Philosophical Perspectives, 15, Metaphysics, 2001

REMARKS ON THE SYNTAX AND SEMANTICS OF DAY DESIGNATORS*

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I shall call an expression such as 'January 24, 2001' a *day designator*. The purpose of the present work is to discuss the syntactic and semantic properties of day designators.[1] Because my topic may seem very narrow to some, let me begin by discussing a few of the broader issues that thinking about the proper semantics of day designators brings to the fore. First, if one views semantics, as I do, as being at least in good part about how language attaches to reality, it becomes very important in formulating a semantic theory of an expression to think about the bit of reality that expression is used to talk about and how we interact with it. We shall see that giving careful consideration to how time is measured leads us to a semantic theory of day designators that we would be otherwise unlikely to propose. Thus I view the present work as a sort of case study illustrating the importance of attention to such details, which are much too often neglected, in proper semantic theorizing. Second, some philosophers think that all noun phrases in natural languages are either quantifier phrases or rigid referring expressions.[2] In what follows, I shall argue that day designators are non-rigid; I shall also argue (somewhat more tentatively) that day designators are not quantificational. If I am right, then natural languages contain non-rigid, non-quantificational expressions, contrary to the claim mentioned above. Further, and perhaps more importantly, the present study illustrates how to go about determining whether an expression is non-rigid and non-quantificational; and how delicate the issues are that one must face in making such a determination.

Let us begin by discussing the syntax of day designators and some of their syntactic constituents. First, there are the words 'January', 'February', and so on. Though these expressions are often called "names of months", there is good reason to hold that they are not names at all. Syntactically, these words behave as count nouns. They combine with determiners such as 'every', 'many', 'exactly three' etc. to form restricted quantifiers:[3]

(1) Every January I go skiing.

(2) I spent many Januarys at Squaw Valley.
(3) I wasted exactly three Januarys in Bakersfield.

Like other count nouns, they can take relative clauses in constructions such as (1)–(3):

(1a) Every January that you visited we went skiing.
(2a) I spent many Januarys that I will never forget at Squaw Valley.
(3a) I wasted three Januarys that seemed interminable in Bakersfield.

They also combine with the copula, indefinite article and adjectival modifiers to form predicates in the way that other count nouns do:

(4) The first full month I lived in Northern California was a pleasant July.

Further, it is generally held that only constituents of the same syntactic category can be conjoined. And as the following example shows, 'January' can be conjoined with other count nouns:[4]

(5) All Januarys and funerals last too long.

Thus distributional evidence strongly suggests that 'January', 'February', etc. are count nouns.

Since in general we take count nouns to express properties, we ought to take 'January', 'February' etc. to express properties as well.[5] We shall return to the question of what properties such words express below. For now, we shall stick with syntax.

Let us turn to the other syntactic constituents of day designators and the syntactic structure of day designators generally. Of course, numerals occur in day designators: one immediately following 'January' etc.; and another following the first and a comma. There is evidence that 'January 24' is a syntactic constituent of 'January 24, 2001', as the placement of the comma in day designators suggests. First, it is generally held that only "phrasal constituents" of sentences can serve as sentence fragments. Thus the acceptability of:

When will you be out of your office in 2001?
January 24.

suggests that 'January 24' is a phrasal constituent of 'You will be out of your office January 24, 2001.' And since 'January 24, 2001' is itself a noun phrase and so a syntactic constituent of the sentence, this suggests that 'January 24' is a phrasal constituent of the noun phrase 'January 24, 2001'. Further, only syntactic constituents can undergo coordination or conjunction. Thus, the acceptability of:

I will be out of my office January 23 and January 24 2002.

suggests that 'January 24' is a syntactic constituent of the above sentence, and hence of 'January 24, 2002'. Thus it would appear that 'January 24' is a syntactic constituent of the noun phrase 'January 24, 2002.' But what is *its* syntactic category?

As with the word 'January' itself, such phrases can be used to form restricted quantifiers ('Every January 24 is a holiday.'). And again like 'January', they can take relative clauses in such constructions ('Every January 24 that you visited was a holiday.'). Finally, once more like 'January', they can be used with the copula and modifiers to form a predicate ('The day you last visited was a very pleasant January 24.'). Other syntactically complex expressions that occur in constructions of this sort, such as 'woman who lives in St. Paul', are of the syntactic category N′. Thus, the distributional evidence suggests that phrases like 'January 24' are N′ constituents and so, like other N′ expressions, express properties. Finally, phrases like 'January 24' combine with "year numerals" to form day designators: noun phrases that designate days.

Syntactically, then, the picture that emerges is that the "month words" (e.g. 'January') are count nouns and so express properties. The concatenation of a month word and a "day numeral" (between 1 and 31) is a syntactically complex N′ expression and so once again expresses a property. The concatenation of such a "complex day expression" (e.g. 'January 24') with a "year numeral" ('1','2',...e.g. '2001') yields a noun phrase that designates a day: a day designator (e.g. 'January 24, 2001').

We must now address the much more difficult questions concerning the precise semantics of (some of) the syntactic constituents of day designators, and the semantics of day designators themselves. Let us begin with the month words 'January', 'February', etc. We have said these words express properties. Perhaps it would be best to ask what sorts of things are in the extensions of such words before turning to the question of what properties determine those extensions.

It seems to me that the things that possess the properties of being a January, being a February, etc. are certain (continuous 28–31 day long) intervals of time. For just as the sentence 'Every skier is happy' intuitively quantifies over skiers, and in so doing makes a claim about them, in virtue of the fact that skiers are in the extension of the property expressed by 'skier', so in (1)–(3) intuitively we seem to be quantifying over intervals of time and making claims about them. Intuitively, (1) claims that during all intervals of time of a certain sort ("Januarys"), I go skiing. Intuitively, (2) claims that I spent many intervals of time of a certain sort at Squaw Valley, and so on. If these intuitions are correct, and they certainly seem to be, 'January' etc. express properties of intervals of time, and these properties deliver sets of such intervals of time as the extensions for 'January', etc.

This view is supported by the fact that the following seems true:

(6) A January is a thirty-one day long interval of time.

But for this to be true, each thing in the extension of 'January' must have the property of being a thirty-one day long interval of time.[6]

An additional reason for thinking that 'January', etc. express properties of intervals of time is that sentences such as the following seem to be true:

(7) Every January is 31 days long.

Thus the things in the extension of 'January' have the property of being 31 days long. Now what sorts of things have this type of property? It seems that only time intervals and events or states have properties like this. Could the things in the extension of 'January' be states or events? Following Jaegwon Kim [1969, 1973], let us assume that events (and states) are objects instantiating properties at (or over) times (or objects standing in relations at (or over) times, etc.). Now what sort of events could be Januarys? That is, what object possessing a property at a time (or what objects standing in relations at a time) could be a January? Certainly no natural candidate suggests itself. By contrast, that Januarys are intervals of time *does* seem the natural view. Since there are no events that are natural candidates for being Januarys, since time intervals are natural candidates for being Januarys, and since the truth of (7) suggests that Januarys are events or time intervals, we have reason to adopt the view that they are indeed time intervals.[7]

Actually, this is not *quite* correct and a qualification is in order. Because of the different time zones on Earth, the exact thirty-one day time intervals that are Januarys, Februarys, etc. vary from time zone to time zone.[8] It was January 2000 in Oswego New York before it was January 2000 in Lake Tahoe California, and it was January 2000 in Lake Tahoe after February had already begun in Oswego. Thus the time interval that is January 2000 in Oswego is slightly different from the time interval that is January 2000 in Lake Tahoe. Hence, 'January' doesn't really express a property of time intervals; rather 'January in Lake Tahoe' does. Thus 'January' itself expresses a relation between locations on Earth (or time zones) and thirty-one day time intervals. Because of the small discrepancy between Januarys at any two locations on Earth, for most purposes we don't worry about this and act as though 'January' expresses a property of time intervals.

Having said all this, in the interest of simplicity I choose to ignore it and pretend that 'January' expresses a property of time intervals. Thus, what I say about 'January' etc. actually applies to expressions like 'January in Lake Tahoe'. So far as I can see addressing this complication by really treating 'January' as expressing a relation between locations on Earth and time intervals would be tedious but straightforward. Hence my opting to ignore the complication and pretend 'January' etc. express a property.

Returning to our main theme, what property of time intervals is expressed by 'January' and exactly what intervals of time are in its extension? We can get some idea of the property 'January' expresses by considering how 'January', 'February' etc. came to have the extensions they currently have. This, in turn, requires saying a bit about the history of the Gregorian calendar and the evolution of international time standards.

Pope Gregory XIII undertook to reform the Julian calendar shortly after he was elected Pope in 1572. He managed to implement his reform in 1582. That year, the day after October 4 was stipulated to be October 15, 1582. This was to counter the cumulative effect of the discrepancy between the average length of the Julian calendar year (including leap years every four years = 365.25 days) and the length of the "tropical year" (number of days required for Earth to move from the vernal equinox back to the vernal equinox again = 365.2422 days). This discrepancy had resulted in the vernal equinox occurring earlier and earlier in the Julian calendar year, occurring on March 21 in 325 A.D. and having moved back to March 11 by 1580. Stipulating that the day following October 4, 1582 would be October 15, 1582 insured that the vernal equinox would occur on March 21, 1583. Further, since the discrepancy between the average Julian calendar year and the tropical year was the result of the average Julian calendar year being too long, Pope Gregory XIII decreed that only centennial years (1600, 1700, 1800, etc.) whose numeral designations are divisible by four hundred are leap years. This has the effect of eliminating three leap days every four hundred years, rendering the discrepancy between the Gregorian calendar year and the tropical year quite small, (though future "corrections" will still be required to keep the vernal equinox on March 21!).

What does all this mean? Pope Gregory fixed the extensions of 'January', 'February' etc. by: 1) stipulating a "starting point": that a particular day is October 15, 1582; 2) implicitly specifying the number and order of the months in a year (by taking them over from the Julian calendar); 3) implicitly specifying the lengths (in days) of all months except February (by taking them from the Julian calendar); and 4) specifying an algorithm for determining the length (in days) of any subsequent February.[9] These four things suffice to determine which (future and past) time intervals are Januarys, Februarys, etc.

At least they *did* until very recently.[10] In the mid-1800's a standardized time was established for the United Kingdom. This time standard, Greenwich Mean Time (GMT), came to serve as the international time standard until 1972. From its establishment (along with the establishment of an international system of time zones) until 1972, GMT served as the basis for so-called "civil time", the "official" time in different time zones.

With the development of extremely accurate clocks in the mid-1900's it became clear that the rate of rotation of the Earth was not uniform.[11] Not only does it fluctuate during a given rotation, but the Earth is decelerating due to "tidal friction". GMT, of course, had been based on the rate of rotation of the Earth. In 1972, Coordinated Universal Time (UTC) displaced GMT as the in-

ternational standard on which civil time is based. UTC is determined by readings from a variety of atomic clocks around the world and runs at a rate determined by those clocks. Since, as mentioned, the rate of rotation of the Earth fluctuates over time and in general has been slowing, the time taken for one rotation of the Earth has been increasing slightly. Currently, the Earth takes 86,400.002 seconds to rotate. One day, twenty four hours, as measured by an atomic clock, is 86,400 seconds. If UTC were never adjusted, the discrepancy between the time taken for the Earth to rotate once and twenty-four hours as measured by atomic clocks would accumulate day after day. The result would be that as time passed "official times", as determined by UTC, would occur at different points in the Earth's rotation. Thus, noon (at a given location), as measured by the rotation of the Earth, would not occur at the official civil time, based on UTC, of 12:OOP.M. (at that location). This discrepancy would, of course, get larger and larger over time. The increasing discrepancy would make UTC a poor basis for civil time. To avoid this, when UTC was adopted as the basis for civil time, it was decided that it would never differ from universal time (UT1—more or less what used to be called 'GMT'), which is based on the rate of rotation of the Earth, by .9 seconds. The mechanism for keeping UTC within less than .9 seconds of UT1 is the "leap second".

The International Earth Rotation Service (IERS) anticipates when the absolute value of UTC-UT1 will be .9 seconds. They then add a leap second to UTC to prevent this from happening. The rate of rotation of the Earth is not predictable, being influenced by a number of complex factors.[12] Thus, the IERS must constantly observe and monitor the rate of rotation and on that basis predict when in the near future |UTC-UT1| would be .9 seconds were correction (via leap second) not to occur. In principle, a leap second can have a positive or negative value, depending upon whether the atomic clock-based UTC is ahead of rate-of-Earth's-rotation based UT1 (so that the Earth rotated "too slowly"—hence a positive value for the leap second) or whether UT1 is ahead of UTC. All leap seconds added to this point have had positive values, (UTC currently runs "too fast" relative to the rotation of the Earth by approximately .73 seconds per year and, as mentioned earlier, Earth is slowly decelerating).

When a (positive) leap second is added to the last day of a month, the last minute of the day has sixty one seconds, and the day itself lasts twenty three hours, fifty nine minutes, and sixty *one* seconds.[13] Thus the month is one second longer than the same month would be in a "non-leap second version" of the month. I wish to emphasize that a (positive or negative) leap second in principle can be added to the end of any month, depending on the observed and anticipated discrepancy between UT1 and UTC, (though the end of June and December are the favored times for adding leap seconds).

It is important to note that *both* as a result of the Gregorian reform of the Julian calendar *and* as a result of the adoption of UTC and the accompanying device of leap seconds, the words 'January' etc. came to have different extensions than they would have had had these events not occurred. The result of the

Gregorian reform was that e.g. time intervals in the extension of 'November' have subintervals that would have been part of what *would have been called* 'October' had the reform not occurred. And even after the Gregorian reform, the adoption of UTC and the device of leap seconds changed the extensions of 'January', 'February' etc. For consider the Gregorian calendar when UT1 (formerly GMT, more or less), rather than UTC, is used as the international time standard. Though UTC is kept within .9 seconds of UT1 by the device of leap seconds, there are generally small, variable discrepancies ($<$ .9 second) between UTC and UT1. Thus, UT1 and UTC will often disagree as to *exactly* when certain days, and hence months, end. Thus, time intervals in the extensions of 'January' etc. when used with the Gregorian calendar and UT1 (GMT) will differ slightly from the time intervals in the extensions of 'January' etc. when used with the Gregorian calendar and UTC. Thus, when UTC displaced GMT as the international time standard, the extensions of 'January' etc. changed slightly.

Thus the Gregorian reform of the calendar together with the adoption of UTC served to determine what now are the extensions of the terms 'January', 'February', etc. Given this account of the determination of the extensions of the terms 'January', etc., what *properties* ought we to say are expressed by 'January', etc.?

Since the principles introduced by the Gregorian calendar reform, (1)–(4) above, together with UTC and the accompanying device of leap seconds comprise the means by which 'January', 'February', etc. came to have the extensions they have, and since the properties expressed by these terms must determine their extensions, it is reasonable to think that (1)–(4) together with UTC and the accompanying device of leap seconds must in some sense characterize the properties expressed by 'January', 'February', etc. But in what sense do they do this? Suppose we spelled out (1)–(4) more explicitly, while adding to them features resulting from adopting UTC and the device of leap seconds, in the following way. Let 't' rigidly designate the second immediately following 11:59:59 P.M. on October 4, 1582 (Julian calendar). Then:

1′) October 15, 1582 is the twenty-four hour period (as measured by the rotation of the Earth) beginning at t.

2′) & 3′) A January prior to 1972 consists of 31 consecutive 23 hour 59 minute and 60 second intervals (as measured by the rotation of the Earth), and after 1972 consists of 31 consecutive time intervals the first 30 of which are 23 hour 59 minute and 60 second intervals and the 31st of which is a 23 hour 59 minute and 60 second time interval plus or minus 1 second (as measured by atomic clocks) depending on whether the discrepancy between UTC and UT1 would exceed .9 seconds were a positive or negative leap second not added to correct the discrepancy; and a January precedes a February, which in non-leap years prior to

1972 consists of 28 23 hour 59 minute and 60 second intervals (as measured by the rotation of the Earth), and after 1972 consists of 28 consecutive time intervals the first 27 of which are 23 hour 59 minute and 60 second intervals and the 28th of which is a 23 hour 59 minute and 60 second time interval plus or minus 1 second (as measured by atomic clocks) depending on whether the discrepancy between UTC and UT1 would exceed .9 seconds were a positive or negative leap second not added to correct the discrepancy; and which in leap years prior to 1972 consists of 29 consecutive 23 hour 59 minute and 60 second intervals (as measured by the rotation of the Earth), and after 1972 consists of 29 consecutive time intervals the first 28 of which are 23 hour 59 minute and 60 second intervals and the 29th of which is a 23 hour 59 minute and 60 second time interval plus or minus 1 second (as measured by atomic clocks) depending on whether the discrepancy between UTC and UT1 would exceed .9 seconds were a positive or negative leap second not added to correct the discrepancy; and which precedes a March, which...and which precedes a December, which... ; and which precedes a January.

4′) Any non-centennial year whose numeral's last two digits designate a number that is evenly divisible by four is a leap year. Centennial years are leap years iff their entire numerals designate numbers that are evenly divisible by four hundred.

Though somewhat unwieldy, 1′), 2′) & 3′) and 4′) together specify the extensions of 'January', etc.[14]

Given the way in which 2′) & 3′) characterizes Januarys, Februarys, etc. by reference to each other (Januarys precede Februarys etc.), it would seem that our "calendar theory" 1′)–4′) "implicitly defines" the month terms 'January', 'February', etc. in terms of each other and all at once. But then if we ask how to characterize e.g. January *by itself*, surely the strategy that suggests itself is to "define" 'January' (and 'February' etc.) *a la* David Lewis [1970, 1972]. We begin by (i) rewriting 1′)–4′) turning 'January' etc. into names (e.g. by replacing 'A January' by 'Something that has January-hood', etc.) and taking their conjunction; and (ii) replacing all the resulting "month names" ('January-hood', etc.) in this conjunction with distinct free variables.[15] Representing the result of (i) as T[January-hood, February-hood, ... , December-hood], the result of (ii) can be represented as $T[x_1,...,x_{12}]$. Then, still following Lewis, define 'January-hood', etc. as follows:

(J) January-hood$=\imath x_1 \exists x_2 ... \exists x_{12}\, \forall y_1 ... \forall y_{12}(T[y_1,...,y_{12}]$ iff $x_1=y_1 \& ... \& x_{12}=y_{12})$

This says that January-hood is the first element of the twelve-tuple that uniquely realizes the theory $T[x_1,...,x_{12}]$. Thus we would hold that 'January-hood' names (and so 'January' expresses) the property denoted by the definite description on the right side of (J).

But how do we know that there is a *unique* twelve-tuple of properties that realizes $T[x_1,...,x_{12}]$ in the actual world? After all, any twelve-tuple of properties whose members have the "right" time intervals (as dictated by $T[x_1,...,x_{12}]$) in their extensions *in the actual world* will realize $T[x_1,...,x_{12}]$ in the actual world, even if they fail to realize $T[x_1,...,x_{12}]$ in other possible worlds. If there is more than one such twelve-tuple, the description on the right side of (J) has no denotation (in the actual world) and (J) fails to supply a property for 'January' to express.

Further, even if we convinced ourselves that only one twelve-tuple of properties realizes $T[x_1,...,x_{12}]$ in the actual world, how could we show that only one twelve-tuple of properties realizes $T[x_1,...,x_{12}]$ in all (relevant) possible worlds? If different twelve-tuples of properties (uniquely) realize $T[x_1,...,x_{12}]$ in different possible worlds, then the description on the right side of (J) denotes different properties in different possible worlds. But then 'January-hood' *names* different properties in different worlds, and so 'January' *expresses* different properties in different worlds. This seems unwelcome.

We could do one of two things to address these worries about multiple realizations of $T[x_1,...,x_{12}]$ both in the actual world and across possible worlds. The first thing we might do is to "beef up" the right side of (J) to insure that the description denotes in the actual world. The formulation that immediately comes to mind is:

(JN) $\text{January-hood} = \imath x_1 \exists x_2 ... \exists x_{12}\ \forall y_1 ... \forall y_{12}\,(\text{Nec}(T[y_1,...,y_{12}])$ iff $x_1 = y_1 \& ... \& x_{12} = y_{12})$

This say roughly that January-hood is the first element of a twelve-tuple of properties that uniquely realizes $T[x_1,...,x_{12}]$ in all possible worlds. Recall that the description on the right side of (J) would fail to denote (in the actual world) if more than one twelve-tuple of properties had the "right" extensions (as dictated by $T[x_1,...,x_{12}]$) in the actual world. By contrast, the description on the right side of (JN) would fail to denote (in the actual world) if more than one twelve-tuple of properties gets the "right" extensions (as dictated by $T[x_1,...,x_{12}]$) across all possible worlds.

But how can we be sure that only one twelve-tuple of properties realizes $T[x_1,...,x_{12}]$ in all possible worlds? At this point, we might wish to junk (J), (JN) and their ilk and "go second order". That is, we could say that to be a January is to possess *some property or other* x_1 such that $\exists x_2 ... \exists x_{12} T[x_1,...,x_{12}]$. On this way of doing things, familiar from philosophy of mind, being a January would be a "second order property" that may well have different first order "realizers" in the actual world and in different possible worlds.

Going second order in this way is bound to solve the "multiple realization problem" (if there is one). And *perhaps* (J), (JN) or some other beefed up version of (J) will do in any case. Since we know we can get around the problem, I propose to ignore it henceforth and to talk as though (J) is fine as it is.

Whatever one may think of Ramsey-Lewis style definitions generally, it seems to me that this type of account of the properties expressed by 'January', etc. has a number of things to recommend it. First, 1′)–4′) is an account of the stipulations made by Pope Gregory and the features of UTC that secured the current extensions of 'January', 'February', etc. As we said, since these things together in fact secured extensions for the "month words", it is reasonable to think that they in some sense characterize or determine the properties expressed by these terms. The Ramsey-Lewis style account gives content to the idea that 1′)–4′) determine the properties expressed by the month terms. For their conjunction essentially is our calendar theory (T[January-hood, February-hood, … , December-hood]—except that the latter contains 'January-hood', etc. instead of 'January'). Clearly, this theory plays a central role in specifying the properties expressed by the month words, as a glance at (J) will confirm.

Second, the month words, and presumably the properties they express, seem "interconnected" in some way. This is reflected in the fact that we use the month words to characterize each other ('February follows January…', etc.) and so e.g. teach them to children as a group. Further, it seems plausible that to be competent with any one month term requires competence with them all. Finally, there is some inclination to think that one cannot be competent with month words or grasp the properties they express without having *some* grip on the calendar theory (T[January-hood, February-hood, … , December-hood]) or 1′)–4′). Because the calendar theory plays the same central role in characterizing each of the properties expressed by the month terms and in effect implicitly defines them, we capture the intuitive "interconnectedness" of properties expressed by 'January', etc. and the idea that to grasp such properties requires having some grip on the calendar theory.

Third, the account delivers the right extensions for the month words in the actual world.[16] If we consider (1)–(3) again, it does seem plausible that we are quantifying over continuous thirty-one day intervals that bear particular temporal relations to other continuous 28–31 day intervals and to the twenty-four hour period stipulated to be October 15, 1582. So our account of the properties expressed by the month terms seems to pick out the intervals of time that we in fact quantify over in (1)–(3).

Further, assuming that times are common to all worlds and that temporal relations between specific times remain the same in them (or at least restricting our attention to such worlds), and for the moment restricting our attention to worlds that are not too remote from our own in relevant respects (discussed below), definitions like (J) characterize properties that deliver the intuitively correct extensions in such possible worlds.[17]

First, consider a counterfactual situation in which the Gregorian reform of the calendar never occurred, (but which "contains" the same times that the actual world contains; and in which those times bear the same temporal relations to each other as they do in the actual world; and in which the Earth's rate of rotation at a given time is the same as in the actual world). In describing such a situation we would still take the extension of 'January' to be what it is in the actual world. Thus we would describe the situation as one in which e.g. they called part of January 'December'. But it is of course part of *January* that they are *calling* 'December'. And this is what our account predicts. It therefore correctly predicts that the sentence "If the Gregorian reform of the calendar had never occurred, we would have called part of January 'December'" is true.

Second, consider a counterfactual circumstance in which the Earth's position relative to the sun in what we call 'January' is exactly the same as the Earth's position relative to the sun when it is July in the actual world (and vice versa—and in which the Earth's orbit is otherwise the same as in the actual world; and again which "contains" the same times that the actual world contains; and in which those times bear the same temporal relations to each other as they do in the actual world; and in which the Earth's rate of rotation at a given time is the same as in the actual world). How would we describe this counterfactual situation? It is one in which in *January*, the Earth occupies the position relative to the sun that in the actual world it occupies in July; and in which in July, it occupies the position relative to the sun that in the actual world it occupies in January. Thus the extensions of 'January' and 'July' are the same set of time intervals in this counterfactual situation as they are in the actual world, just as our account predicts.

Thus far we have considered counterfactual situations in which the rate of rotation of the Earth at a given time is the same as it is in the actual world (and which "contains" the same times that the actual world contains; and in which those times bear the same temporal relations to each other as they do in the actual world). Thus, in the worlds considered thus far, 'January' etc. have had the same extensions as they do in the actual world. However, our account predicts that in worlds in which the Earth's rate of rotation is (slightly!—see below) different from what it is in the actual world, 'January' etc. will have (slightly) different extensions from their actual extensions. For exactly which intervals prior to 1972 are in the extension of 'January', and their lengths, depends on the rate of rotation of the Earth. And exactly which intervals after 1972 are in the extension of 'January' depends on the discrepancy between UT1 and UTC, where UT1 is based on the rate of rotation of the Earth and UTC is based on atomic clocks. But this means that our account predicts that in worlds in which the rate of rotation of the Earth is different than it is in the actual world, the extensions of the month words will be different. Thus we ought to see whether this prediction is borne out.

So consider a world that is just like ours with one exception: the rate of rotation of the Earth since 1972 has been completely uniform and unchanging,

(or the world is as much like ours as is possible, given the difference described). Each rotation takes *exactly* 86,400 seconds as measured by an atomic clock.[18] Thus, there is never a need to add any leap seconds to atomic clocks keeping track of UTC in this world. Our account of the property expressed by 'January' predicts that in this world all time intervals from 1972 on that are in the extension of 'January' are *exactly* 2,678,400 (31 × 86,400) seconds long. Of course, in the actual world, some time intervals between 1972 and now that are in the in the extension of 'January' are 2,678,401 seconds long, since (positive) leap seconds have in fact been added to the last days of some Januarys. Thus, our account predicts that the time intervals in the extension of 'January' in this world are slightly different from the time intervals in the extension of 'January' in the possible world under consideration, (assuming, as seems undeniable, that intervals of time possess their lengths essentially, so that one and the same interval of time could not have different lengths in different possible worlds). Now that you have been apprised of the facts, if you did not already know them, I think you will agree that the sentence

(8) Every January since1972 has been exactly 2,678,400 seconds long.

expresses a proposition that is false in the actual world, but true in the possible world under consideration. Now this requires that every thing (time interval) that possesses the property of being a January since 1972 in the possible world possesses the property of being 2,678,400 seconds long there; and that some thing that possesses the property of being a January since 1972 in the actual world fails to possess the property of being 2,678,400 seconds long. But then (again, assuming that intervals of time possess their lengths essentially), it follows that the extension of 'January' is different in the possible world in question than in the actual world. And this is, of course, what our account predicts about this case.

Similarly, the following sentence seems true:

(9) If every rotation of the Earth since 1972 had taken exactly 86,400 seconds, every January since 1972 would have been exactly 2,678,400 seconds long.

On one standard account of counterfactuals, for (9) to be true, the consequent must be true in the "nearest" possible world in which the antecedent is true. The nearest possible world in which the antecedent is true is the one described above. Thus, the consequent must be true in this world. For the reasons given above, this again requires 'January' to have a different extension in the world in question than it does in the actual world.

There is a final bit of evidence that suggests that our account is correct in predicting that in worlds in which the Earth's rate of rotation is slightly different than it is in the actual world the extensions of month words are different.

Kevin and Teresa are "time geeks". They carefully track differences between UT1 and UTC and eagerly anticipate the addition of leap seconds, throwing parties when this occurs. They knew that a leap second was to be added to the end of December 31, 1998. At precisely 11:59 and 60.5 seconds of December 31, 1998, in front of their hushed party guests who are viewing a clock precisely synchronized with UTC and registering official civil time (in their time zone), Kevin and Teresa clap their hands together once. As cheers and applause break out, Teresa gleefully screams:

(10) That event of clapping occurred in December, but had the Earth rotated slightly more quickly it could have occurred at exactly the same time but been in January.

Intuitively, what Teresa said is true! But this means that the instant of time at which the clap occurred is part of January in some world in which the Earth rotated slightly more quickly. And this in turn means that the extension of 'January' is different in that world than it is in the actual world.[19]

If we were to consider a possible world in which the Earth currently rotates slightly *faster* than it does in the actual world, considerations similar to those just canvassed would show that the extension of e.g. 'January' would be different in this world from what it is in the actual world.

Thus our account of the properties expressed by 'January', 'February' etc. delivers the correct extensions for these terms in this world and in various possible worlds which "contain" the same times that the actual world contains; and in which those times bear the same temporal relations to each other as they do in the actual world; and in which the Earth's rate of rotation (and "history of rotation") is close to what it is in the actual world.[20] But what about worlds that are more remote from ours? For example, what about worlds in which the Earth's rate of rotation and orbit are *very* different? Or worlds that don't contain the times of the actual world and in which those times are differently related to each other? I believe that we don't have clear intuitions about the extensions of our month words in such possible worlds. Our counterfactual talk about months and our evaluation of propositions about months takes place against the background of (if only tacitly) assuming that things are much like they are in the actual world in relevant respects (such as the rate of rotation of the Earth, etc.). To be sure, the properties we claim are expressed by the month words deliver extensions for these words in some worlds that are remote from ours in relevant respects.[21] But because we do not have clear intuitions about the extensions of these terms in such worlds, consideration of them will not provide evidence for or against the present account. Thus, I ignore such remote worlds here.

We now turn to the semantics of another syntactic constituent of day designators: N′ constituents such as 'January 24'. Let us begin as we did with the semantics of the month words, and ask what is in the extension of an N′ phrase

like ‘January 24’. Considerations exactly similar to those that suggested that ‘January’, etc. express properties of time intervals suggest that phrases like ‘January 24’ also express properties of time intervals. Consider the following sentences:

(11) Every January 24 is a holiday.
(12) I spent many July 4ths at the beach.

Intuitively, in (11) one is quantifying over certain twenty-four hour periods and in so doing making a claim about them to the effect that they are holidays. Similarly, in (12) I am quantifying over certain twenty-four hour periods and making a claim to the effect that many such periods were spent by me at the beach. This suggests that the concatenation of a month word and a numeral (between 1 and 31) is an N′ phrase that has as its extension a set of twenty-four hour periods and so expresses a property had by certain twenty-four hour time intervals.

Another reason for thinking this is that sentences such as

(13) Every January 24 is a twenty-four hour interval of time.

are true. But this requires things in the extension of ‘January 24’ to have the property of being a twenty-four hour interval of time.

In addition, sentences such as the following

(14) Every January 24 is twenty-four hours long.

are true. But this requires things in the extension of ‘January 24’ to have the property of being twenty-four hours long. And as we said earlier, it seems that only time intervals and events or states have properties like this. Since there are no events that are natural candidates for being January 24ths and time intervals are natural candidates for being January 24ths and the truth of (14) suggests that January 24ths are events or time intervals, we have reason to adopt the view that they are indeed time intervals. So, as was the case with ‘January’, this provides reason for holding that ‘January 24’ expresses a property of time intervals.

Intuitively, ‘January 24’ expresses the property of being the twenty-fourth consecutive continuous twenty-four hour period that is a subinterval of a time interval possessing the property of being a January. Thus in a “complex day expression” like ‘January 24’, the numeral tells us which consecutive continuous twenty-four hour time periods that are subintervals of a time interval that is a January are in the extension of the term.

From the fact that ‘January’ etc. have different extensions in different possible worlds it follows that ‘January 24’ etc. have different extensions. For consider a possible world, call it *w*, that is exactly like the actual world except that

from July 1997 to January 1999 the rotation of the Earth speeded up slightly so that on average it took exactly 86,400 seconds to rotate once during that period. Since a leap second was added to the end of June 1997, the discrepancy between UT1 and UTC was negligible at that point in both worlds. Thus, in January 1999 the discrepancy was still negligible in the possible world in question. In the actual world, the discrepancy was approaching .9 seconds by the end of December 1998. Thus a leap second was added to the end of December that year. But this means that there is a second, call it *s*, which was part of a December in the actual world and part of a January in w, (thus the extension of 'January' is different in the actual world than it is in w—in w there is a time interval containing s in the extension of 'January'; not so in the actual world.) Now consider 'January 1'. It has in its extension in w a twenty-four hour time interval that includes *s*. But no such time interval is in its extension in the actual world. Thus, 'January 1' has a different extension in w than in the actual world.

Further, this means that *all* complex day expressions have different extensions in w and the actual world. For *s* is the first second of a time interval in the extension of 'January 1' in w, whereas $s+1$ is the first second of the "corresponding" time interval in the extension of 'January' in the actual world.[22] Thus, the twenty-four hour time interval beginning with s and ending with, say, the second *t* is in the extension of 'January 1' in w; whereas the twenty-four hour time interval beginning with $s+1$ and ending with $t+1$ is in the extension of 'January 1' in the actual world. But then in w a twenty-four hour time interval beginning with $t+1$ is in the extension of 'January 2'; but not so in the actual world. Obviously, the same argument can be made for any complex day expression.

As was the case with 'January', intuitions about the truth and falsity in various possible worlds of the propositions expressed by certain sentences suggests that we are right in claiming that 'January 24' etc. have different extensions in different possible worlds. So consider again a world that is just like ours except that each rotation of the Earth since 1972 took *exactly* 86,400 seconds as measured by an atomic clock, (or the world is as much like ours as is possible, given the difference described). Thus, there has never been a need to add any leap seconds to atomic clocks in this world. Now consider the sentence:

(15) Every December 31 since 1972 has been exactly 86,400 seconds long.

The proposition expressed by this sentence is false in the actual world, because leap seconds have been added to some December 31sts making them 86,401 seconds long. But in the possible world in question, the proposition expressed by (15) is true! Again, (assuming time intervals have their lengths essentially) this means that 'December 31' has a different extension in this world and the actual world. For every time interval since 1972 in the extension of 'December 31' in the possible world has the property of being 86,400 seconds long and something in its extension in the actual world lacks this property.

Further, the following conditional seems true:

(16) If every rotation of the Earth since 1972 had taken exactly 86,400 seconds, every December 31 since 1972 would have been exactly 86,400 seconds long.

But this means that in the "nearest" possible world in which the antecedent of the conditional is true (i.e. the one under discussion), the consequent must be true. And, as we have seen, for this to be the case, the extension of 'December 31' must be different in the possible world in question than it is in the actual world.

At long last we turn to day designators themselves. The concatenation of a complex day expression ('January 1') with a year numeral ('1999') yields a noun phrase that designates a day: a day designator ('January 1, 1999'). Intuitively, it designates a twenty-four hour period that has the property of being a January 1 and that is a subinterval of the time interval (year) designated by '1999'. That 'January 1, 1999' designates a twenty-four hour interval of time is supported by the fact that the following sentence is true:[23]

(17) January 1, 1999 was a twenty-four hour interval of time.

The truth of (17) requires January 1, 1999 to possess the property of being a twenty-four hour interval of time. The claim that 'January 1, 1999' designates a twenty-four hour interval of time is also supported by the fact that if on December 31, 1998

I say:

(18) The twenty-four hour time interval beginning with the next occurrence of 12:00 A.M. and ending with following occurrence of 12:00 A.M. is January 1, 1999.

what I have said is true. But (18) appears to be an identity claim.[24] Thus its truth requires what 'January 1, 1999' designates to be identical with what the definite description denotes. And the description denotes a certain twenty-four hour interval of time. And of course, if 'January 1, 1999' designates a certain twenty-four interval of time, it certainly seems plausible that it is a twenty-four hour period that has the property of being a January 1 that is a subinterval of the time interval (year) designated by '1999'.

Now if what we have said to this point is correct, *different* twenty-four hour time intervals have the property of being a January 1 that is a subinterval of the time interval (year) 1999 in different possible worlds, and so 'January 1, 1999' designates different time intervals in different worlds. For consider again a possible world, w, that is exactly like the actual world except that from July 1997 to January 1999 the rotation of the Earth speeded up slightly so that on

average it took exactly 86,400 seconds to rotate once during that period. Recall that since a leap second was added to the end of June 1997, the discrepancy between UT1 and UTC was negligible at that point in both worlds. Thus, in January 1999 the discrepancy was still negligible in the possible world in question, and so there are no further leap seconds to be added. In the actual world, the discrepancy was approaching .9 seconds by the end of December 1998. Thus a leap second was added to the end of December that year. As we noted above, this means that there is a second, *s*, which was part of a December in the actual world and part of a January in w. Now consider 'January 1, 1999'. In w, this day designator designates a twenty-four hour time interval that includes *s*. In the actual world, it designates a twenty-four hour time interval that does not include *s*. Thus, 'January 1, 1999' designates different time intervals in these worlds. That day designators designate different time intervals in different possible worlds is supported by the fact that the following sentence expresses a proposition that is false in the actual world and true in the possible world in question:

(19) December 31, 1998 was exactly 86,400 seconds long.

But for that to be so, 'December 31, 1998' must designate intervals of time of slightly different lengths, and so slightly different intervals of time, in the actual world and the possible world in question. In addition, the following is true:

(20) If the rotation of the Earth had taken a constant and uniform 86,400 seconds from July 1997 to January 1999, December 31, 1998 would have been exactly 86,400 seconds long.

The truth of (20) requires that in the nearest possible world in which the antecedent is true (the one under discussion), the consequent is true. And as we have seen, this requires 'December 31, 1998' to designate a slightly different time interval in that world than it does in the actual world. Thus, as promised, we have established that day designators are not rigid designators.

There is additional evidence that supports the claim that day designators are modally non-rigid.[25] If what I have said is correct, there are worlds in which the interval of time d that 'December 31, 1998' *actually* designates exists and is not designated by 'December 31, 1998' (a slightly different interval being so designated). But then the following is true:[26]

(21) $(\exists x)$ (x = December 31, 1998 & Possibly(x exists & $\sim$(x = December 31, 1998)))

And it does appear that English analogues of this are true:

(21a) There is something/some interval of time that is December 31, 1998 and it is possible that it should have existed and not have been De-

cember 31, 1998 (some slightly different interval being December 31, 1998).

Further, the following sentence also seems true:

(22) December 31, 1998 was 86, 401 seconds long, but it is possible that December 31, 1998 should not have been 86,401 seconds long, (but 86,400 seconds long instead)

Now this sentence has the form

(22a) December 31, 1998 is F but Possibly (December 31, 1998 is not F)

where, if we are correct that day designators designate time intervals and that time intervals have their lengths essentially, 'F' expresses a property that is an essential property (being 86,401 seconds long) of what 'December 31, 1998' designates in the actual world. But then the truth of (22)/(22a) requires 'December 31, 1998' to be non-rigid. The second occurrence of 'December 31, 1998' must pick out a different time interval (one that is not 86,401 seconds long) in another possible world than the first picks out in the actual world. So here again, we have more evidence of the non-rigidity of day designators.

I suspect that many philosophers have thought that day designators are rigid.[27] Why have day designators seemed rigid? I think this illusion has at least three sources. First, I think many are not aware of, or have not thought about the implications of, the non-uniform rate of rotation of the Earth, UTC, leap seconds and so forth. Of course, the conclusion that day designators are not rigid depends heavily on considerations involving these things. Second, the overlap between the twenty-four hour time intervals designated by a day designator in this world and in worlds that are not too remote in the relevant respects is quite significant. It is plausible to suppose that the difference between the intervals designated in such worlds would not exceed, say, ten minutes.[28] And, as I mentioned earlier, our counterfactual talk about months and days takes place against the background of assuming that we are only considering worlds that are very similar to our in terms of the Earth's rate of rotation, etc. Thus, the very large overlap and small difference between the intervals designated by day designators in such worlds can reinforce the illusion that the *same* interval is designated in all such worlds.[29] Third, and related to the previous point, many have thought that the first of the two following sentences is necessary and the second is false (when uttered on February 21, 2001):[30]

(23) Today is February 21, 2001
(24) Today might not have been February 21, 2001.

The necessity of (23) and the falsity of (24) would be explained by holding that 'February 21, 2001' is rigid. For if 'today' rigidly designates February 21, 2001

when uttered on that day, and if 'February 21, 2001' is rigid, and if the 'is'/'have been' in the sentences express identity, then (23) expresses a proposition that is true iff February 21, 2001 is self-identical, and (24) expresses a proposition that is true iff February 21, 2001 might not have been identical to itself.

Of course, if the present view is correct and *if* 'today' as uttered on February 21, 2001 rigidly refers to the *exact* twenty-four hour time interval that in the actual world is February 21, 2001, then (23) is contingently true and (24) is true. I'm not sure how one would go about showing that 'today' when used on February 21, 2001 does or does not *semantically* (rigidly) refer to the *exact* twenty-four hour time interval that in the actual world is February 21, 2001. But what is clear is that 'today' when uttered on a given day is often used to *convey information* about a time interval bigger than or smaller than the exact twenty-four hour time interval that is the day in question. For example, suppose that I stay up until 12:05 A.M. on (the morning of) February 21, 2001, eat some food at that time and then go to bed. Feeling guilty when I wake up, I eat no more food that day. That evening, my friend, who was with me when I had my post-midnight snack and who has noticed that I haven't eaten since rising, says:

(25) You haven't eaten anything today.

This remark would be naturally interpreted by all parties as true in the situation as described, but I did eat during the twenty-four hour time interval that constitutes the day on which 'today' was uttered. Thus in (25) 'today' is used to convey information about a smaller time interval than that. Further, when I say:

(26) Today the United States is the most powerful nation on Earth.

my remark is naturally interpreted as about a time interval greater than the twenty-four hour time interval constituting the day on which (26) was uttered. So there is a certain looseness in what time interval an utterance of 'today' is used to talk about.

Further, as already mentioned, in any possible world very "close" to ours in relevant respects (and these are the worlds we concern ourselves with in evaluating our talk about months and dates in counterfactual circumstances), the twenty-four hour time interval that is February 21, 2001 overlaps very significantly with the time interval that in the actual world is February 21, 2001. These will differ by only a few minutes and so have twenty-three and fifty-some minutes in common. This means that over ninety-nine percent of the two intervals will be the same! The looseness of 'today' combined with the fact that any two time intervals designated by 'February 21, 2001' in worlds close to our in relevant respects will be over ninety-nine percent the same makes (23) seem necessarily true and (24) seem false. A further fact that contributes to this appearance is that when we ask e.g. how (24) could be true we tend to try to

imagine how the *entire* time interval that 'today' refers to (when used on February 21, 2001) could have been some day other than February 21, 2001. But the *entire* time interval that 'today' refers to when used on February 21, 2001 (whatever this time interval is exactly) could not have been (or been part of) some day other than February 21, 2001 in any world very close to ours in relevant respects. And so we tend to think that (24) is false.

That something like these explanations of why (23) seems necessarily true and (24) seems false are correct is supported by the following consideration. When we eliminate the looseness of 'today' and make clear that even small differences in largely overlapping time intervals matter, the intuitions cut the other way. Thus, suppose after explaining all the things I have explained about, leap seconds, UTC etc., I say (on February 21, 2001)

(27) So, we see that the *exact* actual twenty-four hour time interval that is the present day might not have been February 21, 2001 and some time interval differing from it by a second might have been.

It seems to me that this is clearly true! But it differs from (24) only in employing the (rigid) definite description 'the *exact* actual twenty-four hour time interval that is the present day' in place of 'today', thereby eliminating the looseness of 'today' and, by talking about exact (stressed!) twenty-four hour time intervals and intervals differing by only a second, making clear that small differences in time intervals matter. Similarly, in light of all I've said, the following seems only contingently true:

(28) The *exact* actual twenty-four hour time interval that is the present day is February 21, 2001.

Hence, we have an explanation of why (23) seems necessarily true and (24) seems false that is consistent with our claim that 'February 21, 2001' is not rigid.

Before turning to other matters, let us briefly and informally describe the contribution day designators make to propositions on the present view. Let m be a month word, d be a "day numeral" (1–31) and y be a "year numeral" (1,2,...2001,...). Then [md] is a complex day expression and [[m d] y] is a day designator. [[m d] y] contributes to propositions [m* d*] y*], where m* is the property expressed by m, d* is the number referred to by d and y* is a property that is uniquely possessed by the year long time interval that is the year y.[31] When a proposition containing [[m*d*]y*] is evaluated at a world w, this complex propositional constituent denotes the unique twenty-four hour time interval that in w possesses the property of being the d^{th} consecutive continuous twenty-four hour time interval that is a subinterval of a time interval possessing m* and that in w is a subinterval of a time interval possessing y*. Alterna-

tively, we could have [[m d] y] contribute to propositions the (uniquely instantiated) *property* of being the d^{th} consecutive continuous twenty-four hour time interval that is a subinterval of a time interval possessing m* and that is a subinterval of a time interval possessing y* (note that this is distinct from [[m* d*] y*], which is a complex "sub-propositional constituent" that has as constituents the property m*, the number d* and the property y*—see King [1995] and [1998] for discussion). The important point is that day designators contribute to propositions entities that determine which day they denote at a world. The *exact nature* of the entity is not important for present purposes.

Having argued that day designators are not rigid, a further question arises about their semantics. Philosophers of language who adopt an account of propositions according to which they are structured, sentence-like entities, an account of the sort that I presuppose here and have defended elsewhere, have suggested at least three ways in which noun phrases function semantically.[32] First, a noun phrase may be a device of direct reference, contributing only its referent (in a context) to the proposition expressed (in that context) by a sentence in which it occurs. Second, a noun phrase may a quantifier. General accounts as to the propositional contributions of quantifiers vary, but for present purposes we need not worry about this. Third, some hold that a noun phrase may contribute *both* its referent (in a context) to the proposition expressed (in that context) by a sentence in which it occurs *and* some descriptive condition that the referent (in that context) must satisfy at a circumstance of evaluation for the proposition to be true there.[33]

Now if the argument of the present paper is correct, day designators cannot function in the first or third ways just mentioned. Clearly, if day designators are not rigid, they cannot be directly referential. Nor can they function in the third way, again, because they are non-rigid and pick out different referents in different circumstances of evaluation. This means that the truth of propositions expressed by sentences containing them at different circumstances of evaluation cannot require some *one and the same* referent to satisfy some descriptive condition at the *different* circumstances in question. Thus, given the three ways of functioning outlined so far, this leaves only the option that day designators are quantifiers. And here an interesting question arises.

Quantifiers can have varying scope with respect to other scoped elements, whereas neither directly referring expressions nor expressions that function in the third way mentioned above ("articulated terms"/"partially descriptive names") admit of variable scope.[34] It is generally held that the explanation as to *why* natural language quantifiers can have variable scope is that in the mapping from surface structure to the level of syntactic representation whose representations are the syntactic input to semantics, quantifiers undergo "movement" and often can be "moved" to different sites, resulting in different scopes for the quantifiers. Names are generally held not to undergo such movement. Thus quantifiers have variable scope and names and "articulated terms"/"partially descriptive names" do not.

The question then arises whether there is any evidence that day designators undergo movement and have variable scope. If there is, then we have good reason to hold that they are quantifiers. However, if there is not such evidence, then it appears that day designators would be non-rigid designators that do not undergo movement and have variable scope. I shall call (still hypothetical) expressions of this sort *non-rigid terms* (henceforth *NRT*s). So far as I know, there are no non-controversial examples of NRTs in the literature. Indeed, as I mentioned at the outset, many philosophers of language lean toward the view, discussed by Neale [1993], that all natural language NPs are rigid singular referring terms or generalized quantifiers, ("articulated terms"/"partially descriptive names", if there are such, are rigid and refer; so they are rigid referring expressions).[35] Of course if day designators are NRTs, this view is incorrect. Thus, it is worth looking to see if there is evidence that suggests that day designators are quantificational or that they are NRTs. As we will see, it is surprisingly difficult to find evidence that definitively supports either claim. This, in turn, suggests that the question as to whether natural languages contain NRTs is a surprisingly subtle one.

Let us begin by looking at syntactic tests for movement of noun phrases. As suggested above, many philosophers and linguists subscribe to the view that the syntactic representations that are the inputs to semantics are distinct from, and somewhat more abstract than, the surface structures of sentences. Following the usage of Chomskyans, let us call the latter *S structure representations* and the former *LF representations*.[36] As noted above, one of the main differences between LF representations and S structure representations is that in the mapping to LF quantifier phrases are "moved" out of their argument positions and are adjoined to an S node, whereas names are not. So, for example, consider the following two S structures:

(29) $[_s[_{np}\text{Glenn}]\ [_{vp}[_v\text{loves}]\ [_{np}\text{Tracy}]]]$
(30) $[_s[_{np}\text{Every skier}]\ [_{vp}[_v\text{skis}]\ [_{np}\text{some steep chute}]]]$

Since names do not undergo movement, the LF representation underlying (29) is not really any different from (29). However, in (30)'s LF representation, both quantifiers will have been moved out of their argument positions surrounding 'skis', and will have been adjoined to an S node. This can occur is two ways, as follows:

(30′) $[_s[_{np}\text{some steep chute}]_2\ [_s[_{np}\text{Every skier}]_1\ [_s\ e_1[_{vp}[_v\text{skis}]\ e_2]]]]$
(30″) $[_s[_{np}\text{Every skier}]_1\ [_s[_{np}\text{some steep chute}]_2\ [_s\ e_1[_{vp}[_v\text{skis}]\ e_2]]]]$

These LF representations correspond to the two readings of (30) resulting from the quantifiers taking different scope with respect to each other.

Now it is thought that verb phrase deletion is only allowed where neither the missing verb nor its antecedent c-commands the other.[37] But examples like the following violate this condition at S structure:

(31) JC skied every chute that Shane did.

Here 'skied' c-commands 'did' (and hence the missing verb). But if quantifier phrases undergo movement in the mapping to LF, neither 'skied' nor 'did' will c-command the other at LF.[38] Thus if we assume that our condition on VP deletion must be satisfied only at LF, and that quantifiers move in the way indicated in the mapping to LF, (31) no longer constitutes a counterexample to the condition.

Since day designators do not take restrictive relative clauses, we cannot form a sentence of the form of (31) with a day designator in the place of the quantifier.[39] However, we can use non-restrictive relative clauses, and the result is unacceptable:

*(35) Albert dreaded July 12, 2001, which John did.

This would appear to suggest that day designators do not undergo movement in the mapping to LF as quantifier phrases do. However, instead it might be thought that the contrast between (31) and (35) reflects some difference between restrictive and non-restrictive relative clauses and not some difference in the behavior of quantifier phrases and day designators in the mapping to LF. This claim gains support from the unacceptability of the following sentence in which we have a definite description, which most philosophers take to be a quantifier phrase, instead of a day designator:

*(36) Jay feared the mayor of Chicago, who Erik did.

However, it is thought by some that the unacceptability of examples like (35) involving *names* (instead of day designators) does show that names do not undergo movement:[40]

*(37) Albert hated Alan, who John did.

Thus, either (35) and (37) show that names and day designators do not undergo movement (and some other explanation is given of (36)), or the contrast between them and (31) must be explained in terms of some difference between restrictive and non-restrictive relatives. So *perhaps* we have a slight bit of evidence that day designators do not undergo movement and so are NRTs, though it isn't entirely clear.

Another test used to detect the movement of NPs is to look for so-called "weak crossover effects". To illustrate, in the following sentences, the pronouns cannot be interpreted as anaphoric on the quantifier phrases:

(38) Its owner loves every ski.
(39) Their parents love all children.

(38) cannot be interpreted to mean that every ski is such that its owner loves it; and (39) cannot mean that all children are such that their parents love them. By contrast, in the following sentence, 'his' can be interpreted as anaphoric on 'Albert':[41]

(40) His mother loves Albert.

I shall not discuss the details of the explanation of the contrast between (38) and (39) on the one hand and (40) on the other. But it is generally held that the explanation makes essential reference to the fact that quantifiers undergo movement in the mapping to LF and names do not. Consider now examples containing day designators:

(41) Its events distinguished December 7, 1944.
(42) Its detractors who think the millennium begins in 2001 dismissed January 1, 2000.

(41) and (42) do seem to allow readings on which 'Its' is read as anaphoric on the day designators, (or at least co-referential with them). So this initially appears to show that day designators do not exhibit weak crossover effects and so do not undergo movement. This, again, would suggest that they are NRT's. The problem is that again we can find examples in which definite descriptions exhibit the same behavior:

(43) His appointees despise the governor of California.
(44) Its fierce winds distinguished the first hurricane of 2000.

Here too, we seem to get readings on which the pronouns are anaphoric on the definite descriptions, (or at least co-referential with them). As a result, again, it isn't clear how much evidence the data (41) and (42) provide in favor of the view that day designators do not undergo movement and so are NRTs. In considering lots of examples, it seems to me that sentences containing day designators almost never display weak crossover effects and that sentences containing definite descriptions sometimes do. This, if true, would support the view that day designators are NRTs. But the intuitions here are subtle.

Thus, the syntactic tests involving VP deletion and weak crossover effects *may* provide some evidence in favor of the view that day designators are NRT's. How strong that evidence is remains unclear.

Let us now turn to more "semantic" considerations. If day designators are quantificational, they should exhibit scope interactions with other quantifiers. In simple cases in which day designators occur with other quantifiers, we fail to detect scope ambiguities. Thus, the following sentences appear to have only one reading:

(45) Every American looks forward to July 4, 2005.
(46) Many professors dread October 1, 2007.

The lack of multiple readings in such cases might suggest to some that day designators are not scoped elements and so are non-quantificational. However, of course, there is another explanation of the lack of multiple readings in (45) and (46). If we suppose that day designators function somewhat like definite descriptions do, designating the unique thing satisfying certain descriptive conditions, then we should not expect multiple readings with different truth conditions in examples like (45) and (46). For neither do we get such readings in the following sentence:

(47) Every person in the restaurant stared at the man wearing the pink tie.

The reason, of course, is that whether the description takes wide or narrow scope relative to the quantifier 'Every person in the restaurant', we get the same truth conditions.[42] Thus the fact that we don't get readings with different truth conditions in (45) and (46) does not show that day designators don't have scope and so aren't quantifiers. Of course, neither does the lack of readings with different truth conditions support the view that day designators do have variable scope.

There is other data that might be thought to indicate that day designators engage in scope interactions with other scoped elements. On the view we have defended, the truth of the propositions expressed by sentences such as:

(48) July 4, 1998 was a holiday.
(49) Virginia went skiing on August 6, 1997.

requires there to be a unique day, satisfying certain descriptive conditions. In particular, (48) is true iff there is a unique day satisfying the descriptive conditions specified by 'July 4, 1998' and it was a holiday. Now consider sentences of the following form:

(50) September 3, 2000 is not F.

Since negation is an element with scope, if day designators have scope, we would expect instances of (50) to have two readings: one where negation takes wide scope and one where the day designator takes wide scope. These readings of (50) can be represented as follows:

(50a) Not [[September 3, 2000 x] x is F]
(50b) September 3, 2000x [Not[x is F]]

Because the day designator 'September 3, 2000' in fact designates a day, instances of (50a) and (50b) won't diverge in truth value. Both will be true iff the

day designated fails to be F.[43] However, for designators like 'September 31, 2000' that don't designate anything, one might think that instances of the following analogues of (50a) and (50b) *would* diverge in truth value:[44]

(50a′) Not [[September 31, 2000 x] x is F]
(50b′) September 31, 2000x [Not[x is F]]

For (50b′)'s truth requires a day to possess the property of being September 31, 2001 and not to be F. Whereas (50a′)'s truth merely requires it not to be the case that a day possesses the property of being September 31, 2001 and is F. But then (50a′) should be true since no day possesses the property of being September 31, 2001; and (50b′) should be false.

Thus if we could find instances of (50) containing a "non-denoting" day designator, some of which seem true and some of which seem false, that would provide evidence that such sentences have two readings corresponding to (50a′) and (50b′). But then this would be evidence that day designators have variable scope.[45] And we do seem to find such evidence. Both of the following seem true:

(51) September 31, 2000 is not next week. (spoken the week before October 1, 2000)
(52) September 31, 2000 is not a holiday.

And both of the following do not:[46]

(53) September 31, 2000 is not a day I will forget.
(54) September 31, 2000 was not sunny.

Thus (51)–(54) appear to provide some evidence that day designators have variable scope.

Similar remarks apply to the pair

(55) No person died on September 31, 2000.
(56) No hour passed quickly on September 31, 2000.

(55) seems true and (56) does not. This would be explained if (55) strongly favored wide scope for 'No person' and (56) favored narrow scope for 'No hour'. But this explanation assumes that day designators have variable scope.

Though the data comprising (51)–(56) initially appear to provide evidence for the claim that day designators have variable scope and so are quantificational, I don't think the data ultimately support this claim. For non-referring names exhibit behavior exactly like that of 'September 31, 2001' in (51)–(56). Such expressions do not have variable scope. But then data like (51)–(56) cannot provide evidence of variable scope. Thus consider:

(57) Vulcan is not behind the sun right now.
(58) That is not Vulcan. (pointing at Venus)
(59) No one has ever set foot on Vulcan.

All these sentences seem to have true readings and they are analogues of (51), (52) and (55). By contrast, the following sentences do not seem true and they are the analogues (53), (54) and (56):

(60) Vulcan does not have a molten core.
(61) Vulcan is not over 25,000 miles in diameter.
(62) No life exists on Vulcan.

Thus in (57)–(62) we have data that is exactly analogous to (51)–(56). Since the former is not taken to show that names have variable scope, the latter should not be taken to show that day designators do. Thus, (51)–(56) apparently do not, as they initially seemed to, provide evidence that day designators are quantificational.

There is other data that similarly may initially appear to provide evidence for the view that day designators undergo movement and have variable scope. When day designators combine with verbs of propositional attitude, they may seem to exhibit scope interactions with respect to such verbs. For example, imagine that Jay, who knows nothing of the Gregorian calendar, has been stranded on a remote island for years. He takes (what he thinks of as) various divine signs to mean that in twenty-one days, a ship will arrive to rescue him. Thus he believes on what is in fact August 2, 2001 that twenty-one days hence, he will be rescued. However, ignorant of the Gregorian calendar as he is, he has no beliefs about what the current month is, nor what month it will be in twenty one days. Now consider the following belief ascription:

(63) Jay believes that he will be rescued on August 23, 2001.

Is it true? It seems to me that we are ambivalent about its truth value. This ambivalence would have an explanation on the hypothesis that day designators can take wide or narrow scope relative to verbs of propositional attitude. On the wide scope reading of the day designator, arguably the belief ascription is true: concerning the day that satisfies the descriptive condition specified by 'August 23, 2001', Jay believes he will be rescued on it. But on the reading on which the day designator takes narrow scope relative to 'Jay believes', the ascription is false. For on that reading, the descriptive condition specified by 'August 23, 2001' is said to be part of the content of Jay's belief. And it is not.

By contrast, if day designators are NRTs, (63) in the situation described is false. For if day designators do not undergo movement, then (63) *must* attribute to Jay a belief whose content includes the descriptive condition expressed by

'August 23, 2001'. By hypothesis, Jay's belief includes no such thing. But then it appears that the view that day designators are NRTs has no explanation of our ambivalence about (63) in the case as described. It looks like we should be inclined to judge (63) straightforwardly false. In particular, then, to defend the view that day designators are NRTs, some explanation must be offered as to why we have some tendency to think (63) is *true*, and so end up ambivalent.

In defending the view that day designators are NRTs, it will not do *here* to respond that the same phenomenon (i.e. ambivalence in cases of the sort described) arises with *names*, which do not undergo movement or have variable scope. Let us see why. In our example, Jay has a belief about a certain day, which is in fact August 23, 2001, where he doesn't think of the day in question as August 23, 2001. Similarly, people sometimes have beliefs about a person who is in fact Ed, without thinking of that person as Ed. In such a case, we may be ambivalent about the truth value of a belief ascription ascribing a belief to such a person using a sentence containing the name 'Ed'. So if Virginia sees a man, Ed, running every morning and comes to believe he is healthy, but doesn't know his name and would not assent to the sentence 'Ed is healthy', we may be ambivalent about the truth value of:

(64) Virginia believes Ed is healthy.

Even if this right, the problem with appealing to this fact in defense of the claim that our ambivalence in the case of (63) doesn't cut against the view that day designators are NRTs is that on the dominant view of names, they are directly referential. So the embedded sentence in (64) expresses a singular proposition. If we assume that 'believes' expresses a relation between a person and a proposition, then (64) is true iff Virginia stands in the belief relation to the singular proposition that Ed is healthy. And in our story she does appear to believe this. So (64) is true. Thus, if we are really ambivalent about (64) in this case, since it is true, what is needed is an explanation as to why we have some tendency to think that (64) is *false*.[47]

And this is why to defend the claim that day designators are NRTs it does no good to appeal to our ambivalence about (64) in the situation as described. For since (64) is true, explaining the ambivalence here will require offering an explanation as to why we have some tendency to think it is false. But if day designators are NRTs, (63) is false in the situation described. And so explaining our ambivalence in this case requires offering an explanation as to why we have some tendency to think (63) is true. But presumably the sort of explanation offered for our tendency to think that (64) is false will be of no use in explaining our tendency to think (63) is true.

To be sure, we are assuming here that names are directly referential and that 'believes' expresses a relation between people and propositions. If we replaced these assumptions by others, the explanation of our ambivalence about (64) in the situation described could well be quite different; and perhaps we

could appeal to it in explaining our inclination to think (63) is true on the hypothesis that day designators are NRTs. But I shall not take this route, since I do not want the defense of the view that day designators are NRTs to rest on controversial claims about the semantics of names and 'believes'.

So assuming day designators are NRTs, why would we have some inclination to judge (63) true in the situation described? Well, 'August 23, 2001' designates a day, and Jay believes that he will be rescued on that day. (63), in spite of its literal falsity, conveys this truth. It is easy to see how (63) could convey this truth. We in effect ignore the descriptive conditions expressed by 'August 23, 2001' and focus on the day those conditions pick out. This is particularly easy to do, since we don't think of 'August 23, 2001' as having descriptive content in the way that 'the inventor of four buckle ski boots' does. The sentence then conveys true information about the day in question; and this gives us some inclination to think the sentence is true.

But why would we use literally false things like (63) to convey such truths? The answer is that day designators are the canonical expressions we use in talking about days. There are many reasons for this. First, they are relatively short expressions, and so convenient to use. Second, by means of these expressions, we can designate any day we wish. Third, day designators are not contextually sensitive so we can carry them across contexts and continue to designate the same day. Fourth, we all have calendars and we use them, or our knowledge of them, in planning our lives, talking about past and future events, etc. We count on the fact that others around us do the same. Thus, the use of a day designator "locates" the day being talked about relative to other days and makes that day easy to remember. For example, if five weeks and four days ago someone told me that he was leaving for Europe in exactly seven weeks and four days, even if I now remember exactly what he said, I may not be able to determine what day he is leaving. However, if he told me he was leaving on December 22, 2000 and if I now remember what he said, I know the exact day of his departure.[48] Fifth, and related to the previous points, day designators are particularly useful in describing sequences of events and the temporal relations between them. Imagine how history books would read if day designators were banned!

Given the fact that day designators are our canonical expressions for talking about days, in part because they serve to locate days in a way that allows us to retain and easily use information about the day, and because they are particularly useful in describing sequences of events and the temporal relations between them, it isn't at all surprising that we would use day designators in false sentences like (63) to convey truths about certain days by ignoring the descriptive content of the day designator. Indeed, to literally express the truth conveyed by (63) using non-contextually sensitive expressions (which we will often want to do, since e.g. we might be relating the facts in writing or wish to make Jay's beliefs easy to reconstruct in another context) we would have to resort to some awkward, cumbersome thing like 'The day we designate by 'August 23, 2001' is such that Jay believes he will be rescued on it.'[49] That this is

so makes it even less surprising that we would resort to the false (63) to convey the truth in question.

So I think that assuming that day designators are NRTs, we can see why we would use the strictly false (63) to convey the truth in question. In so doing, we end up ambivalent about (63)'s truth value. It is strictly false, but it is conveying something true.

Thus I don't think that considerations having to do with sentences containing verbs of propositional attitude provide much evidence for or against the view that day designators are NRTs. On both the hypothesis that day designators are quantificational and the hypothesis that they are NRTs, we can explain our ambivalence about (63) in the situation described. I would also add that given the flexibility and vagaries of our intuitions about the truth and falsity of belief ascriptions, I don't think such intuitions by themselves are very useful as evidence for or against semantic theories of the sort under consideration.

Let us summarize what the data considered thus far suggest. The syntactic tests involving VP deletion and weak crossover *perhaps* provided some evidence that day designators do not undergo movement and so are NRTs. There initially appeared to be evidence of scope interaction between negation and day designators, as well as between monotone decreasing quantifiers, such as 'No person', and day designators. But names exhibit behavior that is similar to day designators here, and so the behavior of day designators cannot be taken as evidence that they are quantificational and take variable scope. There also initially appeared to be some data providing evidence of scope interaction between day designators and verbs of propositional attitude. However, it turned out that the view that day designators are NRTs could explain the data as well. Thus, the range of data considered to this point probably slightly favors the view that day designators are NRTs. Still, it is perhaps surprising that the data have not come down more firmly on one side or the other.

However, at last we consider some solid evidence that day designators are NRTs. Consider sentences of the following form, where 't' is a singular term:[50]

(65) t might not have been t.

Some philosophers seem to think that Kripke's [1980] intuitive test for rigidity amounts to asking whether for a given singular term 't', instances of (65) have a true reading.[51] If not, so the story goes, 't' is rigid. If so, it isn't. Though there are passages in Kripke [1980] that *might* suggest such a thing (in particular, footnote 25 page 62), it is very unclear to me that Kripke endorses *this* test. His "official" formulations/examples of the intuitive test for rigidity make use of more complex sentences, such as 'No one other than Nixon might have been Nixon'; or 'Although the man (Nixon) might not have been president, it is not the case that he might not have been Nixon.', (Kripke [1980] pps. 48 and 49). These more complex sentences, because they contain quantifiers or anaphoric pronouns, raise issues not raised by sentences of the form (65). But I

have not found passages in Kripke [1980] that justify attributing to him the "test for rigidity" mentioned above involving the more simple (65).

In any case, given certain plausible and widely accepted assumptions, that (65) has no true reading for a given 't' does not show that 't' is rigid. In particular, assume that the modal element in (65) can be treated as a sentence operator (or at least something quantifiers can take wide or narrow scope with respect to), and that the element of negation is a unary sentence operator (that expresses the truth function of negation). So (65)'s "regimented surface structure" is:[52]

(65a) Possibly(not (t=t))

Now instances of (65) involving non-rigid definite descriptions have true readings, as witnessed by Kripke's example:

(65D) The teacher of Alexander might not have been the teacher of Alexander.

But the crucial point here is that this is as much a consequence of the fact that descriptions undergo movement and have scope (and so are quantifiers) as it is a consequence of the fact that the description here is non-rigid. *One* LF representation for (65D) (given the above assumptions about the modal element and negation) is:

(65D′) (The teacher of Alexander: x) Possibly (the teacher of Alexander: y (not (x = y)))

Since one occurrence of the description occurs outside the modal operator and one occurrence occurs inside, the different occurrences are allowed to choose their denotations from different worlds.[53] Given the description is not rigid, different individuals may be chosen in the different worlds, and in such a case we get a true reading of (65D). But it is only the fact that descriptions qua quantifiers undergo movement that yields an LF representation like (65D′) in which one occurrence of the description occurs inside the scope of the modal operator and the other occurs outside. Since descriptions undergo movement, they leave their argument places surrounding the identity predicate (leaving behind the "traces"/variables 'x' and 'y') and can end up at various sites, including those they occupy in (65D′).[54]

Now suppose 't' in (65) is an NRT. Since, by hypothesis, it doesn't undergo movement in the mapping to LF, (65)'s only LF representation will be no different from its (regimented) surface structure. Thus it will be

(65NRT) Possibly(not (t=t))

The occurrences of 't', since they do not undergo movement, must remain in their "argument" positions flanking the identity sign. But of course, (65NRT) is false, despite the non-rigidity of 't'! So for 't' an NRT, (65) will have no true reading.[55] Obviously, then, the fact that (an instance of) (65) has no true reading cannot show that 't' is rigid.

We have already established that day designators are non-rigid. The question that remains, and the one we are addressing, is whether they are quantifiers or NRT's. Consider the following sentence:

(66) January 24, 2001 might not have been January 24, 2001.

I cannot get a true reading of this sentence, even when I rehearse all the facts about leap seconds etc, that we have discussed. But if 'January 24, 2001' were non-rigid *and* a quantifier, (66) should have a true reading just as (65D) does. However, as we have seen, if 'January 24, 2001' were an NRT, (66) would have no true reading. Thus, the lack of a true reading for (66) provides evidence for the view that day designators are NRT's, (again, given that we have established that they are non-rigid). This is rather ironic, since, as mentioned, some have taken the lack of a true reading in a sentence like (65) (of which (66) is an instance) to indicate rigidity!

Interestingly, when we replace the first occurrence of 'January 24, 2001' in (66) by the description 'the time interval that is (identical to) January 24, 2001', the result has a true reading:

(66D) The time interval that is January 24, 2001 might not have been January 24, 2001.

After what we have covered regarding leap seconds etc., (66D) clearly seems to have a true reading, since some time interval slightly different from the one that was January 24, 2001 might have had that honor. But this again supports the view that the reason for the lack of a true reading for (66) is that day designators are NRTs and so don't move. For one would think that 'The time interval that is January 24, 2001' and 'January 24, 2001' co-refer in every possible world. And of course they are both non-rigid, if the present view is correct. Thus, the only difference between them is that 'The time interval that is January 24, 2001', being a quantifier, undergoes movement. This, in turn, makes possible the following LF representation underlying (66D):

(66D′) The time interval that is January 24, 2001:x (Possibly (not (x= January 24, 2001)))

And this, of course, is true when evaluated in the actual world. Thus, the data (66)–(66D′) appear to provide solid evidence that day designators are NRTs.

Similarly, consider

(67) December 31, 2000 might have been 86,401 seconds long.

Given everything I have said about UTC, leap seconds, etc., (67) seems obviously true. Though December 31, 2000 was 86,400 seconds long, if the Earth had rotated slightly more slowly (and so a leap second needed to be added), December 31, 2000 would have been slightly longer. By contrast, I cannot get a false reading for (67). But if 'December 31, 2000' were a quantifier and underwent movement, one LF representation corresponding to (67) should be

(67′) December 31, 2000: x (Possibly (x is 86,401 seconds long).

But (67′) is false! The time interval that in fact is designated by 'December 31, 2000' has its length essentially and so could not have had a different length from its actual length. So again, the fact that (67) appears to have *only* a true reading suggests that day designators do not have variable scope and so are NRTs. This claim again appears to be supported by the fact that the following sentence *does* appear to have a false reading

(67D) The time interval that is December 31, 2000 might have been 86, 401 seconds long.

(67D) appears to have a reading on which it expresses the false claim that the interval that in fact is December 31, 2000 might have had a length other than its actual length. Again, since descriptions can have variable scope, the following should be one of the LF representations associated with (67D)

(67D′) The time interval that is December 31, 2000: x (Possibly (x is 86,401 seconds long))

And (67D′) is of course false. As before, the fact that the sentence containing a description instead of a day designator, where both are non-rigid and coreferential in all possible worlds, has a reading where the sentence containing the day designator has no corresponding reading, and that supposing descriptions have variable scope and day designators don't would allow the former to have an LF representation that yields the reading but not the latter, provides strong evidence that day designators are NRTs. So it does appear as though the interaction of day designators and modal elements at last provides solid evidence that day designators are not quantifiers but NRTs.[56]

In closing, I wish to again emphasize the broader issues highlighted by the present case study. First, as we saw, that day designators are non-rigid is something we would not have noticed had we not payed careful attention to how time is measured, etc. Thus the present case highlights the importance, in con-

structing a semantic theory for a certain expression, of thinking about the portion of the world that the expression attaches to. Second, we saw that contrary to what a lot of philosophers believe, natural language contains NRTs. And we saw how subtle the data was that ultimately showed this and so how difficult this fact was to establish. Finally, I hope the present work illustrates a methodological point that has always been close to my heart: sound conclusions in philosophy of language require careful attention to detail.

Notes

*Thanks to the members of the Bay Area Philosophy of Language Discussion (BAPHLD) Group for reading an earlier version of this manuscript and making helpful suggestions. A (much shortened) version of this paper was presented to the Rutgers Semantic Workshop on the autumnal equinox 2000. I thank the participants in the workshop and my commentator Philippe Schlenker for their helpful comments. Thanks also to Kent Bach, David Copp, Mark Crimmins, Ron Pritchard, Mark Richard, Jason Stanley and George Wilson for helpful comments. Finally, thanks to Mark Wilson, whose way of thinking about semantics has influenced me deeply.

1. Henceforth I ignore the fact that such designators designate different intervals of time at different places on Earth. Hence what I subsequently say is more applicable to expressions such as 'January 24, 1999 in Los Angeles'. I don't think ignoring this complication affects any of the substantive issues I shall discuss. Below in the body of the text I discuss ignoring the analogous feature of the month terms 'January' etc. Finally, I ignore relativistic considerations in what follows.
2. E.g., Neale [1993] discusses and tentatively endorses this view. See my note 35 below.
3. Of course, as is the case with other quantifiers, context generally further restricts the range of quantification in some sense. When I say 'Every student did well on the exam' I generally don't intend to, and am not taken to, make an assertion about every student in the universe.
4. Any oddness one may find with (5) results from the fact that the sorts of things in the extensions of 'January' and 'funeral' are very different. For similar reasons, sentences like the following may sound slightly odd too:

   All virtues and country singers are overrated.

   The problem here is that it is hard to find a (clear case of a) count noun that has in its extension things that are (in some sense) similar to the things in the extension of 'January' (where the count noun isn't 'February', etc). Mark Richard suggested to me that the following is fine:

   'Most Januarys and (other) months I find depressing I snort Prozac.'

   It seems clear that 'months I find depressing' is a "count N′" (i.e. N′ whose head noun is a count noun) and 'Januarys' is coordinated with it. Thus 'Januarys' must be a count N′ whose head noun ('Januarys') is a count noun.
5. In saying this I am simply assuming that properties are the sorts of things that are the semantic values of count nouns. Some will suggest that 'January' sometimes

functions as a "name" of a *particular* period of time, as when I say 'In January, I am going to Lake Tahoe'. It seems to me that in such uses 'January' is in some sense a proxy for or elliptical for something like 'the upcoming January'. Indeed, when we look at larger prepositional phrases of which 'In January' is a part, it appears that 'In January' may have an additional argument place that needs to be filled by an expression specifying which January or Januarys are being talked about and which is elided in the sentence 'In January, I am going to Lake Tahoe'. The expression in question can specify a year ('In January 1979'; 'In January next year'; 'In January two years from now'; etc.) or quantify over them ('Every year in January'). If something like this is right, then it obviously supports the view that in the sentence 'In January, I am going to Lake Tahoe', 'In January' is elliptical for something like 'In the upcoming January'. It is also worth noting that month words seem to have something like "generic" uses, as in 'January is warm in New Zealand.' Such uses seem similar to uses exhibited by other count nouns, as in 'Man is a rational animal'. This provides more evidence that the month terms are count nouns.

6. Ron Pritchard pointed out to me that we take sentences like: 'Every January in Waterloo is cold' to be true. But on the present theory, the quantification here is over time intervals and so we are saying that these time intervals have the property of being cold. But it isn't clear that time intervals can have this property and so on the present theory it isn't clear why we should take such sentences to be true. However, Mark Richard notes that we also say things like 'Summer days in Davis are hot', (and take them to be true) but there doesn't seem to be any candidate for being a day that is a more plausible candidate for being hot than are time intervals. Perhaps what is going on in both cases is that we use expressions that pick out time intervals and contain expressions that refer to places (e.g., 'Every January in Waterloo' picks out time intervals (intervals that are Januarys-in-Waterloo) and contains a name that refers to a place ('Waterloo')) to convey claims about the air or environment in the place in question during the time interval in question.
7. For ease of exposition, I am assuming a theory of time according to which there really are instants of time and intervals of time that are independent of the events occurring in time. I believe that the main conclusions I wish to defend do not depend on this assumption, though without it the arguments I give for those conclusions would be somewhat different.
8. See note 1.
9. Pope Gregory simultaneously fixed the extensions of the "year numerals" '1583', etc., by these means. E.g. '1584' would have had as its extension a slightly different interval of time had it not been for Pope Gregory's reform.
10. Information on the topics I go on to discuss including UTC, leap seconds etc. is available on the websites of the United States Naval Observatory, the National Institute of Standards and Technology and the International Earth Rotation Service. These groups also have paper publications on these topics. I have benefited from these sources and from e-mail correspondence with Dennis McCarthy, Director of the United States Naval Observatory's Directorate of Time.
11. Here and throughout, when I talk about a rotation of the Earth, I am talking about a rotation of the Earth relative to the sun. Further, when I talk about the rotation of the Earth taking a certain amount of time, I am talking about the *average* time taken for the Earth to rotate once relative to the sun (a mean solar day), as measured by an atomic clock (where the seconds used as units are defined in terms of the

duration of a certain number of cycles of radiation corresponding to two hyperfine levels of the ground state of cesium 133). Similarly, *general* remarks about the Earth's rate of rotation are about the average rate of rotation relative to the sun.

12. In e-mail correspondence, Director of the United States Naval Observatory's Directorate of Time Dennis McCarthy characterized the rate of rotation of the Earth as "inherently unpredictable", apparently even being influenced by weather!
13. I *believe* that days that are twenty three hours fifty nine minutes and sixty one seconds long are properly said to be twenty four hours long. For the sixty one second interval that includes the leap second is said to be a minute (so that some minutes are sixty one seconds long, and were a negative leap second ever to be used, we would have a fifty nine second minute). But then such days are twenty-three hours sixty minutes long, and so, one would think, are twenty-four hours long. At any rate, henceforth, when I talk of days as twenty-four hour time intervals, I mean to include days that are twenty three hours fifty nine minutes and sixty one (or fifty nine) seconds long.
14. Or rather, 1′)–4′) specify the extensions of 'January', etc. given the rate of rotation of the Earth over time. If these facts are not "fixed" in the future, if it is *now* undetermined at what rate the Earth will rotate in the future, then it isn't clear that 1′)–4′) specify the *future* time intervals that are in the extension of 'January', etc. Here we encounter very deep issues in metaphysics that I will henceforth ignore; and so I will suppose that 1′)–4′) do specify which past, present *and future* time intervals are Januarys, etc.
15. (i) requires us to replace 'A January...' etc. by 'Something that has January-hood' etc. But 1′) introduces a complication because here we have 'October' occurring without the indefinite article ('October 15, 1582'). So we really should rewrite this as 'the 15th day in an October in 1582'. Further, for reasons having to do with what we want the Ramsification of our theory to do, we need to change 1′) in another way. As before, letting 't' rigidly designate the second immediately following the last second of October 4, 1582 (Julian calendar), what we need is something like this:

    > 1″) October 15, 1582 is the twenty four hour period (as measured by the rotation of the Earth) beginning at 12:00 A.M. (as measured by the rotation of the Earth) closest to t.

    I mention below why we need a formulation like this.
16. Except that we have to decide what to do about the odd October of 1582. My inclination is to think that the "October" of that year was an odd amalgamation of a Julian October and a Gregorian October. Thus, the "pure" Gregorian October of that year includes part of a Julian September. If this is correct, we need do nothing. Note that once we have implemented the Gregorian calendar, there is no reason not to count time intervals prior to its implementation as (Gregorian) Januarys, etc. Our theory in fact does this, and so makes good sense of sentences like: 'One million years ago, Januarys in the Finger Lakes region of New York were arctic-like'.
17. It was because we wanted the Ramsification of 1′)–4′) to play a role in delivering the correct extensions for our month words in other possible worlds that we had to alter 1′) in the way discussed in note 15 above. For we want to consider worlds in which the Earth behaved very much like it did in the actual world through October 4, 1582 (Julian calendar) except that it rotated *slightly* more slowly or more quickly. Though in the actual world, October 15, 1582 begins with the second t, in other

possible worlds it may begin at a somewhat different time. This is why in 1″) (note 15) we talk about the twenty-four hour period beginning at 12:00 A.M. *closest to t*. I assume here that we restrict our attention to worlds in which the twenty-four hour period beginning at 12:00 A.M. closest to t begins within, say, ten minutes of t and that this rotation of the Earth "corresponds" to the rotation of the Earth that in the actual world occurs on October 15, 1582. That is, in both worlds the Earth rotated the same number of times to this point. Below I briefly discuss the reason for this restriction.

18. As mentioned above, in the actual world the Earth presently takes 86,400.002 seconds to rotate, (and is slowing). This gives rise to a discrepancy between UT1 and UTC of approximately .73 seconds per year (365x.002). Thus a leap second needs to be added about once every 1.23 years.
19. Thanks to Mark Crimmins for suggesting this sort of example. It might be better to imagine Teresa saying, instead of (10), simply: 'That clapping event might have occurred at exactly the same time but been in January'. Perhaps intuitions are more robust with respect to this simpler sentence.
20. One sometimes reads things such as the following in books about the Roman, Julian and Gregorian calendars: 'December is the twelfth month, but its name tells us it was once the tenth, from the Latin 'decem'. Likewise, September, October and November were originally the seventh, eighth and ninth months, respectively.' (from *Pictorial Astronomy* (fifth revised edition), 1983, Climinshaw et al, Harper and Row, New York). And Mark Richard noted that it is natural to say things like 'If Gregory had put a leap year adjustment at the end of January, January would sometimes be 32 days long' and 'If Gregory hadn't changed the calendar, it would be December now (not January)', (spoken in the first week of January). Yet such things come out false on the current view. My temptation is to think that such remarks should be construed as "implicitly metalinguistic" Thus, the first sentence above should be construed as: 'The tenth month of the old Roman calendar was called "December".' And Richard's examples ought to be construed along the lines of: 'If Gregory had put a leap year adjustment at the end of the month he called 'January' (instead of the month he called 'February'—and left everything else the same), the month we would have called 'January' would sometimes be 32 days long'. I suspect that one of the reasons ordinary folk are so inclined to use (as opposed to mention) month terms in conveying metalinguistic assertions is that they think of month words as part of a system for talking about time that is completely arbitrary in the sense that it doesn't get at anything in the nature of time intervals (nor would any different system). There is no "correct way" to divide up time intervals. But ordinary folk tend not to think of many other property terms in this way. They tend to think that some things are really dogs and some are really cats, and so using the terms 'dog' and 'cat' to divide certain individuals up is far from arbitrary (though of course that we use the particular words 'dog' and 'cat' is arbitrary). Given that there is no correct way to divide up time intervals, it is easy to slip into thinking that in some deep sense there is nothing more to being a January than being called 'January'. But having slipped this far, it is easy to see why one would convey claims about what things are (or would be) called 'January', by talking about what things *are* (or would be) January.
21. Perhaps an account that simply didn't assign extensions to 'January' etc. in such worlds would be better. For one might think that if our counterfactual talk about

months and our evaluation of propositions about months really does take place against the background of assuming that things are much like they are in the actual world in relevant respects, then there is no fact of the matter about what the extensions of our month terms are in remote worlds. I am sympathetic to this idea, which is similar in spirit to ideas in the excellent Wilson [1982].

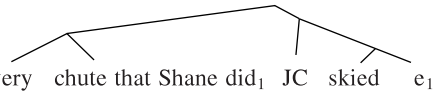
22. I use '$s+1$' and similar notation to designate the second immediately following *s*.
23. (17) is a bit pedestrian, and so may sound slightly odd. It helps to imagine it being uttered in response to someone *completely* unfamiliar with the Gregorian calendar, and perhaps calendars generally (say, a Venutian), asking 'What is/was January 1, 1999?'.
24. As Frege noted, identity statements are "reversible", whereas predications in which 'is' is used as the copula in general are not. Thus, 'Shane is the world extreme skiing champion' and 'The world extreme skiing champion is Shane.' are both fine; but the second of the pair 'Shane is happy' and 'Happy is Shane' sounds at least odd. And (18) is clearly reversible:

    (18′) January 1, 1999 is the twenty-four hour time interval beginning with the next occurrence of 12:00 A.M. and ending with following occurrence of 12:00 A.M.

25. Day designators *are* temporally rigid. That is, within a given world, a given day designator designates the same interval at all times in that world, (if we set aside worries about whether e.g. *now* 'January 24, 2444' designates a specific time interval, given that it is not now determined how fast the Earth will rotate for the next 444 years or so). So temporal and modal rigidity come apart in the case of day designators. Henceforth, talk about rigidity should be understood as being about modal rigidity.
26. Jason Stanley [1997] notes that the truth of sentences like the one to follow suffices to show that the expression occurring where 'December 31, 1998' does is not rigid.
27. Stephan McCaffery [1999], for example, explicitly defends the view that day designators are rigid.
28. This allows for worlds in which the rate of rotation of the Earth is currently a constant and uniform 86,400 seconds, worlds in which only negative leap seconds have been used, etc.
29. Though as Kent Bach pointed out to me, on the present view there are possible worlds which are very similar to the actual world in terms of the Earth's rate of rotation (and rotational history), but for which a *very* slight current discrepancy between the rate of rotation of Earth there and in the actual world would result in day designators designating different, *non-overlapping* twenty-four hour intervals in the two worlds in the far future.
30. For example, McCaffery [1999] claims this.
31. For simplicity, here we suppose that "day numerals" directly refer to numbers. This, of course, may not be the case for at least two reasons. First, numerals may not be mechanisms of direct reference. And second, there may not be any numbers; that is, it may turn out that the best way to understand what mathematics is about precludes our holding that numbers are "things" that can be referred to by singular terms. On the other hand, the considerations we have raised suggest that "year numerals" are non-rigid and so cannot directly refer to years. E.g. if two possible worlds differ only in that in one December 31, 1998 was 86,401 seconds long and ended with

second *s*, whereas in the other December 31, 1998 was 86,400 seconds long and ended with second $s-1$, '1998' designates slightly different year long intervals of time in the two worlds. Thus, we must have year numerals contribute to propositions properties of year long time intervals that are uniquely satisfied by different time intervals in different worlds.

32. See King [1995] and references there for the account of structured propositions I favor. I don't mean to suggest that all philosophers who adopt the structured proposition approach agree that each of the three semantic ways of functioning I discuss is such that some noun phrase functions in that way. I mean that in this tradition, for each of the three ways I shall discuss, someone in the tradition has claimed that some noun phrase or other functions in this way.
33. Scott Soames [2000] calls such expressions *partially descriptive names*. See Chapter Three. Mark Richard [1993] calls such expressions *articulated terms*, and holds that complex demonstratives are examples of articulated terms. Strictly, for Richard, in the general case, articulated terms contribute to propositions a referent, an "articulated content", and a relation. The truth of the resulting proposition at a circumstance of evaluation e requires the referent to bear the relation to the articulated content at e. In the case of complex demonstratives, the articulated content is something like a property (expressed by the N′ constituent of the complex demonstrative) and the relation is instantiation. Thus, the truth at a circumstance of evaluation e of a proposition expressed by a sentence containing a complex demonstrative (in a context) requires the referent (in that context) to instantiate the property that is the articulated content at e. So *in the case of complex demonstratives*, Richard's view amounts to saying that such a noun phrase contributes *both* its referent (in a context) to the proposition expressed (in that context) by a sentence in which it occurs *and* some descriptive condition that the referent (in that context) must satisfy at a circumstance of evaluation for the proposition to be true there. And this is the view under discussion in the body of the paper.
34. Or at any rate, I read Soames and Richard this way and so as holding that "articulated terms"/"partially descriptive names" do not have variable scope.
35. Neale [1993] actually defends the stronger claim that 'Every meaningful noun phrase (NP) in natural language is either a semantically unstructured, rigid referring expression (singular term) or else a semantically structured, restricted quantifier." (p. 90). In fairness to Neale, though he defends this claim in various ways, he only ends up endorsing the view that it is "...very much closer to being correct than many people think." (p. 91), and admits that it may ultimately be false (see pps. 91 and 109).
36. This isn't quite right, since for Chomskyans S structure is itself slightly more abstract in certain ways than real surface structure. But these subtleties don't matter here.
37. Roughly, α c-commands β iff the first branching node that dominates α dominates β and α does not dominate β.
38. If such movement occurs, the tree for the LF representation of (31) looks as follows:



It should be clear that neither 'skied' nor 'did' c-commands the other here.

39. That day designators don't take restrictive relative clauses might itself be taken as an indication that day designators are not quantifier phrases, since names and some other non-quantificational NP's do not take restrictive relatives:

    (32) *Al Gore who Jane admires is happy.
    (33) *I will ski tomorrow that is a holiday.

    However, quantifiers sometimes will not take restrictive relatives, as the following example shows:

    (34) *The current president of the United States who Jane loves is happy.

    It seems to me that the reason that day designators will not take restrictive relatives is that these relative clauses are always gratuitous. Day designators are guaranteed unique designations without such clauses. Thus the addition of gratuitous relatives clauses is infelicitous. This appears to be the problem with (34) as well.
40. E.g. Robert May [1985] claims this in Chapter 1.
41. Or, more cautiously, 'his' and 'Albert' can be understood as coreferring.
42. Of course if a definite description contains a pronoun, we can get truth conditional differences resulting from differences of scope. E.g. with respect to 'Every male skier loves the steepest run at his favorite mountain' there is a reading of the sentence on which 'Every male skier' binds 'his', so that the sentence is true iff every male skier loves the steepest run at that skier's favorite mountain (possibly different runs for different skiers). Here of course the description must take narrow scope with respect to 'Every male skier' so that the latter can bind the pronoun in the description. If the description is read as taking widest scope, then the pronoun cannot be bound by 'every male skier'. Thus the pronoun can be assigned a referent in context. Say it is assigned Greg. Then the sentence will be true iff every male skier loves the steepest run on Greg's favorite mountain. So here we get a truth conditional difference between wide scope and narrow scope readings of the description with respect to the universal quantifier. But this is only possible because definite descriptions allow restrictive relative clauses, and so can contain pronouns that can get bound by higher quantifiers. Day designators do not, and so there is no way to get a pronoun into a day designator. Hence we cannot get truth conditional differences of this sort with day designators.
43. For ease of exposition, I here and below talk sloppily of the truth of things like (50a) and (50b) rather than the truth of their instances.
44. Of course, one might hold that (50a′) and (50b′) don't express propositions at all. Perhaps one could hold that there is some sort of presupposition failure that has this result. I ignore such views here.
45. I shall not attempt to show that *one sentence* of the form of (50) (containing a non-denoting day designator) seems to have both a true and a false reading. Rather, I shall attempt to find an instance of (50) (containing a non-denoting day designator) that seems true and another instance that seems false (or at least doesn't seem true). See next note.
46. I don't say that the following sentences seem *false*. But this is similar to the case of definite descriptions. Certain sentences containing non-denoting descriptions and negation seem true, such as 'The present King of France is not under this table' (indicating a particular table), and so presumably the description is read as taking narrow scope. Others do not seem true, though it is a bit strong to say they seem

false, such as 'The present King of France is not bald'; and so presumably the description is read as taking wide scope. Apropos my remarks in the previous note, it is hard to find cases in which one and the same sentence of this sort seems to have both a true and a not true (or false) reading. But still, Russellians about descriptions take the fact that some sentences of this sort seem true and others not to indicate a scope ambiguity.

47. And direct reference theorists have offered such explanations. Scott Soames [1987], for example, in discussing a similar example notes that when we are inclined to judge (64) false in a situation of the sort I have described, it is because of the attitude the agent of the ascription has toward the embedded *sentence* in the ascription. Soames holds that the ascription is true in a case of the sort described, because Virginia does stand in the belief relation to the proposition expressed by the embedded sentence in (64). But (64) *suggests*, though it does not assert, that Virginia has a pro attitude towards the embedded *sentence* in (64). And of course she does not in the case as described. This inclines us to say that (64) is false in the situation described.
48. Sometimes there are reasons for favoring other day designating expressions. For example, sometimes I wish to locate a day relative to the present, as when I am trying to convey to you how long it will be from now until I leave for Europe. I might then say 'I leave in two weeks.' But if you are simply trying to say something concise about a day (other than today or yesterday) and you want your audience to retain and make use of what you say, and to locate the day you are talking about relative to other days, nothing beats a day designator.
49. It might be thought that 'August 23, 2001 is such that Jay believes he will be rescued on it' does the job. Of course, this is pretty cumbersome and awkward too. But if, as we are assuming, day designators are NRTs there is some reason to think that pronouns anaphoric on them are not rigid referring expressions. Let me cryptically remark that the fact the following sentence seems true suggests this: 'Concerning December 31, 1998, it is possible that it should have been 86,400 seconds long'. Thus, it is not at all clear that the above sentence says of the day designated by 'August 23, 2001', that Jay believes he will be rescued on it.
50. By 'singular term', I mean an expression that purports to designate (not refer to!) an individual. Thus, e.g. both names and definite descriptions are singular terms.
51. I have heard this many times in conversation. It appears in many, many places, including, for example, Dummett [1981], p. 580; Laporte [2000], p. 307; and More [1980], p. 327.
52. (65a) isn't really a surface structure, since scope relations between negation and the modal operator are explicitly represented. (65) might have another regimented surface structure. See note 55 below.
53. Of course, if we are evaluating (65D′) in the actual world, the first occurrence chooses its denotation from the actual world, and the second from another possible world. For simplicity, I talk here and below about evaluating LF representations like (65D′) at various possible worlds. I think that it is *propositions* that are evaluated at possible worlds, but I think sentences express propositions that are structurally identical to their LF representations, (see King [1995] and references there). So talking this way does no harm.
54. The descriptions could be moved to other sites as well. Thus there are other LF representations underlying (65D) and so it has other readings.

55. (65) might have another "regimented surface structure" corresponding to negation taking wide scope over the modal element as follows:

    (65b) not(Possibly(t=t))

    If 't' is an NRT and so doesn't move, then (65b) will be another LF for (65). But clearly (65b) cannot be true, and so will not yield a true reading for (65) (for 't' an NRT) either. So, again, if 't' is an NRT, (65) will have no true reading.

56. My argument that day designators are NRTs here involving (65)–(67D′) depends on a number of assumptions that some might deem false, in particular that the modal element in instances of (65) is a sentence operator, and that the only way for the NP in subject position in an instance of (65) to be outside the scope of the modal element at LF is for it to have been moved there by a movement rule that applies only to quantificational NPs (i.e. quantifier raising). If one denied this second assumption, one might hold that the subject NP in an instance of (65), *whether quantificational or not*, must appear outside the scope of the modal element at LF (on at least one reading of the instance of (65)). But then even if 't' is an NRT, this would yield a true reading of (65) contrary to what is claimed in the text, (since one occurrence of the NRT would be outside the scope of the modal element and one would be inside). Rather than debate these points, let me simply say that we could re-run my entire argument using the sentence:

    (65′) It is possible that t should not have been t.

    (and replacing each of (65)–(67D′) with its (65′) analogue). Here the modal element is explicitly a sentence operator; and it is very plausible to suppose that the only way for an occurrence of 't' to be outside the scope of the modal operator at LF is for it to undergo quantifier raising. The argument for the conclusion that day designators are NRTs that is exactly like the one given in the text except that it uses (65′) and its analogues thus doesn't depend on the controversial assumptions mentioned. Hence the conclusion stands even if these assumptions are rejected.

    Finally, if the assumptions in question are rejected and certain other views adopted (e.g. that the subject NP in an instance of (65) whether quantificational or not must appear outside the scope of the modal element at LF on at least one reading of the instance of (65)), perhaps whether instances of (65) have true readings or not could be resurrected as a legitimate test for rigidity, (though this would still not be true of (65′)). But these are all controversial questions! Thus, those who endorse testing for rigidity by asking whether instances of (65) have true readings or not should not simply blithely state and endorse the test, but should note that the claim that it is a good test rests on a number of controversial assumptions in linguistics. I thank Jason Stanley for raising questions that helped me get clear on these points.

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