five years.
He usually spends his weekends at the beach.
- (84) ?John has been serving his prison sentence for the last five years.
He usually spends his weekends at the beach.

Because of our knowledge of facts about the real world, we know that the relevant moments included in *the last five years* in (83) do not include weekends, vacations, etc., whereas the relevant moments covered by the same quantifier in (84) are much more inclusive. I doubt that anyone would claim that the time adverb itself has a different logical structure in (83) and (84). I realize that "relevant psychological moment" may sound like a vague notion at this point, but it seems that we must either adopt it for the time being or else stop using the universal quantifier to represent durational adverbs. Note that in the analysis presented above the actual number of moments in an interval is not important; as long as there are at least two, then (75) is contradictory.

A second objection to the analysis would be that there are potential counter-examples to it in the form of sentences like (85):

- (85) John found his son's tricycle in the driveway for six weeks.

(85) appears to be well-formed, despite the fact that it contains an achievement verb, a durative time adverbial, and no indefinite plural or mass noun.

Part of the solution to this problem is that (85), on its acceptable reading, is understood to be elliptical, in that a second time adverbial of some kind is implicit:

- (85') John found his son's tricycle in the driveway

}	every day
	once a week
	frequently
	etc.

for six weeks.

That is, the different occasions of "finding" are separated by intervals. (The same observation should perhaps be made about (77), but this is only part of the difference.) I am not sure what the best way of handling this matter is.

A second difference between (85) and (75) is that *discover* in (75) is more likely to mean "come to know the existence of" whereas *find* in (85) is more likely to mean "come to know that NP is at x place at y time." Coming to

know the existence of something is a once-and-for-all event (barring memory lapse), whereas an object that reappears in unexpected places presents ever-new "facts" to be discovered. The nouns *buried treasure* and *tricycle* were thus not chosen at random; a buried treasure, once discovered, is not likely to surprise one a second time by reappearing unexpectedly, but a tricycle is just the kind of object that would. The main claim, that one does not discover the same fact more than once, still seems valid, and I think that this way of treating the anomaly of (74) vis-à-vis (77) is viable in spite of the problem of vagueness in durative adverbs.

2.3.4. Carlson's Treatment of 'Bare Plurals'

Though the treatment of indefinite plurals and achievements just given (which come from Dowty 1972) seems adequate as far as it goes, it leaves one important question unanswered: if it is correct to analyze an indefinite plural like *fleas* as involving an existential quantifier (i.e. as equivalent to *a flea* or *some fleas*), then just why must this quantifier have narrower scope than the durative adverbial? From what has been said, it might be supposed that the contradictoriness of the wide scope reading with an achievement verb is all that prevents this second reading from being apparent, but this is not so. Examples like (86) and (87) (from Carlson, 1977, p. 27) have stative and activity verbs respectively, yet the (b) sentences only appear to have readings in which this putative existential quantifier has narrower scope than the adverbial, while the (a) sentences with an explicit quantifier *a* or *some* clearly have a reading with the existential quantifier taking wider scope (as well as perhaps a less obvious reading with the quantifier taking narrower scope):

- (86) a. { A cat has } been here since the Vikings landed.
 b. Cats have been here since the Vikings landed.
- (87) a. { A tyrant } ruled Wallachia for 250 years.
 b. Tyrants ruled Wallachia for 250 years.

This is only the beginning of a long story, however. Carlson (1977) examines a number of quantifier-like constructions (negation, other NP quantifiers, durative and frequentative adverbs, aspectual verbs like *continue*, anaphoric constructions) that might be expected to bring out a scope ambiguity with