Russell *and* Analytic Philosophy

Edited by

A.D. IRVINE *and* G.A. WEDEKING

UNIVERSITY OF TORONTO PRESS
Toronto Buffalo London

Toronto Buffalo London
Printed in Canada
Toronto Studies in Philosophy

ISBN 0-8020-2875-6

Printed on acid-free paper

Canadian Cataloguing in Publication Data

Main entry under title:

Russell and analytic philosophy

(Toronto studies in philosophy)
Based on a conference held at the University of British Columbia, June, 1991.
Includes bibliographical references and index.
ISBN 0-8020-2875-6

1. Russell, Bertrand, 1872–1970 – Congresses.
2. Analysis (Philosophy) – History – Congresses.
I. Irvine, A.D. II. Wedeking, G.A. (Gary A.).
III. Series.

B1649.R94R8 1993 146'.4 C93-094200-0

Contents

Preface

This anthology has its origin in a conference held at the University of British Columbia in June of 1991. The theme of the conference was "Russell and the Rise of Analytic Philosophy". Speakers at the conference included Ray Bradley (Simon Fraser), Michael Detlefsen (Notre Dame), Nicholas Griffin (McMaster), Graeme Hunter (Ottawa), Peter Hylton (Illinois, Chicago), Gregory Landini (Iowa), Bernard Linsky (Alberta), Jean-Pierre Marquis (Montréal), Stephen Neale (California, Berkeley), Michael Pakaluk (Clark), Judy Pelham (Concordia), Mark Sainsbury (King's College, London), Michael Scanlan (Oregon), Stuart Shanker (York), Robert Tully (St Michael's College, Toronto), and Gary Wedeking (UBC). This volume supplements thirteen of the papers presented at this conference with three additional ones: "The Power of Russell's Criticism of Frege" by Simon Blackburn (North Carolina, Chapel Hill) and Alan Code (Ohio State), "Russell's Strange Claim That '*a* exists' Is Meaningless Even When *a* Does Exist" by William Lycan (North Carolina, Chapel Hill), and "The Origins of Russell's Theory of Descriptions" by Francisco Rodríguez-Consuegra (Barcelona).

Of these sixteen papers, three have appeared previously but are being reprinted here for the first time in an anthology. We are grateful to Simon Blackburn and Alan Code for permission to reprint "The Power of Russell's Criticism of Frege", to Michael Detlefsen and *Philosophia Mathematica* for permission to reprint "Logicism and the Nature of Mathematical Reasoning", and to Francisco Rodríguez-Consuegra and *Russell* for permission to reprint "The Origins of Russell's Theory of Descriptions".

Generous financial support for the original conference was provided by

– [Forthcoming d] "A Comparison among the Theories of Descriptions by Frege, Peano and Russell", in preparation.
– [Forthcoming e] "Mathematical Logic and Logicism from Peano to Quine", in I. Grattan-Guinness (ed.), *Encyclopaedia of the History and Philosophy of the Mathematical Sciences*, London: Routledge.
Sainsbury, R.M. [1979a] *Russell*, London: Routledge.
Schilpp, P.A. (ed.) [1944a] *The Philosophy of Bertrand Russell*, 4th ed., La Salle, Ill.: Open Court 1971.
Skosnik, J. [1972a] "Russell's Unpublished Writings on Truth and Denoting", *Russell*, no. 7, 12–13.
Strawson, P.F. [1950a] "On Referring", in Klemke [1970a], 147–72.
Vuillemin, J. [1968a] *Leçons sur la première philosophie de Russell*, Paris: Colin.
Watling, J. [1970a] *Bertrand Russell*, Edinburgh: Oliver.
Weitz, M. [1944a] "Analysis and the Unity of Russell's Philosophy", in Schilpp [1944a], 57–121.
Welding, S.O. [1972a] "Russell's Theory of Definite Descriptions as Opposed to Quine's Singular Terms", *Revue internationale de philosophie*, **26**, 513–33.

5

Grammatical Form, Logical Form, and Incomplete Symbols[†]

STEPHEN NEALE

1. Introduction

It is not uncommon to find philosophers appealing to Russell's Theory of Descriptions when attempting to shed light on the *logical forms* of certain statements, perhaps the premisses or the conclusions of certain philosophical arguments. One philosopher might accuse another of committing a "substitution fallacy" by treating a particularly significant expression as a referring expression when really it is a description; or one philosopher might accuse another of committing a "scope fallacy" involving the interpretation of a description with respect to, say, a modal or temporal operator.

Curiously, it is less common for philosophers to construe Russell's theory as a component of a systematic and compositional semantics for natural language. Now I would have thought that it is only *because* the Theory of Descriptions can be construed as a component of a systematic semantical theory that philosophers are entitled to appeal to it in the ways they do. Consequently, I would maintain that there is an onus on anyone who wishes to appeal to the theory in explicating the logical forms of statements of English to be explicit about its role in a systematic semantics for English.

From a semantical perspective, the essence of the theory concerns *logical form* and *truth conditions*. Russell argued that descriptions are not genuine singular terms (genuine singular referring expressions). According to Russell, sentences containing descriptions are *inherently quantificational*: they express *general* (rather than *singular*) propositions. Specifically, the truth conditions of (the proposition expressed by) an utterance of a simple sentence of the form ⌜the *F* is *G*⌝ are given by the familiar expansion (1):

(1) $(\exists x_1)((\forall x_2)(Fx_2 \equiv x_2 = x_1)\ \&\ Gx_1)$.

For the purposes of the present paper, I will assume that Russell's theory is at least truth-conditionally adequate (a view I defended at length in *Descriptions*). What I shall be concerned with here is the view that (1) gives the "logical form" of $\ulcorner$the F is $G\urcorner$ and the matter of the logical forms of sentences more generally. By drawing attention to a distinction between grammatical form and logical form, the Theory of Descriptions helps to raise some important questions about the role of logical form in semantical investigations. Furthermore, reflecting on Russell's theory as a contribution to semantics helps with the formulation of some very good answers. In my view, we are unlikely to progress much further in our understanding of the semantics of natural language without a well-worked-out theory of logical form; and in view of the fundamental importance of natural language semantics to clear-headed philosophical inquiry, to my mind there is a pressing need for such a theory. As Russell stressed, much bad philosophy is the product of bad logical grammar.

Let me pose two questions straight away: (i) How should we understand the claim that the doubly quantified formula in (1) *gives the logical form* of $\ulcorner$the F is $G\urcorner$? and (ii) How is the claim that (1) gives the logical form of $\ulcorner$the F is $G\urcorner$ connected to Russell's conception of $\ulcorner$the $F\urcorner$ as an "incomplete symbol"? By addressing these questions I hope (a) to motivate a particular conception of logical form that borrows from philosophy and linguistics and promises to be of service to both, and (b) to help clarify the role of the Theory of Descriptions within a systematic semantical theory. (A related question is: (iii) How important is it that we view the implication relations between $\ulcorner$the F is $G\urcorner$ and *e.g.* $\ulcorner$an F is $G\urcorner$ and $\ulcorner$there is exactly one $F\urcorner$ as *formal*? Limitations of space prevent an adequate discussion of this question.)

2. Quantification and Logical Form

Often we say that a particular argument has such-and-such a *logical form*. For example, someone who infers from the truth of (2) and (3) to the truth of (4)

(2) Every farmer is happy
(3) Pierre is a farmer
(4) Pierre is happy

might be said to be endorsing an argument of the following logical form:

(5) $(\forall x_1)(Fx_1 \supset Hx_1), Fp\ /\therefore\ Hp$.

My primary concern here is not with the logical forms of *arguments* but with the prior notion of the logical forms of *sentences*. The philosophical logician might say that it is in virtue of being able to assign particular logical forms to the *sentences* (2), (3), and (4) that we are entitled to say that the *argument* from (2) and (3) to (4) has the logical form given in (5). And it is, perhaps, only a short step from here to the view that the logical forms of the sentences (2), (3), and (4) are given in the three formulae in (5), or rather, by formulae very like these.

In some sense, then, the notion of the logical form of an argument is dependent upon a well-understood notion of the logical form of a sentence. Furthermore, to provide a theory of the logical forms of the sentences of a natural language L is (I maintain) to make an important contribution to the project of constructing a systematic semantical theory for L. To specify the logical form of a sentence S is to specify its structure in a way transparently related to its meaning, transparently related to the proposition S expresses in a given context, transparently related to the world.[1] Ultimately, I would like to espouse the view that the logical form of a sentence S belonging to a language L is the structure imposed upon S in the course of providing a systematic and principled mapping from sentences of L (as determined by the best syntactical theory for L) to the propositions (or perhaps proposition types) those sentences express. As a point of departure and with an important caveat, I propose to adopt a perspective one finds in the work of Davidson and many of those he has influenced:[2] the logical form of a sentence S belonging to a language L is the structure imposed upon S in the course of providing a systematic and principled truth definition for L. For present purposes it will have to be taken on trust that it is possible to provide a systematic and principled truth definition for a substantial fragment of English. My main efforts will be directed towards one way of cashing out the idea that there is a level of syntactical representation that satisfies this constraint on logical form and possesses other properties that philosophers have traditionally ascribed to logical form.[3] The first step in all this involves saying something about the nature of quantification in natural language.

When philosophers want to characterize the logical form of a quantified English sentence S, typically they will attempt to provide a sentence of some version of the first-order predicate calculus, a sentence that has the same truth conditions as S. From the perspective I am adopting here, reliance on the calculus brings up a variety of well-known logical puzzles involving such things as systematicity of translation, plurality-quantification, branching quantification, and donkey anaphora.[4] It is not necessary to venture very far in order to see that we need a more refined system than the standard calculus if we are to think of logical form as playing a serious role in a systematic semantics. In the calculus, in order to characterize the "logical forms" of sentences like (6) and (7):

(6) Some farmers are happy
(7) Every farmer is happy

we have to introduce sentential connectives as well as quantifiers, as in the translations (8) and (9):

(8) $(\exists x_1)(\text{farmers}(x_1)\ \&\ \text{happy}(x_1))$
(9) $(\forall x_1)(\text{farmer}(x_1) \supset \text{happy}(x_1))$.

And, if we buy into Russell's Theory of Descriptions, the logical form of (10) will be given by (11), which contains two quantifiers and two connectives, further obscuring the relationship between surface syntax and logical form:

(10) The farmer is happy
(11) $(\exists x_1)((\forall x_2)(\text{farmer}(x_2) \equiv x_2 = x_1)\ \&\ \text{happy}(x_1))$.

There is a worse problem, however: there are syntactically simple, quantified sentences that cannot be handled within the calculus at all. (12) is such a sentence:

(12) Most farmers are happy

because "most" is not definable in first-order logic, even if attention is restricted to finite domains.[5] (It should be stressed that this fact by itself does not undermine truth-theoretic semantics.)

A familiar way to solve all of these problems simultaneously is to view natural-language quantification as *restricted*. A simple modification of the predicate calculus will serve our purposes. Call the resulting language RQ. In RQ, a determiner is an expression that combines with a formula to create a restricted quantifier.[6] For example, "some$_1$" combines with, say, "farmers x_1" to create the restricted quantifier given in (13):

(13) $[\text{some}_1\ \text{farmers}\ x_1]_1$.

This quantifier may combine with a second formula such as "happy x_1" to form a formula as in (14):

(14) $[\text{some}_1\ \text{farmers}\ x_1]_1\ (\text{happy}\ x_1)$

where the semantics of RQ (see below) ensures that (14) is equivalent to (8).

In order to provide a truth definition for RQ, we need first to specify its syntax clearly: to this end we can modify the formation rules of a standard first-order language. We replace the rules specifying that if a is a well-formed formula then so are $\ulcorner (\forall x_k)\alpha \urcorner$ and $\ulcorner (\exists x_k)\alpha \urcorner$ with the following (for any $k \geq 1$):

(Q1) If α is a well-formed formula and D is one of (*e.g.*) "every", "all", "each", "a", "no", "some", "most", then $\ulcorner [\mathrm{D}_k\ \alpha]_k \urcorner$ is a well-formed restricted quantifier phrase.
(Q2) If β is a well-formed formula and $\ulcorner [\mathrm{D}_k\ \alpha]_k \urcorner$ is a well-formed restricted quantifier phrase, then $\ulcorner [\mathrm{D}_k\ \alpha]_k\ \beta \urcorner$ is a well-formed formula.

Second, we specify conditions on binding and scope in RQ. There are two types of variable-binding operator to worry about: determiners and restricted quantifiers. A determiner $\ulcorner D_k \urcorner$ is really an unrestricted quantifier that binds any free occurrences of $\ulcorner x_k \urcorner$ in the formula a with which it combines to form a restricted quantifier. And a restricted quantifier $\ulcorner [\mathrm{D}_k\ \alpha]_k \urcorner$ binds any free occurrences of $\ulcorner x_k \urcorner$ in the formula β with which it combines to form a formula. The scope of a variable-binding operator (or any other expression) is just the expression (or expressions) with which it combines to form a well-formed expression, exactly as in the first-order predicate calculus.

Finally, we can supply a truth definition for RQ. For each proper name we provide an axiom similar to the following axiom for "Russell":

(i) Ref("Russell", s) = Russell.

This says that the referent of "Russell" with respect to an arbitrary sequence (or assignment) s is Russell (for simplicity, I shall suppress universal quantification over sequences, terms, and formulae throughout). For individual variables $\ulcorner x_k \urcorner$, we will have the following axiom schema:

(ii) Ref($\ulcorner x_k \urcorner$, s) = s_k

which says that the referent of ⌜x_k⌝ with respect to a sequence s is the k-th element of s.

For each one- or two-place predicate there will be an axiom similar to one of the following:

(iii) s satisfies ⌜t snores⌝ iff Ref(t, s) snores
(iv) s satisfies ⌜t admires u⌝ iff Ref(t, s) admires Ref(u, s)

where t and u are terms (*i.e.* names or variables).

The first recursive axioms, for connectives, are also no different from the analogous axioms in the predicate calculus. For example, for "&" we get the following:

(v) s satisfies ⌜α & β⌝ iff s satisfies α and s satisfies β.

We can replace the unrestricted quantifier axioms of a Tarski-style truth definition for a standard first-order language by axioms appropriate for restricted quantifiers:

(vi) s satisfies ⌜[every$_k$ α]$_k$ β⌝ iff every sequence satisfying α and differing from s at most in the k-th place also satisfies β.
(vii) s satisfies ⌜[most$_k$ α]$_k$ β⌝ iff most sequences satisfying α and differing from s at most in the k-th place also satisfy β.

As usual, a sentence is true iff it is satisfied by all sequences.

In a standard first-order language, no expressive power is obtained, of course, by introducing the existential quantifier as a primitive quantifier when the language already contains the universal quantifier and negation. Similarly, the expressive power of RQ is not increased by introducing a new determiner "some" along with the following axiom:

(viii) s satisfies ⌜[some$_k$ α]$_k$ β⌝ iff at least one sequence satisfying α and differing from s at most in the k-th place also satisfies β.

But introducing (viii) makes it easier to translate sentences of English into RQ; let's add it, then, along with parallel axioms for "no", "each", and "a". And let's say (informally for now) that sentences of RQ "give the logical forms" of the English sentences with which they are paired. This will, of course, need to be justified because I am subscribing (as a first shot) to the view that the logical form of a sentence S of a language L is the structure imposed upon S in the course of providing a systematic and principled truth

definition for L. An account is still needed of how, for example, (14) can be viewed as the structure imposed upon (6) in the course of discharging this obligation. Before addressing this matter, I need to say a few things about the expressive power of RQ and about Russell's account of definite descriptions.

The formal language RQ can be used in a systematic way to perspicuously and unambiguously capture the "logical forms" of sentences with more than one operator. For example, the negation sign "¬" can be prefixed either to the entire sentence, as in (15), or to the open sentence that contains the predicate, as in (16):

(15) ¬[every$_1$ farmer x_1]$_1$ (happy x_1)
(16) [every$_1$ farmer x_1]$_1$ ¬(happy x_1).

Quantifications on non-subject positions and multiple quantifications can also be represented in RQ. For instance, the alleged scope ambiguity in

(17) Every farmer milked some cows

is captured as follows:

(17_1) [every$_1$ farmer x_1]$_1$ ([some$_2$ cows x_2]$_2$ (x_1 milked x_2))
(17_2) [some$_2$ cows x_2]$_2$ ([every$_1$ farmer x_1]$_1$ (x_1 milked x_2)).[7]

In (17_1) and (17_2) a quantifier combines with an open sentence that is itself the product of combining a quantifier with an open sentence.

Before hooking all of this up with surface syntax, I want to bring definite descriptions back into the picture and also highlight some important points about Russell's conception of incomplete symbols more generally, especially in connection with the notion of logical form.

3. Formal Properties of the Theory of Descriptions

According to the Theory of Descriptions, the truth conditions of a simple sentence of the form "the F is G" are given by (18):

(18) $(\exists x_1)((\forall x_2)(Fx_2 \equiv x_2 = x_1) \,\&\, Gx_1)$.

As I said at the outset, I am not going to consider objections to the truth-conditional deliverances of the theory. Rather, I want to consider objections to, and issues raised by, what we might call its *formal* properties. For even among those who profess allegiance to the theory's truth-conditional content, there is sometimes resistance to (i) the idea that (18) reveals the logical form of $\ulcorner$ the F is G $\urcorner$, (ii) the idea that descriptions may take various "scopes", and (iii) the idea that descriptions are "incomplete symbols". In my view, such resistance is based on either a failure to separate the essential from the inessential formal features of the theory or else a failure to grasp the nature of the connection between logical form and semantics.

In *Principia Mathematica*, a definite description $\ulcorner$ the F $\urcorner$ is represented by a term of the form $(\iota x_1)(Fx_1)$, which might be read as "the unique x_1 such that (Fx_1)". On the face of it, then, the *iota*-operator is a variable-binding operator for creating terms from formulae: a simple one-place predicate symbol G may be prefixed to a description $(\iota x_1)(Fx_1)$ to form a formula $G(\iota x_1)(Fx_1)$. For Russell, descriptions were really just abbreviatory devices that enabled him to simplify his formulae and shorten his proofs: $G(\iota x_1)(Fx_1)$ is ultimately to be understood as (18) above.

On the face of it, complications seem to arise because of matters of scope. The formula (19)

$$(19) \quad \neg G(\iota x_1)(Fx_1)$$

is ambiguous as there is not, on Russell's account, a unique formula for which it is an abbreviation:

$$(19_1) \quad \neg(\exists x_1)((\forall x_2)(Fx_2 \equiv x_2 = x_1) \mathbin{\&} Gx_1)$$
$$(19_2) \quad (\exists x_1)((\forall x_2)(Fx_2 \equiv x_2 = x_1) \mathbin{\&} \neg Gx_1).$$

When working with the *iota* notation, ι, Whitehead and Russell adopt an awkward device for representing what they call the "scope" of a description. In effect, the description is recopied within square brackets and placed immediately to the left of the formula within its scope. Thus (19_1) and (19_2) are represented as (19_3) and (19_4) respectively:

$$(19_3) \quad \neg[(\iota x_1)(Fx_1)]\, G(\iota x_1)(Fx_1)$$
$$(19_4) \quad [(\iota x_1)(Fx_1)]\, \neg G(\iota x_1)(Fx_1).$$

In (19_4) the description has a "primary occurrence" by virtue of having scope over the negation; in (19_3) the description has a "secondary occurrence" by virtue of lying within the scope of the negation.

The main proposition of the Theory of Descriptions is *Principia Mathematica* *14.01:

$$*14.01 \quad [(\iota x_k)(Fx_k)]G(\iota x_k)(Fx_k) \;=_{\text{df}}\; (\exists x_i)((\forall x_k)(Fx_k \equiv x_k = x_i) \mathbin{\&} Gx_i)$$

By successive applications of *14.01 and *14.02

$$*14.02 \quad E!(\iota x)(Fx_k) \;=_{\text{df}}\; (\exists x_i)((\forall x_k)(Fx_k \equiv x_k = x_i))$$

any well-formed formula containing a definite description (regardless of the complexity of the predicate G) can be replaced by an equivalent formula that is description-free. It is clear, then, that adding the definite description operator to an ordinary first-order language does not add to its expressive power.

I want now to state four claims about the formal properties of the Theory of Descriptions, each of which seems to me to do some sort of injustice to the theory as a whole, and each of which ought to be countered if we are to incorporate Russell's insights into a semantical theory that assigns a central role to logical form in the way I have suggested.

(i) Russell's theory cannot play a role in a serious compositional semantics because the "logical forms" it delivers bear so little relation to surface syntax or to what we now know about syntactical structure in the light of developments in generative grammar.[8]

(ii) Attempts to provide theories that deliver improved "logical forms" in which descriptions are treated as "logical units" or "semantical units" must involve fundamental departures from Russell's theory, because on Russell's account descriptions are "incomplete symbols" that "disappear on analysis".[9]

(iii) Whitehead and Russell's notion of the *scope* of a description has no formal analogue in natural language; and besides, any theory of logical form that contains the resources necessary to represent descriptions as taking various scopes will have an *ad hoc* character.[10]

(iv) The existence of complex definite descriptions that contain as proper parts quantified noun phrases upon which subsequent pronouns are anaphoric (as in "the farmer who bought a brown cow vaccinated her") demonstrates conclusively that descriptions in natural language cannot be treated as logical or semantical units.[11]

By way of developing the account of logical form proposed in the previous section, I hope to show that each of these claims is fundamentally mistaken, and thereby demonstrate that there is no formal obstacle to incorporating Russell's insights into such a theory.

4. Logical Subjects and Incomplete Symbols

For Russell, a referring expression R may be combined with a predicate phrase to express a proposition that simply could not be entertained or expressed if the entity referred to by R did not exist. In places, Russell puts this point by saying that the referent of R is a *constituent* of such a proposition, but no substantive point will turn on this particular conception of a so-called *singular* (or *object-dependent*) proposition in what follows.

A sentence consisting of a definite description ⌜the F⌝ combined with a predicate phrase does not express a singular proposition; it expresses a *general* (or *object-independent*) proposition, a proposition that is not *about* a specific entity, in the sense that the existence of the proposition is not contingent upon the existence of the entity which in fact satisfies the predicate F (if anything does).

I am going to belabour this point because many people who appeal to (or at least claim to endorse) the Theory of Descriptions seem not to appreciate it. If one does not see that on Russell's account ⌜the F is G⌝ expresses a general proposition, that ⌜the F⌝ does not refer, one simply does not understand the theory.

Just as one can grasp the proposition expressed by (or the truth conditions of) an utterance of a sentence of the form ⌜every F is G⌝ or no ⌜F is G⌝ without knowing who or what satisfies the predicate F (if anything does), so one can perfectly well grasp the proposition expressed by an utterance of a sentence of the form ⌜the F is G⌝ without knowing who or what satisfies the predicate F (if anything does). That is, one can perfectly well understand or grasp the proposition expressed without knowing who or what answers to the description ⌜the F⌝, indeed independently of whether or not anything actually answers to ⌜the F⌝. And to this extent, it makes no sense to say that the existence of the proposition depends upon the identity of the "denotation" of ⌜the F⌝; so the proposition expressed is not singular, not object-dependent.

To say that the proposition expressed by a sentence S is singular is really just to say that the grammatical subject of S *stands for* an object and *contributes* that object to the proposition expressed by an utterance of S (or, if you prefer, contributes that object to a specification of the truth conditions of an utterance of S). To say that a sentence S expresses a *general* proposition is just to say that the grammatical subject of S is not the sort of expression that stands for an object and does not contribute an object to the proposition expressed by (or the truth conditions of) an utterance of S. This is the key to understanding Russell's position that phrases of the form ⌜every F⌝, ⌜some F⌝, and ⌜the F⌝ ("denoting phrases") are *incomplete* symbols. They are incomplete because they do not "stand for" or "directly represent" objects.[12] The proposition expressed by ⌜the F is G⌝ is the general proposition that there is one and only one F and everything

that is F is also G. That is, the truth conditions of ⌜the F is G⌝ are given by the formula in (1), which contains quantifiers and predicates but no singular term corresponding to the grammatical subject of ⌜the F is G⌝. And this is what Russell means by saying that the *proposition* has no *logical subject*, even though the *sentence* has a *grammatical subject*; and what he means by saying that the sentence's *grammatical form* is not a good indication of its *logical form* (or the logical form of the proposition the sentence expresses). The proposition is not about an object at all; it is about the relationship between two properties, F-ness and G-ness: exactly one thing has F-ness, and nothing has F-ness while lacking G-ness. As we might put it, ⌜some F is G⌝ is true if and only if the SOME relation holds between F-ness and G-ness; and ⌜the F is G⌝ is true if and only if the THE relation holds between them.

Sometimes it is claimed that the Theory of Descriptions is too cumbersome and unfaithful to surface syntax to warrant a place in a serious compositional semantics. To represent the logical form of a sentence of the form "the king is happy" as

(20) $(\exists x_1)((\forall x_2)(Kx_2 \equiv x_2 = x_1) \;\&\; Hx_1)$

is certainly to render obscure the relationship between surface syntax and "logical form". And of course the situation worsens when we turn to sentences containing more than one description. A sentence such as "The king married the countess" will come out as

(21) $(\exists x_1)(\exists x_3)((\forall x_2)(Kx_2 \equiv x_2{=}x_1) \;\&\; (\forall x_4)(Cx_4 \equiv x_4{=}x_3) \;\&\; Mx_1x_3)$.

But the formal language used in *Principia Mathematica* (or a notational variant thereof) plays no essential role in the Theory of Descriptions. If we wanted, we could translate (20) into RQ as (22):

(22) $[\text{some}_1\ Fx_1]_1\ ([\text{every}_2\ Fx_2]_2\ (x_2{=}x_1 \;\&\; Gx_1))$.

To do this would *not* be to present an *alternative* to Russell's account of ⌜the F is G⌝; it would simply be to choose a different language in which to state it.

Clearly there is no need to use such an indirect method of implementing Russell's proposal. ⌜the F is G⌝ is true iff (i) all Fs are Gs and (ii) there is exactly one F. Since the word "the" is a one-place quantificational determiner just like "some", "every", "no", "most", *etc*., in RQ we can treat ⌜the$_k$⌝ as combining with a formula α to form a restricted quantifier

⌜ [the$_k$ α]$_k$ ⌝.[13] On such an account, a sentence of the form ⌜the F is G ⌝ will be represented as, *e.g.*

(23) [the$_1$ Fx_1]$_1$ (Gx_1).

And Russell's insights are perfectly well captured by the following axiom for "the" (as it combines with singular complements):

(ix) s satisfies ⌜[the$_k$ α]$_k$ β ⌝ iff the sequence satisfying α and differing from s at most in the k-th position also satisfies β.

I have used a determiner "the" in the metalanguage so as to make (ix) congruent with the axioms for the other determiners. The right-hand side of (ix) is to be understood as equivalent to "there is exactly one sequence satisfying α and differing from s at most in the k-th position and every sequence satisfying α and differing from s at most in the k-th position also satisfies β".[14]

Plural descriptions are easily accommodated. Whereas ⌜the F is G ⌝ is true iff every F is G and there is *exactly one F*, on its non-collective reading ⌜ the Fs are Gs ⌝ is true iff every F is G and there is *more than one F*.[15] We can therefore add the following axiom for "the" when it takes plural complements:

(x) s satisfies ⌜ [the$_k$ α]$_k$ β⌝ iff the sequences satisfying α and differing from s at most in the k-th position also satisfy β.

Again, I have used a determiner "the" in the metalanguage; the right-hand side of (x) is to be understood as equivalent to "there is more than one sequence satisfying α and differing from s at most in the k-th position, and every sequence satisfying α and differing from s at most in the k-th position also satisfies β".

It might be thought that by presenting a formal language in which descriptions are treated as restricted quantifiers, although I have succeeded in presenting an account of descriptions that might find a place within a general compositional semantics, I have achieved this only by presenting an account that is inconsistent with Russell's own account. For in RQ, definite descriptions are complete "logical units", but on Russell's account, as presented in *Principia Mathematica*, they are "incomplete symbols" that "disappear on analysis".

This is the position taken by Linsky in his review of *Descriptions*.[16] I do not think there is a legitimate complaint here. Before addressing the formal elements of Linsky's claim, I want to echo certain informal remarks I made in *Descriptions*. Although Russell did not have the resources of generalized quantifier theory at his disposal and, although he had philosophical aims that went beyond semantics, it seems to me that the RQ account of descriptions is just Russell's theory stated in a way that allows us to see the relationship between surface syntax and logical form more clearly. By virtue of being Russellians about descriptions, we are not committed to the view that the only way to represent the logical form of a sentence S containing a description is to translate S into a formula of the language of *Principia Mathematica* (or a similar language). As far as explicating the logical structure of sentences containing descriptions is concerned, treating them as restricted quantifiers results not in a falling out with Russell but in an explanation of where the Theory of Descriptions fits into a more general theory of natural language quantification, a theory in which determiners like "every", "some", "all", "most", "a", "the", and so on, are treated as members of a unified syntactical and semantical category.

I turn now to the formal elements of Linsky's worry. Although Russell's theory is often put forward as the paradigm case of a theory that invokes a distinction between *grammatical form* and *logical form*, ironically there is a sense in which it preserves symmetry: the gap between *grammatical form* and *logical form* in the case of ⌜ the F is G ⌝ is no wider than it is in the case of ⌜every F is G⌝ or ⌜some F is G ⌝ because "the" is of the same syntactical and semantical category as "every" and "some".[17] On this account, a description (or any other quantified noun phrase) is still an *incomplete* symbol: for Russell a *complete* symbol stands for some entity and contributes that entity to the propositions expressed by (or to specifications of the truth conditions of) utterances of sentences containing that symbol. And of course quantified noun phrases do not do this, *not even in* RQ. In fact, this is reflected in both the syntax and semantics of RQ. The formula β with which a description ⌜ [the$_k$ α]$_k$⌝ combines to form a formula will contain a variable ⌜ x_k ⌝. Consider (24):

(24$_1$) [the$_1$ king x_1]$_1$ (x_1 likes Russell).

The variable "x_1" occupies the "subject position" of the formula "(x_1 likes Russell)" and, so to speak, marks the position upon which the quantifier operates, the position that, in effect, represents the spot the quantifier occupies in surface syntax. Since "Russell" stands for an object (the same object, whatever the sequence) it is a complete symbol:

(i) Ref("Russell", s) = Russell.

Now perhaps there is a sense in which the *variable* in (24) might be thought of as *complete-with-respect-to-a-sequence* by virtue of standing for an object in its own relativized way:

(ii) Ref($\ulcorner x_k \urcorner$, s) = s_k.

But however you look at it, the quantifier "[the$_1$ king x_1]$_1$" that binds the variable is an incomplete symbol. It doesn't even purport to stand for an object, not even when relativized to a sequence. There is no sense, then, in which the RQ account of descriptions conflicts with Russell's conception of descriptions as incomplete symbols.[18] It is the element of quantification in $\ulcorner$ the *F* is *G*$\urcorner$, $\ulcorner$ every *F* is *G*$\urcorner$, and $\ulcorner$ some *F* is *G*$\urcorner$ that creates a gap between grammatical form and so-called "logical form". The next step is to see how we can reduce, or at least systematize, even that gap.

5. Logical Form and Grammatical Form

We have now a formal language in which quantified noun phrases are treated as restricted quantifiers; but by the definition of logical form I took up earlier, we do not yet have a theory of the logical forms of sentences of English because we lack a mechanism capable of delivering formulae of RQ as the structures imposed on sentences of English in the course of providing a truth definition. We can make considerable headway here by appealing to Noam Chomsky's pioneering work on the syntax of natural language.[19] In the course of providing successively richer and more explanatory syntactical theories, Chomsky and others have explored the view that so-called "*wh*-phrases" like "which botanist", "whose party", and "who" are quasi-quantifiers that bind variables in the sentences in which they occur. Take (25):

(25) which country imprisoned Russell?

To anyone exposed to introductory logic, there is certainly an intuitive sense in which the "logical form" of (25) might be thought of as given by the quasi-English sentence (25$_1$):

(25$_1$) which country *x* is such that *x* imprisoned Russell?

On independent syntactical grounds that need not detain us here, Chomsky has argued that something very similar to the quantifier-variable structure in

(25$_1$) is actually present in the syntactical structure of the English sentence (25). And out of this idea and detailed work on quantification and anaphora, there has emerged a level of syntactical representation called "LF" ("Logical Form") a level distinct from "surface structure" and "deep structure", but with some affinity to the conception of "deep structure" championed by Harman, Lakoff, McCawley, Ross, and others in the late 1960s and early 1970s.[20]

LF is of interest to the theorist of logical form because it can be construed (and by some Chomskyans *is* construed) as the syntactical level at which scope assignments are made explicit and, consequently, the syntactical level relevant to semantical interpretation.[21] For concreteness, assume a three-tiered Chomskyan syntax comprising D(eep)-Structure, S(urface)-Structure, and LF, and take a sentence to be an ordered triple ⟨DS, SS, LF⟩ consisting of a D-Structure representation, an S-Structure representation, and an LF representation. A purported sentence is grammatical just in case it has a well-formed DS, SS, and LF. For the purposes of this paper, I shall be concerned only with the relationship between surface syntax and LF, so I will take the liberty of viewing a sentence as an ordered pair ⟨SS, LF⟩.[22]

A reasonable case can be made for the view that the distinction between S-Structure and LF provides an independently motivated way of capturing what Russell and Davidson are after when they appeal (in their own ways of course) to a distinction between *grammatical form* and *logical form*. Consider again (24), the RQ rendering of which is (24$_1$):

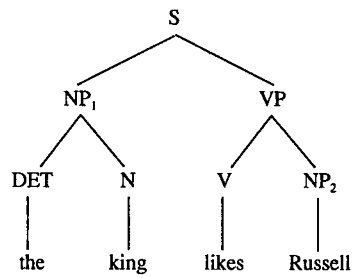
(24) the king likes Russell
(24$_1$) [the$_1$ king x_1]$_1$ (x_1 likes Russell).

Something very close to (24$_1$) is the LF representation for (24).[23] S-Structure representations are mapped onto LF representations by an elementary syntactical operation sometimes known as "Quantifier Raising". With the aims of (a) focusing on the *phenomenon* rather than any rule of grammar, (b) avoiding any sort of commitment to particular implementations found in the literature, and (c) allowing for the possibility of "lowering" as well as raising quantifiers, let us say that quantified NPs are *evacuated* rather than *raised* (they must be forced out of the matrix sentence at LF). The S-Structure (24$_2$) is mapped onto the LF representation (24$_3$) by the evacuation of "the king":

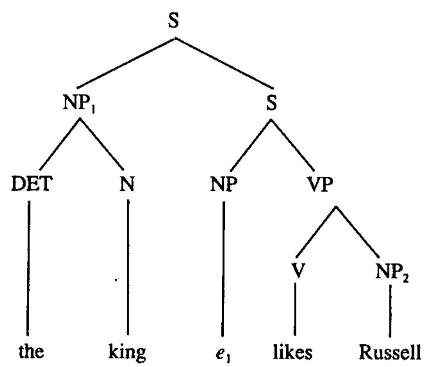
(24$_2$) $[_S\ [_{NP}$ the king$]_1\ [_{VP}$ likes $[_{NP}$ Russell$]_2]]$
(24$_3$) $[_S\ [_{NP}$ the king$]_1\ [_S\ e_1\ [_{VP}$ likes $[_{NP}$ Russell$]_2]]]$.

In tree notation:

(24_2)



(24_3)



Here, the evacuation of the quantified NP creates an S node immediately dominating the original S node: at LF, the evacuated NP is an immediate constituent of the new S node and a sister to the original S node (to use some linguistics jargon, the quantified NP has been "Chomsky-adjoined" to the original S node). The trace "e_1" left by the evacuated quantifier functions as a variable bound by that quantifier. (In effect, then, quantified NP-evacuation might be viewed as the product of a "transformational" operation in the sense familiar from early generative grammar.[24])

How can the notion of LF in Chomsky's theory be of use to the philosopher or logician interested in logical form in the sense I advocated earlier? The answer to this question emerges if one reflects on the following points. (i) The semantical properties of a sentence are to some extent determined by its syntactical properties. (ii) If sentences have syntactical representations with the properties that LFs are supposed to possess, the vitally important semantical notion of the *scope* of an expression in natural language may well admit of a syntactical characterization: for the *scope* (in exactly the standard sense of Whitehead and Russell) of the evacuated quantifier can be

identified with the S node to which it has been Chomsky-adjoined. (iii) The mapping from LF representations to sentences of RQ looks to be straightforward. (iv) RQ has many of the properties of a logically perfect language, and its truth definition is straightforward.

I suggest, then, that an independently motivated syntactical theory that delivers an S-Structure representation and an LF representation for each sentence of a fragment of a given language ought to be of considerable interest to philosophers and linguists who take the logical form of a sentence *S* belonging to a language *L* to be the structure imposed upon *S* in the course of providing a systematic and principled semantics for *L*. Arguably, we can make some serious progress by exploring the view that a fully worked-out theory of LF will be a fully worked-out theory of logical form.[25]

The relationship between (24_1) and (24_3) is transparent; and on the assumption that the objects of semantical interpretation are LFs rather than S-Structures, we can, in effect, use the truth definition for RQ as a truth definition for a quantified fragment of English. This idea becomes less offensive once more is said about scope and variable-binding. The scope of a quantified NP is just the S node to which it has been Chomsky-adjoined at LF; and this is really a consequence of a general characterization of scope that emerged from interactions in the late 1960s between linguists and philosophers interested in the relationship between "deep structure" and "logical form". In order to see this, we can introduce a notion that has become a central component of syntactical theory through the work of *e.g.* Reinhart [1978]:

(A) An expression α c-commands an expression β iff the first branching node dominating α dominates β (and neither α nor β dominates the other).

Employing any of the usual sorts of formation rules and truth definitions for the propositional calculus, the first-order predicate calculus, RQ, and standard modal extensions of each of these, we see straight away that an expression β is within the *scope* of an expression α iff α c-commands β. For example, The scope of a unary connective such as "$\neg$" or "$\Box$" is just the wff it c-commands; the scope of a binary sentential connective, such as "&" or "$\supset$", consists of the two wffs it c-commands; and the scope of a quantifier, such as $\ulcorner(\forall x_k)\urcorner$, $\ulcorner[\text{the}_k\ \alpha]_k\urcorner$, or $\ulcorner[\text{the}_k\ \alpha]_k\urcorner$, is the wff it c-commands. This is a relatively trivial consequence of the way these languages are constructed and interpreted.

In the late 1960s and early 1970s, Bach, Harman, Lakoff, McCawley, and others suggested that the same is true of natural language; more precisely, they suggested that the scope of an expression in natural language is its c-command domain at the syntactical level relevant to semantical interpretation.[26] Thus we reach the following, which is in fact accepted by many linguists working within Chomsky's framework:

(B) The scope of an expression α is everything α c-commands at LF.

On the assumption that a trace $\ulcorner e_i \urcorner$ left by evacuation is understood as a variable and thereby falls under an instance of the axiom schema

(ii) $\text{Ref}(s, \ulcorner x_k \urcorner) = s_k$

we get exactly the right truth conditions for (24) as the occurrence of "e_1" in that sentence is bound by the evacuated description "[the$_1$ king]$_1$" by virtue of lying within its scope at LF.

For all intents and purposes, (24_1) and (24_3) can be viewed as notational variants. In a more developed theory, we would provide a truth definition for a fragment of English by modifying the axioms of the truth definition for RQ in such a way that it can be applied to LF representations directly. For present purposes we can continue to use the truth definition for RQ, trading on the transparency of the relationship between an LF and the sentence of RQ with which it is associated. We have examined only one simple example, but in fact the aforementioned transparency is preserved even in considerably more complex cases. For our concerns, there is no harm, then, in using formulae of RQ to stand for LFs except where there is some specific syntactical reason for using LF representations.

The fact that certain pronouns anaphoric on quantified noun phrases appear to be understood as variables bound by those noun phrases, while others are not, is readily accommodated. For concreteness, let us say (provisionally) that

(C) An expression α is *anaphoric* on an expression β iff (i) the semantical value of α is determined, at least in part, by the semantical value of β, and (ii) β is not a constituent of α.

Where α is anaphoric on β, let's say (again, provisionally) that β is the *antecedent* of α.

Grammatical theory must provide an account of when a pronoun can be understood as anaphoric on some other NP (a name, a demonstrative, a restricted quantifier, another pronoun, or even a variable). In addition, for every sentence S containing a pronoun P that is understood as anaphoric on some other NP, semantical theory must provide an account of the contribution that P makes to the truth conditions of S. If the antecedent is a referring

expression such as a name, it is plausible to suppose that the pronoun refers to the same thing as its antecedent and that this effectively answers any truth-conditional questions we might have about P.[27] The truth theory for RQ guarantees that a referring expression in a sentence S contributes just its bearer to a specification of the truth conditions of S. For example, the axiom

(i) Ref("Russell", s) = Russell

guarantees that "Russell" contributes Russell to a specification of the truth conditions of a sentence containing "Russell".[28] And it seems reasonable to suppose that a pronoun anaphoric on "Russell" should do likewise.

There are several ways one might proceed here and I pick one more or less at random. Consider (26) on the reading upon which "she" is understood as anaphoric on "Dora":[29]

(26) Dora$_2$ respects the man she$_2$ married.

As is customary, I have indicated the anaphoric connection by "coindexing" the NPs "Dora" and "she", *i.e.* by giving them matching numerical subscripts. Coindexing noun phrases in this way is more than just a way of indicating anaphoric connections to other linguists. Indices are ordinarily taken to be parts of syntax that are semantically relevant. If α is anaphoric on β then α is coindexed with β. But it would be wrong to equate "α is coindexed with β" and "α is anaphoric on β": (i) *being coindexed with* is a symmetric relation whereas *being anaphoric on* is an asymmetric relation; (ii) *being coindexed with* is syntactical relation whereas *being anaphoric on* is a semantical relation.

For concreteness, let us say (provisionally) that

(D) A pronoun $\ulcorner P_k \urcorner$ that is anaphoric on a referring expression $\ulcorner R_k \urcorner$ is understood as $\ulcorner R_k \urcorner$.

The net result of this is that the LF (26_1) will be understood as (26_2):

(26_1) [the man she$_2$ married]$_1$ [$_S$ Dora$_2$ respects e_1]
(26_2) [the$_1$ man x_1 & Dora$_2$ married x_1]$_1$ (Dora$_2$ respects x_1).

Probably something like this is tacitly assumed by many linguists (though there are, of course, other ways one might proceed that may ultimately turn out to be technically superior).

When it comes to pronouns anaphoric on quantified noun phrases, matters are more complex. Coindexing the pronoun with its antecedent so as to indicate an anaphoric connection is a start; but then we need to know which axiom of the truth definition to apply to the pronoun. Consider the following:[30]

(27) [Some philosophers]$_2$ like [students who argue with them$_2$]$_3$
(28) [The president]$_1$ loves [the woman he$_1$ married]$_4$
(29) [Most linguists]$_1$ admire [their$_1$ cousins]$_2$

It will not do to see the pronouns in these examples as subject to the same axioms as their antecedents. (For example, (27) simply does not have the same truth conditions as "some philosophers like students who argue with some philosophers".) As Geach and Quine have emphasized, the right truth conditions will be forthcoming for sentences such as (27) and (28) if the pronouns are understood as bound variables in the manner familiar from first-order logic. It is a simple matter to adapt this suggestion to suit the present discussion, and thereby provide the means of handling sentence (29) as well. For example, the truth conditions of (28) are given by the following sentence of RQ:

(28$_1$) [the$_2$ president x_2]$_2$ ([the$_1$ woman x_1 & x_2 married x_1]$_1$ (x_2 loves x_1)).

This suggests that we treat "he$_2$" exactly as we would treat an occurrence of a trace "e_2", *i.e.* as an occurrence of the variable "x_2". The pronoun will then be subject to an instance of axiom schema (ii).

In general, then, we might (provisionally) accept the following:

(E) When a pronoun $\ulcorner P_k \urcorner$ is anaphoric on a c-commanding quantifier $\ulcorner [D_k\ \alpha]_k \urcorner$, the axiom for $\ulcorner x_k \urcorner$ applies to $\ulcorner P_k \urcorner$.

The net result of all this is that such a pronoun will be understood as a bound variable.[31]

Given the usual assumptions of standard logics, it makes no sense of course to talk of a quantifier binding a variable that is not within its scope (its c-command domain). And on the assumption that the scope of an expression in natural language is to be characterized in exactly the same way as the scope of an expression in a standard logic, it will make no sense to talk of a quantified noun phrase binding a pronoun that it does not c-command (at LF). To say all this is not, of course, to deny that a pronoun P may be *anaphoric on* a quantifier Q that does not c-command it at LF; it is just to deny that in such a case P is *bound by* Q, and to maintain that some other account is needed of the semantics of P.

Before looking at a possible semantics for pronouns anaphoric on quantifiers that do not c-command them at LF, it is necessary to examine an

important feature of natural language that the LF proposal seems to handle very effectively: the possibility of so-called "ambiguities of scope". This will put us into position for a discussion of the fact that the members of a syntactically specifiable class of pronouns must be allowed to enter into scope interactions with quantifiers and other sentential operators, a fact that is itself explicable on the assumption (for which there is independent evidence) that the pronouns in question are understood as Russellian descriptions.

6. Truth Conditions and Scope Permutations

I turn now to a philosophically important feature of natural language that the LF proposal may help to illuminate: the matter of ambiguity involving quantifier scope. It is a commonplace of philosophy and linguistics that many sentences containing two or more quantifiers admit of distinct readings, i.e. readings with distinct truth conditions. Typically, the readings in question are captured in terms of relative scope; thus (30) is given the readings (30$_1$) and (30$_2$):

(30) Every poet respects some sculptor
(30$_1$) [every$_1$ poet x_1]$_1$ ([some$_2$ sculptor x_2]$_2$ (x_1 respects x_2))
(30$_2$) [some$_2$ sculptor x_2]$_2$ ([every$_1$ poet x_1]$_1$ (x_1 respects x_2)).

By the truth definition for RQ, (30$_1$) and (30$_2$) are not equivalent; this suggests very strongly that if we want to pursue the idea that LF representations are representations of the logical forms of sentences in the sense given earlier, we need to associate two distinct LFs with the surface string (30), one corresponding to (30$_1$), the other to (30$_2$):

(30$_3$) [$_S$ [every poet]$_1$ [$_S$ [some sculptor]$_2$ [$_S$ e_1 respects e_2]]]
(30$_4$) [$_S$ [some sculptor]$_2$ [$_S$ [every poet]$_1$ [$_S$ e_1 respects e_2]]].

If the identity of a sentence is determined by an S-Structure representation and an LF representation (and also a D-Structure representation, irrelevant for immediate concerns), rather than saying that (30) is an ambiguous sentence, really we should say that (30) is the surface representation of two distinct sentences – *viz* ⟨(30), (30$_3$)⟩ and ⟨(30), (30$_4$)⟩ – that share an S-Structure representation and in fact look and sound alike (for convenience we might still want to say, loosely of course, that the "string" (30) is ambiguous).[32]

There are several ways one might structure the theory in order to obtain (30$_3$) and (30$_4$) as two distinct LF representations for the string (30). For reasons that will emerge, I suggest we view evacuation as the Chomsky-adjunction of any quantified NP in an argument position to any superior S-node. Evacuation is a phenomenon rather than a rule of grammar; it is the product of two very natural constraints on the well-formedness of representations at the syntactical level relevant to semantical interpretation, *viz* LF: (i) only referential NPs (*e.g.* names, variables, and NPs anaphoric on referential NPs) may occupy argument positions; (ii) no variables may remain free. I will say more about these conditions later; for immediate purposes it will be enough to note that one consequence of such constraints is that every quantified NP will vacate its S-Structure position for a position that c-commands the "original" position at LF. On this account, we can derive (30_4) in one of two ways. (i) A first evacuation results in the adjunction of "every philosopher" to the S node of the original S-Structure representation to produce the "intermediate" representation (30_5):

(30_5) $[_S$ [every poet]$_1$ $[_S$ e_1 respects [some sculptor]$_2$]].

A second evacuation adjoins "some linguist" to the higher S node of (30_5) to produce the LF representation (30_4). (ii) Alternatively, a first evacuation adjoins "some linguist" to the S node of the original S-Structure representation to produce the intermediate representation (30_6):

(30_6) $[_S$ [some sculptor]$_2$ $[_S$ [every poet]$_1$ respects e_2]].

And a second evacuation results in the adjunction of "every philosopher" to the *lower* S node of the intermediate representation (30_6) to produce the LF representation (30_4).

A general point about redundancy should be taken up here. I am assuming that exactly one quantifier is evacuated at a time. For any sentence ⟨SS, LF⟩, let us say that the sentence has one or more *LF Histories*: an LF History is a sequence of representations ⟨$R_1,\ldots, R_n$⟩, where R_1 is SS, R_n (for $n > 1$) is LF, and each R_k results from R_{k-1} after at most one evacuation. Let us now say that for any $k > 1$, a representation R_k in an LF History is a *candidate-LF* representation. Finally, let us say that if a candidate-LF representation satisfies the conditions on well-formedness for LF representations, it is an LF representation (we can now eliminate talk of "intermediate" representations).

The sentence ⟨(30), (30_4)⟩ has two distinct LF Histories: ⟨(30), (30_5), (30_4)⟩ and ⟨(30), (30_6), (30_4)⟩. (Similarly, ⟨(30), (30_3)⟩ has two distinct LF Histories.) It might be thought that the theory ought to be tightened up so as to eliminate unnecessary redundancy. That is, it might be suggested that a sentence ⟨SS, LF⟩ should have *exactly one* LF History, and that a theory with this desirable consequence will result if evacuated quantified NPs adjoin only to the *topmost* S node of the relevant representation. Whatever the aesthetic merits of such a proposal, it is known to be empirically deficient. The following strings containing verbs of propositional attitude make the point very clearly:

(31) Bill thinks that someone downstairs is following him
(32) Bill thinks that the person upstairs is ignoring him.

Each of these strings is ambiguous between a *de re* and a *de dicto* reading. Following Russell, it is usual to account for this ambiguity in terms of the scopes of the quantified NPs ("someone downstairs" and "the person upstairs", respectively). Take (32). This is ambiguous between (32_1) and (32_2):

(32_1) Bill_2 thinks that [the_1 person upstairs x_1]$_1$ (x_1 is ignoring him_2))
(32_2) [the_1 person upstairs x_1]$_1$ (Bill thinks that (x_1 is ignoring him_2)).[33]

While the LF associated with (32_2) can be derived from S-Structure by Chomsky-adjoining the quantifier to the higher S node, in order to derive the LF associated with (32_1) the quantifier adjoins to the *lower* S node. To my mind this demonstrates conclusively that if we are to follow Russell in capturing *de re–de dicto* ambiguities in terms of scope permutations (and I think we must), an adequate theory of LF, as currently understood, must allow evacuated quantified NPs to adjoin to S nodes other than the topmost S node. (There are also examples involving anaphora that demonstrate the same point [see below], but I do not want to rely on facts involving anaphora before saying something about the topic more generally.)[34] For the present, then, I shall maintain that evacuated quantified NPs may adjoin to any superior S node.[35]

The original motivation in logic for wanting to allow quantifier permutation within a "sentence" was of course the desire to capture readings with distinct truth conditions. But as is well known, permuting quantifiers does not always result in a difference in truth conditions, as, for example, in

(33) Every poet respects every sculptor
(34) Some poet respects some sculptor.

Of course, the version of the LF theory I am advocating declares that each of (33) and (34) is the surface manifestation of two distinct but logically equivalent sentences. This might strike some people as introducing yet another unnecessary redundancy; but again I think this is illusory. As theorists we should be striving after the most general and aesthetically satisfying theory, and the fact that no truth-conditional differences result from scope permutations in *some* simple sentences is of no great importance by itself. It should be noted that, contrary to what some people have claimed, in order to produce such examples, it is not necessary to use the same determiner twice. In effect, this was pointed out in *Principia Mathematica* by Whitehead and Russell when they emphasized that scope interactions involving definite descriptions and some other quantifiers are truth-conditionally inert. For example, (35) is the surface form of two distinct, but logically equivalent, sentences, the LFs of which are (35_1) and (35_2):

(35) The king owns a bicycle
(35_1) [the$_1$ king x_1]$_1$ ([a$_2$ bicycle x_2]$_2$ (x_1 owns x_2))
(35_2) [a$_2$ bicycle x_2]$_2$ ([the$_1$ king x_1]$_1$ (x_1 owns x_2)).

Similarly for (36):

(36) Every knight talked to the king.

The moral that emerges, then, from reflecting on examples like (33)–(36) is that they reinforce the working assumption that a theory of logical form is rather more than a theory that associates a sentence of a well-behaved formal language with each sentence of a natural language. If the best syntax and semantics we have both say (or jointly entail) that there are two distinct logical forms associated with some particular string, then it would be absurd to claim that the string in question is not the surface form of two distinct sentences just because the two purported LFs are logically equivalent. My point here is not the familiar one that truth conditions are not fine-grained enough to serve as propositions or meanings. This matter is irrelevant to the point at hand – but notice that although, say, (35_1) and (35_2) are truth-conditionally equivalent, the axioms of the truth definition will apply in a different order, and to that extent there may still be room for the truth-conditional semanticist to say that the sentences differ *semantically*. My point is much simpler. We all accept that the string "Visiting professors can be a nuisance" is the surface manifestation of two distinct sentences with distinct truth conditions, and we don't mind saying this even though the two sentences are written and sound alike. Equally, we all accept that "Bill sold Mary a car" and "Mary bought a car from Bill" are the surface manifestations of two distinct sentences with the same truth conditions. So neither the "surface sameness" of two purported sentences nor the "truth-conditional sameness" of two purported sentences is sufficient to demonstrate that a single sentence is actually under scrutiny. And as far as I can see, there is no

compelling reason to think that the combination of surface sameness and truth-conditional sameness demonstrates this either. So there is no compelling reason to reject the view that each of (33)–(36) is the surface manifestation of a pair of sentences. At times we must let the theory decide. If the best syntax and semantics we have say there are two distinct sentences corresponding to a single string, so be it.

In response to all this, it might be countered that the absence of a difference in truth conditions for (35_1) and (35_2) lends support to the view that descriptions are *not* ordinary quantified NPs that admit of various scope assignments.[36] However, there is plenty of evidence against this approach, much of which involves truth-conditionally active scope permutations. For example, as Russell observed, scope matters in (32) just as much as it does in (31). And as Russell also pointed out, even within the relative safety of extensional constructions, the scope of a description is important. Russell makes the point with the sentence "the king of France is not bald", which he claims has two readings according as the description or the negation has larger scope. Within the framework we have in place, we can bolster Russell's point by considering sentences containing a description together with a quantifier that is monotone decreasing:[37]

(37) Few women have met the king of France.

For present concerns, the importance of the various examples we have been considering is that they suggest very strongly that an adequate semantics for English must treat descriptions as quantified noun phrases with various scope possibilities, exactly as Russell claimed. (Russell's "The king of France is not bald" might also be taken to show that something very similar to evacuation results in the Chomsky-adjunction of "not" to an S node.[38]

7. Pronouns and Incomplete Symbols

In order for a variable to be bound by a quantified noun phrase, the latter must c-command the former at LF.[39] So the following question naturally arises: can a pronoun be anaphoric on a quantified noun phrase that does not c-command it at LF, and if so, how is such a pronoun understood? Russell's Theory of Descriptions is highly relevant to many of the issues raised by these questions. First, it seems to be the case that some pronouns are understood as descriptions. Second, it is arguable that the pronouns in question are anaphoric on quantified noun phrases that do not c-command them at LF. Third, it has been claimed by Evans [1977, 1982] that the possibility of such anaphoric connections provides conclusive evidence for the view that definite descriptions are not "logical units".

Consider the following examples:

(38) Russell bought [some hens]$_1$ and Whitehead vaccinated them$_1$

(39) [Just one man]$_1$ drank rum and he$_1$ was ill afterward.

As pointed out by Evans [1977], the pronouns in these examples cannot be understood as variables bound by the quantifiers upon which they are anaphoric. If "them" in (38) were treated as a variable bound by "some hens", the quantifier would have to be understood as taking scope over the sentential connective "and", and so the truth conditions of (38) would be given by (38_1):

(38_1) [some$_2$ hens x_1]$_1$ (Russell bought x_1 and Whitehead vaccinated x_1).

But (38_1) captures the truth conditions of "Russell bought some hens that Whitehead vaccinated", not the truth conditions of (38). Suppose Russell bought twelve hens and Whitehead vaccinated only three of them. In such a situation, (38_1) is true but (38) is false.

Similarly, there would be trouble ahead if we attempted to treat the pronoun "he" in (39) as a variable bound by "just one man". We would have to understand the quantifier as taking scope over "and", and so the truth conditions of (39) would be given by (39_1):

(39_1) [just one$_1$ man x_1] (x_1 drank rum and x_1 was ill afterwards).

While (39_1) seems to capture the truth conditions of "Just one man drank rum and was ill afterward", it certainly does not capture the truth conditions of (39). Suppose two men drank rum and only one was ill afterward. In such a situation (39_1) is true but (39) is false.[40]

Interestingly, the most promising approach to such pronouns is Russellian in character: such pronouns are *quantificational* by virtue of being equivalent to definite descriptions.[41] The singular pronoun "he" in (39) seems to be understood as the singular description "the man who drank rum"; and the plural pronoun "them" in (38) seems to be understood as the plural description "the hens Russell bought". That is, (38) and (39) seem to be understood as meaning what is meant by (38_3) and (39_3) respectively:

(38_3) Russell bought some hens and Whitehead vaccinated the hens Russell bought

(39_3) Just one man drank rum and the man who drank rum was ill afterward.

These results appear to be forthcoming on the Evans-inspired theory I presented in *Descriptions*, according to which a pronoun P that is anaphoric on a quantifier Q that does not c-command P at LF is understood as a definite description typically recovered from Q and everything Q c-commands at LF. Adapting that idea to the present discussion, we get the following:

(F) If a pronoun $\ulcorner P_k \urcorner$ is anaphoric on but not within the scope β of a quantified NP $\ulcorner [D_k\ \alpha]_k \urcorner$ then $\ulcorner P_k \urcorner$ is understood as $\ulcorner [\text{the}_k\ \alpha\ \&\ \beta]_k \urcorner$.[42]

An example will help fix ideas. The logical form of the first conjunct of (39) is

(39_4) [just one$_1$ man x_1] (x_1 drank rum).

Since the pronoun "he$_1$" in the second conjunct is not c-commanded by "just one man" at LF, by (F), the pronoun will be understood as

(39_5) [the$_1$ man x_1 & x_1 drank rum].

And so (39) as a whole will be understood as

(39_6) [just one$_1$ man x_1]$_1$ (x_1 drank rum) &
[the$_1$ man x_1 & x_1 drank rum]$_1$ (x_1 was ill afterward).

Analogously, (38) will be understood as

(38_4) [some$_1$ hens x_1]$_1$ (Russell bought x_1) &
[the$_1$ hens x_1 & Russell bought x_1]$_1$ (Whitehead vaccinated x_1).

And (40), in which the pronoun's antecedent is a *wh*-phrase (interrogative quantifier), will be understood as (40_1):

(40) [which hen]$_1$ died and which philosopher vaccinated her$_1$?

(40_1) [which$_1$ hen x_1]$_1$ (x_1 died) & [which$_2$ philosopher x_2]$_2$
([the$_1$ hen x_1 & x_1 died]$_1$ (x_2 vaccinated x_1)).

Any pronoun that is understood as equivalent to a definite description we can call a *D-type* pronoun.[43]

The semanticist who endorses a D-type account of pronouns anaphoric on quantified NPs that do not c-command them at LF looks to be in a very attractive position. In conjunction with the axioms for the various determiners, the axiom schema for variables provides a plausible semantics for pronouns anaphoric on c-commanding quantifiers. And in conjunction with Principle (F), the axioms for "the" seem to provide a plausible semantics for pronouns anaphoric on non-c-commanding quantifiers.[44]

The range of a theory of unbound anaphora can be seen by returning to the matters of quantifier scope and incomplete symbols. On the assumption that (F) is a correct generalization, in addition to the pronouns in (38)–(40), the indexed pronouns in each of the following examples will be understood as definite descriptions:[45]

(41) [A man]$_1$ has murdered Smith. The police have reason to think he$_1$ injured himself in the process

(42) Next year [a man from Texas]$_1$ will be in charge of the economy and I'm sure he$_1$'ll help the oil business.[46]

If D-type pronouns are understood as descriptions, one might expect the clauses containing the pronouns in (41) and (42) to exhibit scope ambiguities of the sort found with overt descriptions; and indeed this seems to be the case. For example, there is a perfectly natural reading of (41) upon which both "a man" and "he (the man who murdered Smith)" are understood with large scope, and there is also a perfectly natural reading upon which they are both understood with small scope (mixed readings are much less natural, but not impossible). The main point is that there are pronouns for which matters of scope are important.

We are now in a position to remark on claims made by Gareth Evans about Russell's idea of descriptions as incomplete symbols and about the correct way to capture the anaphoric relations between pronouns and incomplete symbols. As is well known, there is an alternative to the view that quantified noun phrases in natural language are restricted quantifiers. According to the alternative proposal, determiners are *binary quantifiers* (rather than unary quantifier-formers). That is, a determiner combines with a pair of formulae to form a formula (the quantifier is "binary" not in the sense that it simultaneously binds two distinct variables, but in the sense that it combines with two formulae).[47] On this account, the logical form of (43) might be given by (43$_1$), which corresponds to (43$_2$) in RQ:

(43) The farmer bought Daisy

(43$_1$) [the]$_1$ (farmer x_1 ; x_1 bought Daisy)
(43$_2$) [the$_1$ farmer x_1]$_1$ (x_1 bought Daisy)

where the semi-colon in (43$_1$) is just a syntactical device for separating the two formula with which the quantifier "[the]$_1$" combines. Again, it is a routine matter to specify a syntax, characterize variable-binding and scope, and provide the relevant axioms of a theory that defines truth in terms of satisfaction. Call the resulting system BQ. In place of principle (F), the BQ theorist will have something rather more complex – the "output" component will have to be stated in terms of the entire clause containing the pronoun – but still workable.[48]

As far as I can ascertain, RQ and BQ are equivalent in both expressive power and capacity to encode antecedent-anaphor relations. To begin with, sentences in which there is a description containing a restrictive relative clause can be represented in either system. Let us assume (counterfactually, but harmlessly for immediate concerns) that relative pronouns in restricted relative clauses are simple bound variables. Thus (44) can be represented as (44$_1$) in RQ or as (44$_2$) in BQ:

(44) the farmer who bought Daisy is happy
(44$_1$) [the$_1$ farmer x_1 & x_1 bought Daisy]$_1$ (x_1 is happy)
(44$_2$) [the$_1$] (farmer x_1 & x_1 bought Daisy ; x_1 is happy).

Similarly, (45):

(45) the farmer whom Daisy kicked is unhappy
(45$_1$) [the$_1$ (farmer x_1 & Daisy kicked x_1]$_1$ (x_1 is unhappy)
(45$_2$) [the$_1$] (farmer x_1 & Daisy kicked x_1 ; x_1 is unhappy).[49]

However, according to Evans, there is a crucial difference between RQ and BQ. In (44$_1$) and (45$_1$), since the descriptions are treated as restricted quantifiers, they are treated, says Evans, as "logical units" whereas in the BQ renderings (44$_2$) and (45$_2$) they are not. Additionally, says Evans, once we take into account more complex sentences, we must abandon the view that descriptions are restricted quantifiers; indeed we will have to abandon RQ altogether in favour of BQ.

Evans appeals to cases of so-called "donkey anaphora" to make his point. Up to now, the examples of pronouns anaphoric on non-c-commanding quantified NPs we have examined have all been in structures of the form

$[_{S0}\ [_{S1} \ldots Q \ldots]$ connective $[_{S2} \ldots P \ldots]]$

where the quantified NP Q is a constituent S1 and the pronoun P is a constituent of S2. But, notoriously, there is at least one more type of structure in which it is possible to have a pronoun anaphoric on a non-c-commanding quantified NP.[50] Consider sentences like the following:

(46) [every farmer who bought [some cows]$_2$]$_1$ vaccinated them$_2$
(47) [most men who own [a car]$_2$]$_1$ wash it$_2$ on Sundays
(48) [the farmer who bought [a cow]$_2$]$_1$ vaccinated her$_2$
(49) [which farmer who bought [a donkey]$_2$]$_1$ paid cash for it$_2$?

The interesting fact about these sentences is that even if they admit of readings upon which the embedded quantified NPs ("some cows", "a car", "a cow", and "a donkey") have large scope, it is clear that they have perfectly natural readings upon which the NPs in question have small scope.[51] But upon such readings the pronouns cannot function as variables bound by their antecedents because they do not lie within their scopes (the pronouns are not c-commanded by the quantified NPs at LF). Take (46) and (48). If the pronouns "them" and "it" are construed as variables we would get the following logical forms:

(46$_1$) [every$_1$ farmer x_1 & [some$_2$ cows x_2]$_2$ (x_1 bought x_1)] (x_1 vaccinated x_2)
(48$_1$) [the$_1$ farmer x_1 & [a$_2$ cow x_2]$_2$ (x_1 bought x_2)]$_1$ (x_1 vaccinated x_2).

But the final occurrences of "x_2" (corresponding to "them" in (46) and "her" in (48)) simply fail to be bound by their antecedents.

According to Evans, there is a problem here for RQ that is not shared by BQ, the upshot of which is that we will have to treat "every", "the", "which", "most" and other quantificational determiners as binary quantifiers in order to get the semantics to work out in any sentence exhibiting the sort of anaphoric connection exemplified in (46)–(49). Evans points out (correctly) that once we have distinguished clearly between bound and unbound/descriptive anaphora, we will see that the anaphoric pronouns in (46)–(49) are descriptive. But, in addition, he argues that it is not possible to evaluate (46)–(49) if the pronouns are treated descriptively and the subject NPs are treated as the sorts of "logical units" that RQ requires. And so, Evans concludes, quantified noun phrases are not restricted quantifiers.

With respect to (48), Evans sees his conclusion as supporting Russell's view that descriptions are incomplete symbols:

> For the language fragment Russell studied, there is in fact no need to regard "The" even as a binary quantifier. We can think of "The" as an expression which takes a simple or complex one-place concept-expression ("man who broke the bank at Monte Carlo") to yield a unary quantifier ("the man who broke the bank at Monte Carlo") ... This would make Russell wrong in his claim that "the ϕ" does not form a logical unit in "the ϕ is F". However, once again Russell has ultimately turned out to have been right, but for the wrong reasons.[52]

Russell has turned out to be right, Evans claims, because in sentences such as (46)–(49) "... the quantifier expression and the main concept-expression ... cannot be independently constructed" (*ibid.*).

For the details of the argument Evans refers the reader to his technical work on pronouns.[53] Fortunately, it is not necessary to go into the details of the argument to see that it must contain a flaw. There are two points to take up, one conceptual the other technical. First, as pointed out in §4, it is simply a mistake to think that the RQ treatment of the determiner "the" as what Evans calls a "unary quantifier-former" conflicts with Russell's view that descriptions are incomplete symbols. In both RQ and BQ descriptions do not stand for objects and are not logical subjects. In RQ a description is replaced by a restricted quantifier and a variable that, so to speak, occupies the position the description occupies in surface *syntax*. The fact that the syntax of a binary quantifier analysis "breaks up" descriptions still further does not make the binary analysis *more* Russellian. Descriptions are no less incomplete symbols in RQ than they are in BQ. Evans and Linsky are making the same mistake.

More important than this point of interpretation is the fact that Evans is wrong when he claims that the semantics of the anaphoric connections in (46)–(49) cannot be captured in RQ. Given the way I presented principles (E) and (F), there is no formal problem for the RQ theorist. According to principle (E), a pronoun anaphoric on a quantified noun phrase is a bound variable only if it is c-commanded by its antecedent at LF. But on the readings in question, the embedded quantifiers have small scope and this corresponds to the fact that (on these readings) the quantifiers evacuate only as far as the embedded S node (relative clause)). By Principle (F), the pronouns receive D-type interpretations. Take (46). The quantifier ⌜[D_k α]$_k$⌝ upon which "them" is anaphoric is "[some$_2$ cows x_2]$_2$"; and its scope is "(x_1 bought x_2)". Thus k is "2", α is "cow x_2" and β is "(x_1 bought x_2)". Consequently the description ⌜[the$_k$ α & β]$_k$⌝ that binds the pronoun "them" *is* understood as

(50) [the$_2$ cows x_2 & (x_1 bought x_2)]$_2$

which contains a free occurrence of "x_1". Thus (46) ought to be interpretable as either (46_2) or (46_3), according as the subject quantifier or the D-type pronoun has larger scope:

(46_2) [every$_1$ farmer x_1 & [some$_2$ cows x_2]$_2$ (x_1 bought x_2)]$_1$
([the$_2$ cows x_2 & (x_1 bought x_2)]$_2$ (x_1 vaccinated x_2))

(46_3) [the$_2$ cows x_2 & (x_1 bought x_2)]$_2$
([every$_1$ farmer x_1 & [some$_2$ cows x_2]$_2$ (x_1 bought x_2)]$_1$
(x_1 vaccinated x_2)).

(46_3) is useless because it contains a free occurrence of "x_2". But (46_2) is fine: it also represents the English sentence "[every farmer who bought some cows$_1$ vaccinated [the cows he$_1$ bought]$_2$" on the reading in which the pronoun "he" is understood as a variable bound by the subject NP "every farmer who bought some cows", which c-commands the pronoun as required.

Similarly, (48) will come out as (48_2):

(48_2) [the$_1$ farmer x_1 & [a$_2$ cow x_2]$_2$ (x_1 bought x_2)]$_1$
([the$_2$ cow x_2 & x_1 bought x_2]$_2$ (x_1 vaccinated x_2))

again, exactly as required.[54]

To the extent that it is possible to reconstruct Evans' argument against RQ, it appears to presuppose that the descriptions in terms of which unbound anaphors are understood may never take small scope. But as we saw earlier, there is ample evidence that this is false.[55] The following sentence reinforces the point and also highlights the fact that ontological problems analogous to those that can be eradicated by paying attention to the logic of descriptions can be eradicated by paying attention to the logic of anaphora:

(51) Hob$_1$ thinks that [a witch]$_2$ killed Trigger. He$_1$ also suspects that she$_2$ blighted Daisy.

Surely there is a reading of (51) that can be true even if there are no witches. Suppose Hob thinks there are witches and has been led to believe that a witch killed Trigger. Suppose he is then led to believe that a witch blighted Daisy and that *one* witch is responsible for both acts. When the pronoun "she" is understood as the small-scope description "the witch who killed Trigger", (51) correctly describes this situation. In short, Russell's insights concerning overt descriptions carry over to pronouns interpreted as descriptions, and again we are assured a sensible interpretation of a sentence containing a non-denoting expression without ontological inflation.

There would appear to be no reason, then, to dispute the claim that RQ and BQ have precisely the same expressive power and exactly the same capacity for encoding antecedent-anaphor relations. I have used RQ because its formulae tend to be easier to parse and because it allows us to view quantified noun phrases as the sorts of *syntactical* units utilized in the best theory of syntax available. If the logical form of a sentence is the structure imposed upon it in the course of providing a systematic semantics based on a systematic syntax, at the present time RQ seems to be exactly what we need. Moreover, the general framework allows us to incorporate Russell's insights about the semantics of definite and indefinite descriptions at no cost, thereby vindicating Russell as far as technical and aesthetic objections motivated by syntactical and semantical considerations are concerned. Russell cannot be blamed for not having the resources of generalized quantifier theory and generative syntax at his disposal at the beginning of the century; but he can be commended for a truly insightful theory, some of the merits of which are only now emerging.

Notes

† Thanks to Noam Chomsky, Saul Kripke, Richard Larson, Bernard Linsky, Peter Ludlow, Mark Sainsbury, and Scott Soames for valuable discussion. Some of the issues discussed here are taken up in more detail in my "Logical Form and LF". There is considerable overlap in §§2, 5, and 6.

1 Some linguists see themselves as addressing semantical considerations simply by virtue of providing a theory of the relationship between representations of surface syntax and representations in some quasi-logical formalism, a view that appears to be based on the assumption that theories of "logical form", "psychological form", or "conceptual representation" completely obviate the need to explicate the relationship between language and the world (see *e.g.* Hornstein [1984]). I shall not dwell on the difficulties inherent in such views here.

2 Davidson [1967]; Harman [1972], [1975]; Platts [1979]; Wiggins [1980].

3 Davidson [1967], [1975]; Harman [1972], [1975]; Higginbotham [1983], [1987]; Lycan [1984]; Platts [1979]; Wiggins [1980]; Russell [1905].

4 Barwise [1979]; Barwise and Cooper [1981]; Evans [1977]; Heim [1988]; Hintikka [1974]; McCawley [1981]; Montague, Kalish, and Mar [1980]; Neale [1990a]; Wiggins [1980].

5 Rescher [1962]; Kaplan [1966]; and Barwise and Cooper [1981].

6 Barwise and Cooper [1981]; Higginbotham and May [1981]; Higginbotham [1987]; McCawley [1981]; May [1987]; Neale [1990].

7 Sometimes it is suggested that (17) is unambiguous. The thought behind this

suggestion seems to be that since (172) entails (171), the weaker reading can be viewed as giving the truth-conditions of (17); however, in some contexts the speaker seeks to convey something stronger than this, a fact, so the suggestion continues, that can be explained pragmatically by invoking Gricean principles and a distinction between what a speaker literally *says* and what he or she *means*. Like Grice, I think it is fruitful to pursue pragmatic explanations of alleged ambiguities wherever possible; but in the present example the case for a genuine truth-conditional, structurally determined ambiguity is overwhelming.

8 Thomason [1969].

9 Evans [1982]; Linsky [1992].

10 Hintikka [1989]; Hintikka and Kulas [1985]; Hintikka and Sandu [1991].

11 Evans [1977], [1982].

12 There is also a purely formal way of understanding "incomplete symbol". On my account, it is a consequence of the characterization just given (see below).

13 Grice [1969]; Barwise and Cooper [1981]; Higginbotham and May [1981]; Neale [1990].

14 In fact, (ix) itself can be simplified. However, questions about the syntax, semantics, and systematicity of the axioms (and the metalanguage in which they are stated), as well as questions about the distinction between semantics and analysis, have a considerable bearing on the proper form of any truth definition that is to play a serious role in a semantical theory for natural language and also on the characterization of that role itself.

15 Chomsky [1975]; Evans [1977].

16 Linsky [1992].

17 As Saul Kripke has pointed out to me, Russell himself seems to be aware of this in the opening paragraph of "On Denoting".

18 There are also a number of problems in Linsky's discussions of (a) quantified modal statements, (b) the relationship between logical form and truth conditions, and (c) the relationship between logical form and the formalisms of a representational system. I plan to comment in detail at some point.

19 Chomsky [1975], [1977], [1980], [1981], [1986].

20 See, *e.g.*, Harman [1972], [1975]; Lakoff [1971], [1972]; McCawley [1968], [1970], [1972]; and Ross [1974].

21 Chomsky [1977], [1981], [1986]; Higginbotham [1980], [1983], [1987]; Higginbotham and May [1981].

22 As a matter of fact, I am not convinced there is a need for D-Structure. My own inclination is to see LF as the most basic level with surface-structure representations just projections of LF representations (for a preliminary discussion, see Neale [1992]). Although I use the label "S-Structure", Chomsky has pointed out to me that ultimately what I have in mind is arguably better thought of as PF ("Phonetic Form").

23 Chomsky [1977], [1981], [1986]; Higginbotham [1980], [1983]; Higginbotham and May [1981]; May [1987].

24 In current versions of Chomsky's Extended Standard Theory, it can be viewed as an instance (along with, *e.g.* *wh*-movement ("*wh*-evacuation")) of the more general schema "move α". For detailed discussion, see Chomsky [1981], [1986]. Arguably, quantified NPs may be adjoined to categories other than S, for example NP or VP. For the concerns of the present paper, it will do no harm to assume that quantified NPs adjoin only to S nodes.

25 It is sometimes claimed that theories of LF or logical form cannot be contributions to *semantics* because they are theories about representations and inferential relations rather than about the relationship between language and the world. However, it should be perfectly clear that anyone who (a) views a fully worked-out theory of LF as a fully worked-out theory of logical form and (b) takes the logical form of a sentence to be the structure imposed upon it in the course of providing a truth definition cannot be accused of failing to hook up language and the world. By saying this, I hope it is clear that I am distancing myself from certain ways of viewing LF that have appeared in the literature. For the record, I wish to explicitly distance myself from the LF theory proposed by Hornstein [1984] and the account of definite descriptions proposed therein. For important work on LF in the tradition to which I see the present paper as belonging, see Higginbotham [1980], [1983], [1987]; Higginbotham and May [1981]; and May [1987]. Criticisms of some conceptions of LF can be found in Hintikka [1989] and Hintikka and Sandu [1991].

26 Bach [1968]; Harman [1972]; Lakoff [1971], [1972]; McCawley [1968], [1970], [1972]. This principle is stated explicitly in Harman's paper, though he does not use the *term* "c-command", which is due to Reinhart. For Harman *et al.*, the level of linguistic representation relevant to semantical interpretation was Deep Structure, but a Deep Structure with much more affinity to LF than current D-Structure. The relevance of c-command to the interpretation of certain anaphoric pronouns as variables bound by quantified NPs was noticed by, *inter alia*, Evans [1977] and Reinhart [1978]. With the benefit of hindsight, it is clear that the relevance of the notion of c-command to bound pronouns is a trivial consequence of the truth of the Bach-Harman-Lakoff-McCawley Thesis.

27 Soames [1990] suggests that this may be too simplistic a picture.

28 I am suppressing the difficulties raised by occurrences of names in the referentially opaque contexts created by verbs of propositional attitude. Contrary to what some people have thought, modal contexts are not referentially opaque (see Neale [1990], Chap. 4), so I am suppressing no difficulty raised by names in modal contexts.

29 According to Lasnik [1976] pronouns refer to salient objects; the referent of "Dora" is one such object, and since Lasnik's rule of non-coreference does not

preclude "Dora" and "she" from being coreferential in (18), one possible way of understanding the sentence has "she" referring to Dora. So on Lasnik's account we do not get grammatically specified anaphora here. Lasnik's theory is criticized by Evans [1980].

30 The reader is asked to ignore (until the next section) the fact that in each of (27)–(29) the VP contains a quantificational NP. I am concerned at this point only with the anaphoric pronoun within the VP.

31 Example (28) reinforces the Russellian point that the scope of a description matters even in an extensional context: if "the woman he married" contains a pronoun bound by "the president", then the first must have larger scope. The matter of quantifier-quantifier scope is addressed in the next section.

32 Higginbotham [1987]. In principle, we might also find two sentences that differ in respect of S-Structure representation but not in respect of LF representation. Examples might be (i) and (ii), where each is construed as the sentence on which "someone" has small scope:

(i) Someone is certain to win the lottery
(ii) It is certain someone will win the lottery.

33 I hope this point is clear despite the fact that I make no attempt to provide the additional axioms necessary to provide a truth definition for an extension of RQ containing verbs of propositional attitude. As is well known, there are tremendous philosophical and technical problems involved in attempting to provide such axioms. Suffice to say they will have to comport with the fact that (12) is the surface manifestation of (at least) two sentences that do not entail one another. (For interesting proposals, see Davidson [1968] and Larson and Ludlow [1992].)

As pointed out by Smullyan [1948], the same sort of ambiguity is found in constructions containing modal operators and descriptions:

(i) The first person to climb Kilimanjaro might have been American
(ii) The number of planets is necessarily odd.

By comparison with attitude verbs, modal adverbs do not create very much difficulty when it comes to formulating axioms that bring them within the purview of a truth definition (see Peacocke [1978] and Davies [1981]). As pointed out by Kripke [1977], the ambiguities of scope in attitude and modal constructions predicted by Russell's theory cannot be replaced by some sort of ambiguity in the definite article.

34 Other ways have been suggested for capturing such ambiguities but they have not met with much success. For discussion, see Kripke [1977], Neale [1990], and Ludlow and Neale [1991].

35 A question that naturally arises at this point is whether evacuated quantified NPs can adjoin only to S nodes. There may well be reasons for holding that evacuees may adjoin to *any* superior node (or any superior node of specified types, *e.g.* maximal projections, or any node at all). This is not a matter for *a priori* stipulation, it is a question for empirical research. For discussion, see May [1985].

36 This appears to be the view of Hornstein [1984], who uses examples similar to (35) and (36) to motivate his non-Russellian account of descriptions according to which they are always interpreted as if they took wide interpretive scope, something he sees as explicable on the assumption that they are closer to ordinary referring expressions than quantifiers that undergo evacuation. This position is criticized by Soames [1987] and Neale [1990].

37 Following Barwise [1979] and Barwise and Cooper [1981], a determiner D is monotone decreasing just in case (i) is valid:

(i) $$\frac{\begin{array}{l}[D_k\,\alpha]_k\,\beta\\ [\text{every}_k\,\beta']_k\,\beta\end{array}}{[D_k\,\alpha]_k\,\beta'}$$

Quick test: D is monotone decreasing just in case (ii) entails (iii):

(ii) D dog(s) were barking
(iii) D dog(s) were barking loudly.

Examples: "no", "few", "fewer than seven". (For convenience, if D is monotone decreasing, let's say that a quantifier $\ulcorner [D_k\,\alpha]_k \urcorner$ is also monotone decreasing, for any α.

38 See *e.g.* Harman [1972]; McCawley [1972].

39 It is not necessary for the quantified noun phrase to c-command the pronoun at S-Structure. Consider the following examples, due to May [1987]:

(i) [The father of [each girl]$_2$]$_1$ waved to her$_2$
(ii) [Some man from [every city]$_2$]$_1$ despises it$_2$

In each of these sentences, the complex quantified NP in subject position contains, as a proper part, another quantified NP that (a) is understood with largest scope and (b) appears to bind a subsequent pronoun. Take (ii). Evacuating the subject quantifier to the top of the tree yields the intermediate representation (iii):

(iii) [$_S$ [some man from [every city]$_2$]$_1$ [$_S$ e_1 despises it$_2$]].

Evacuating "every city" to the top of the intermediate tree yields (iv):

(iv) [$_S$ [every city]$_2$ [$_S$ [some man from e_2]$_1$ [$_S$ e_1 despises it$_2$]]].

In RQ notation this is just (v)

(v) [every$_2$ city x_2]$_2$ ([some$_1$ man x_1 & x_1 is from x_2]$_1$ (x_1 despises x_2)).

which has exactly the right truth conditions. In the LF representation (iv) the pronoun "it" is within the scope of (*i.e.* c-commanded by) "every city", so it is legitimately understood as a variable bound by that quantified NP. From a truth-conditional perspective this turns out to be exactly right; witness the fidelity of (v). In short, the LF theorist has a very elegant account of the fact that (v) gives the truth conditions of (ii). (Similarly with (i) and an indefinite number of similar examples). If we were to state a descriptive generalization, it would be the following: a pronoun P can be understood as a variable bound by a quantified NP Q only if Q c-commands P at LF. But of course this doesn't need to be stated anywhere: it is a consequence of the general theory.

40 Examples like (38) and (39) raise a question that the LF theorist must confront at some point: If (i) LF is derived from S-Structure by a series of evacuations, and (ii) the S-Structure representation of a conjunction $\ulcorner \alpha$ and $\beta \urcorner$ contains two subsentences as in the structure $[_{S0} [_{S1} \alpha]$ and $[_{S2} \beta]]$, then some sort of constraint on evacuation appears to be required to prevent a QNP that is a constituent of S1 (or S2) in such a structure (whether or not S0 is a constituent of a larger S) from Chomsky-adjoining to S0. For without such a constraint the LFs (38_2) and (39_2) could be derived from the S-Structures for (38) and (39):

(38_2) $[_S$ [some hens]$_1$ $[_S [_S$ [Russell bought e_1] and $[_S$ Whitehead vaccinated them$_1$]]]

(39_2) $[_S$ [just one man]$_1$ $[_S [_S$ e_1 drank rum] and $[_S$ he$_1$ was ill this morning]]].

And in RQ notation (38_2) and (39_2) are just (38_1) and (39_1), which as we have already seen ascribe the wrong truth conditions to (38) and (39). For discussion, see Neale [1992].

41 Evans [1977], [1980]; Davies [1981]; Neale [1990].

42 There is no space here to discuss the question of the precise status of (F) *vis-à-vis* an adequate truth definition and its role within a theory of LF. For discussion, see Neale [1992].

43 This label (borrowed loosely from Sommers [1982]) is meant to conjure up both the similarities and differences between D-type pronouns and Evans's [1977], [1980] *E-type* pronouns. On the differences, see below.

44 I should stress that there is still considerable work to be done if the D-type theory of unbound anaphora is to form part of a general theory that appeals to LF as I am construing it. For a preliminary discussion, see Neale [1992].

45 Davies [1981]; Soames [1989].

46 It is important to see that the LF/D-type theory differs significantly from Evans' E-type theory. On Evans' account (i) a pronoun P anaphoric on a quantified NP Q is an *E-type* pronoun iff P is not c-commanded by Q at S-Structure, and (ii) E-type pronouns are referring expressions whose references are fixed rigidly by description (in the sense of Kripke [1972]). By contrast, Principle (F) of the LF/D-type theory is stated in terms of LF representations and the axioms for "the". This is a syntactically and semantically significant fact: (i) D-type pronouns are quantified NPs and hence undergo evacuation, and (ii) the axioms of the truth definition operate on LF representations. As Russell stressed, serious philosophical error may be the reward for confusing reference and quantification, so the philosophical grammarian must be sensitive to the distinction between E-type and D-type interpretations. And of course linguists who want to appeal to LF (as I have construed it) must also pay attention to the distinction.

Although the pronoun "he" in (39) is understood as "the man who drank rum", it certainly does not have its reference fixed by this description, and hence it would be a mistake to think of it is an E-type pronoun. If it had its reference fixed by description, it would refer to the man who actually drank rum – call him "Gideon" – and so what is expressed by (39) would be true at any circumstance of evaluation in which just one man drank rum and Gideon was ill this morning. But this is clearly wrong, so the occurrence of "he" in (39) does not receive an E-type interpretation (this type of argument against Evans' theory was first presented by Soames [1989]).

Although Evans says explicitly that E-type pronouns are rigid referring expressions, in his formalism they end up being treated as equivalent to Russellian descriptions that insist on large scope. But even this modified notion of an E-type interpretation will not do because of examples such as (41) and (42). In each case, it is clear that the description "he" can be understood with small scope (see above). It is clear, then, that at least some unbound anaphoric pronouns receive D-type rather than (modified) E-type interpretations.

In the absence of evidence for the existence of (modified) E-type interpretations, I suggested in *Descriptions* that natural languages are simply not the sorts of languages that contain E-type pronouns. To say this is not to say that the notion of an E-type pronoun is incoherent. On the contrary, it is a simple matter to construct an intelligible artificial language containing such expressions. My claim is an empirical one: such a language would indeed be *artificial*; natural languages are of such a nature that they do not contain E-type pronouns. The difference between E-type and D-type interpretations is, then, very marked. All the more so if there are, as maintained in Neale [1992], correlated syntactical, semantical, and structural differences between referential and quantificational NPs.

47 Evans [1977]; Wiggins [1980]; Davies [1981].

48 See Davies [1981].

49 Following Quine [1960] and Evans [1977], it is usual to think of relative pronouns (as they occur in restrictive relative clauses) as devices of *predicate abstraction* rather than as variables. On such an account, the logical forms of (44) and (45) are given by (44_3) and (45_3), respectively:

(44_3) [the$_1$ farmer x_1 & $[\lambda x_2](x_2$ bought Daisy$)x_1]_1$ (x_1 is happy)

(45_3) [the$_1$ farmer x_1 & $[\lambda x_2]$(Daisy kicked $x_2)x_1]_1$ (x_1 is unhappy).

However, for the sake of simplicity the relative pronouns in (44) and (45) are often thought of as variables bound by determiners since (44_1) and (45_1) are equivalent (by lambda-elimination) to (44_3) and (45_3). A good reason for preferring the semantical structures in (44_3) and (45_3) is that they fit well with the view that at LF (and in English at S-Structure) relative pronouns occupy non-argument positions and as such are naturally treated as variable-binding operators. For syntactical considerations that lend support for such a view, see Chomsky [1986], Chap. 2.

50 See *e.g.* Evans [1977]; Kamp [1981]; Heim [1988]; Neale [1990a].

51 A large-scope reading for the embedded quantifier comes through clearly in the following example:

(i) Every man who saw [a painting I bought last week]$_1$ wanted to buy it$_1$.

It is important not to confuse the idea that the indefinite description in (i) may take large scope with the idea that it admits of a semantically referential interpretation. See Kripke [1977] and Ludlow and Neale [1991].

52 Evans [1982], p. 59.

53 Evans [1977], pp. 134–9.

54 The reading of (48) upon which the embedded quantifier has small scope is equivalent to the reading upon which it has large scope and binds "her". In essence, this is really a consequence of the fact that scope permutations involving definite descriptions and quantifiers that are not monotone decreasing are truth-conditionally inert; this has no bearing on the issue discussed in the text.

55 See also Davies [1981]; Wilson [1984]; McKinsey [1986]; Soames [1989]; Neale [1990].

References

Bach, E. [1968] "Nouns and Noun Phrases", in E. Bach and R. Harms (eds), *Universals in Linguistic Theory*, New York: Holt, Reinhart, Winston, 91–124.

Barwise, J. [1979] "Branching Quantifiers in English", *Journal of Philosophical Logic*, **8**, 47–80.

– [1989] *The Situation in Logic*, Stanford: CSLI Publications.

Barwise, J., and R. Cooper [1981] "Generalized Quantifiers and Natural Language", *Linguistics and Philosophy*, **4**, 159–219.

Chomsky, N. [1970] "Remarks on Nominalization", in Chomsky, *Studies on Semantics in Generative Grammar*, The Hague: Mouton 1972, 11–61.

– [1975] *Reflections on Language*, New York: Pantheon.

– [1977] *Essays on Form and Interpretation*, New York: North Holland.

– [1980] *Rules and Representations*, Oxford: Blackwell.

– [1981] *Lectures on Government and Binding*, Dordrecht: Foris.

– [1986] *Knowledge of Language*, New York: Praeger.

Cooper, R. [1983] *Quantification and Syntactic Theory*, Dordrecht: Reidel.

Davidson, D. [1967] "Truth and Meaning", *Synthese*, **17**, 304–23.

– [1967a] "The Logical Form of Action Sentences", in N. Rescher (ed.), *The Logic of Decision and Action*, Pittsburgh: University of Pittsburgh Press, 81–95.

– [1968] "On Saying That", *Synthese*, **19**, 130–46.

– [1973] "In Defense of Convention T", in H. Leblanc (ed.), *Truth, Syntax, and Modality*, Amsterdam: North Holland, 65–75.

– [1975] "Semantics for Natural Languages", in D. Davidson and G. Harman (eds), *The Logic of Grammar*, New York: Dickenson, 18–24.

Davies, M. [1981] *Meaning, Quantification, Necessity*, London: Routledge & Kegan Paul.

Donnellan, K. [1966] "Reference and Definite Descriptions", *Philosophical Review*, **77**, 281–304.

Evans, G. [1977] "Pronouns, Quantifiers and Relative Clauses (I)", *Canadian Journal of Philosophy*, **7**, 467–536. Reprinted in G. Evans, *Collected Papers*, Oxford: Clarendon Press 1985, 76–152. References to the latter.

– [1977a] "Pronouns, Quantifiers and Relative Clauses (II)", *Canadian Journal of Philosophy*, **7**, 777–97.

– [1980] "Pronouns", *Linguistic Inquiry*, **11**, 337–62.

– [1982] *The Varieties of Reference*, Oxford: Clarendon Press.

Grice, H.P. [1969] "Vacuous Names", in D. Davidson and J. Hintikka (eds), *Words and Objections*, Dordrecht: Reidel, 118–45.

Harman, G. [1972] "Deep Structure as Logical Form", in D. Davidson & G. Harman (eds), *Semantics of Natural Language*, Dordrecht: Reidel, 25–47.

– [1975] "Logical Form", in D. Davidson & G. Harman (eds), *The Logic of Grammar*, New York: Dickenson, 289–307.

Heim, I. [1988] *The Semantics of Definite and Indefinite Noun Phrases*, New York: Garland Press.

Higginbotham, J. [1980] "Pronouns and Bound Variables", *Linguistic Inquiry*, **11**, 679–708.

– [1983] "Logical Form, Binding, and Nominals", *Linguistic Inquiry*, **14**, 395–420.

– [1987] "On Semantics", in E. LePore (ed.), *New Directions in Semantics*, New York: Academic Press, 1–54.

Higginbotham, J., and R. May [1981] "Questions, Quantifiers, and Crossing", *Linguistic Review*, **1**, 41–80.

Hintikka, J. [1974] "Quantifiers and Quantification Theory", *Linguistic Inquiry*, **5**, 153–77.

– [1989] "Logical Form and Linguistic Theory", in A. George (ed.), *Reflections on Chomsky*, Oxford: Blackwell, 41–57.

Hintikka, J., and J. Kulas [1985] *Anaphora and Definite Descriptions*, Dordrecht: Reidel.

Hintikka, J., and G. Sandu [1991] *The Methodology of Linguistics*, Oxford: Blackwell.

Hornstein, N. [1984] *Logic as Grammar*, Cambridge, Mass.: MIT Press.

Kamp, H. [1981] "A Theory of Truth and Semantic Interpretation", in J. Groenendijk *et al.* (eds), *Formal Methods in the Study of Natural Language*, Amsterdam: Amsterdam Centre, 277–322.

Kaplan, D. [1966] "Rescher's Plurality–Quantification", *Journal of Symbolic Logic*, **31**, 153–4.

Kripke, S. A. [1972] "Naming and Necessity", in D. Davidson and G. Harman (eds), *Semantics of Natural Language*, Dordrecht: Reidel, 253–355, 763–69.

– [1977] "Speaker Reference and Semantic Reference", in P.A. French, T.E. Uehling, Jr., and H.K. Wettstein, *Contemporary Perspectives in the Philosophy of Language*, Minneapolis: University of Minnesota Press, 6–27.

Lakoff, G. [1971] "On Generative Semantics", in D. Steinberg and L. Jakobovits (eds), *Semantics*, Cambridge: Cambridge University Press, 232–96.

– [1972] "Linguistics and Natural Logic", in D. Davidson and G. Harman (eds), *Semantics of Natural Language*, Dordrecht: Reidel, 545–665.

Larson, R., and P. Ludlow [1992] "Interpreted Logical Forms", to appear in *Synthese*.

Lasnik, H. [1976] "Remarks on Coreference", *Linguistic Analysis*, **2**, 1–22.

Linsky, B. [1992] "The Logical Form of Descriptions", to appear in *Dialogue*.

Ludlow, P., and S. Neale [1991] "Indefinite Descriptions: In Defense of Russell", *Linguistics and Philosophy*, **14**, 171–202.

Lycan, W. [1984] *Logical Form in Natural Language*, Cambridge, Mass.: MIT Press.

McCawley, J. [1968] "The Role of Semantics in Grammar", in E. Bach and R. Harms (eds), *Universals in Linguistic Theory*, New York: Holt, Reinhart, Winston, 125–70.

– [1970] "Where Do Noun Phrases Come From?", in R. Jacobs and P. Rosenbaum (eds), *Readings in English Transformational Grammar*, Waltham, Mass.: Ginnand Co., 166–83.

– [1972] "A Program for Logic", in D. Davidson and G. Harman (eds), *Semantics of Natural Language*, Dordrecht: Reidel, 498–544.

– [1981] *Everything That Linguists Have Always Wanted to Know About Logic*, Chicago: University of Chicago Press.

McKinsey, M. [1986] "Mental Anaphora", *Synthese*, **66**, 159–75.

May, R. [1985] *Logical Form: Its Structure and Derivation*, Cambridge, Mass.: MIT Press.

– [1987] "Logical Form as a Level of Linguistic Representation", in E. LePore (ed.), *New Directions in Semantics*, New York: Academic Press, 187–218.

Montague, R., D. Kalish, and G. Mar [1980] *Logic: Techniques of Formal Reasoning*, New York: Harcourt, Brace, Jovanovich.

Neale, S. [1990] *Descriptions*, Cambridge, Mass.: MIT Press.

– [1990a] "Descriptive Pronouns and Donkey Anaphora", *Journal of Philosophy*, **87**, 113–50.

– [1992] "Logical Form and LF", to appear in C. Otero (ed.), *Noam Chomsky: Critical Assessments*, London: Routledge & Kegan Paul.

– [Forthcoming] *The Language of Philosophy*.

Peacocke, C. [1978] "Necessity and Truth Theories", *Journal of Philosophical Logic*, **7**, 473–500.

Platts, M. [1979] *Ways of Meaning*, London: Routledge & Kegan Paul.

Quine, W.V. [1960] *Word and Object*, Cambridge, Mass: MIT Press.

Reinhart, T. [1978] "Syntactic Domains for Semantic Rules", in F. Guenthner and S.J. Schmidt (eds), *Formal Semantics and Pragmatics for Natural Languages*, Dordrecht: Reidel, 107–30.

– [1983] *Anaphora and Semantic Interpretation*, London: Croon Helm.

Rescher, N. [1962] "Plurality-quantification", abstract in *Journal of Symbolic Logic*, **27**, 373–4.

Ross, J.R. [1974] "Excerpts from *Constraints on Variables in Syntax*", in G. Harman (ed.), *On Noam Chomsky: Critical Essays*, Amhertst, Mass.: U. of Massachusetts Press 1974, 165–200.

Russell, Bertrand A.W. [1905] "On Denoting", *Mind*, **14**, 479–93.

Smullyan, A.F. [1948] "Modality and Description", *Journal of Symbolic Logic*, **13**, 31–7.

Soames, S. [1987] Review of Hornstein's *Logic as Grammar*, *Journal of Philosophy*, **84**, 447–55.

– [1989] Review of Gareth Evans' *Collected Papers*, *Journal of Philosophy*, **86**, 141–56.

– [1990] "Pronouns and Propositional Attitudes", *Proceedings of the Aristotelian Society*, **40**, 191–212.

Sommers, F. [1982] *The Logic of Natural Language*, Oxford: Clarendon Press.

Thomason, R. [1969] "Modal Logic and Metaphysics", in K. Lambert (ed.), *The Logical Way of Doing Things*, New Haven: Yale University Press, 119–46.

Wiggins, D. [1980] "'Most' and 'All': Some Comments on a Familiar Programme, and on the Logical Form of Quantified Sentences", in M. Platts (ed.), *Reference, Truth, and Reality*, London: Routledge & Kegan Paul, 318–46.

Williams, E. [1977] "Discourse and Logical Form", *Linguistic Inquiry*, **8**, 101–38.

Wilson, G. [1984] "Pronouns and Pronominal Descriptions: A New Semantical Category", *Philosophical Studies*, **45**, 1–30.

Whitehead, Alfred North, and Bertrand A.W. Russell [1910, 1912, 1913] *Principia Mathematica*, 3 vols, 2nd ed., New York: Cambridge University Press 1925 (vol. 1), 1927 (vols 2, 3).