CHAPTER THREE

COMING TO TERMS WITH SOMMERS

Classical logic was obviously in closer accord with natural language forms than its modern successor. The intriguing logical question remains, whether this modest rehabilitation might be pursued to create a "classical" theory of inference, rivalling, say, Fregean predicate logic in breadth of coverage and elegance of presentation.

J. van Bentham

There are now two systems of notation, giving the same formal results, one of which gives them with self-evident force and meaning, the other by dark and symbolic processes. The burden of proof is shifted, and it must be for the author or supporter of the dark system to show that it is in some way superior to the evident system.

Jevons

The Calculus of Terms

Such is the advantage of a well-constructed language that its simplified notation often becomes the source of profound theories.

Laplace

An important step in solving a problem is to choose the notation. It should be done carefully. The time we spend now on choosing the notation carefully may be repaid by the time we save later by avoiding hesitation and confusion.

G. Polya

A good notation [is] . . . like a live teacher.

Russell

According to contemporary theories of scientific evolution (first Popper's, but more particularly those of Kuhn and Lakatos), an established "normal" science, accepted as paradigmatic by those working within the field, eventually gives way under pressure to a new theory or science. A "paradigm shift" takes place. A new "research programme" is instituted.

A revolution has taken place within the science. Such scientific revolutions are the result of several predictable factors. During the period of normal, pre-revolutionary science, the established theory is seen as accounting for a significant and large portion of relevant phenomena. Its ability to do so depends on the acceptance of certain assumptions and conjectures, which are accepted because of the explanatory power of the theory based upon them. Moreover, the established theory is "progressive" in that it opens up new areas of research and offers explanations, which, in turn, lead to even further new research programmes. Eventually, however, there comes a "crisis." Limitations are found in the main (and subsidiary) theory. Paradoxes are revealed that had been ignored or forgotten. Refutations of the explanatory theses and, eventually, of the ground assumptions and conjectures proliferate. Rival paradigms begin to demand attention. Defections of researchers from the old theory begin. This period of crisis, this revolution, ends only when one of these rival theories commands enough allegiance from researchers to serve as a new paradigm. Acceptance of the new paradigm is the result of the general agreement that the new theory can solve or dissolve the anomalies and paradoxes hidden within the old, and that it can match or exceed the old theory's power to solve problems and furnish explanations. A theory that may have been viewed as outlandish or radical or ultra-reactionary may, in time, turn out to be the new paradigm, the next normal science. "Theories, which looked counter-intuitive or even perverted when first proposed, assume authority" (Lakatos, 1978, 2: 41). From the point of view of the new science, the old theory is seen as riddled with paradox, nonprogressive, and dogmatic. This picture, or something fairly similar, is now generally accepted to be a good portrait of the rise and fall of scientific theories. Science is seen as continually progressing along this roller-coaster track. No theory can rest in the false security that it is irrefutable, that no revolutionary theory could ever capture the throne. A scientific theory that cannot even accept the possibility of its own replacement is no scientific theory at all.

Kant told us in the first *Critique* that logic was just that kind of science—complete. For him, the possibility of the logic he knew being replaced by a different logic was unthinkable. But, of course, he was wrong. Unfortunately, even with the example of Kant as an object lesson, most contemporary logicians persist in believing that the system of logic now entrenched as *the* logic, normal logic, will never be replaced by any other theory. It is unfortunate that so many contemporary logicians have this attitude toward their field of study, since the fact is that logic is now in a period of crisis and revolution. And, as with any other science, this new revolution is just the latest in a string of such periods that have punctuated its long history. That most contemporary logicians fail to see this is due in part to the false security they derive from their numbers and in part to their lack of interest in the history of their subject. Researchers working in the midst of an established theory rarely look farther back in time than to the

revolution that placed their own theory in power. All those who toiled the field before that time were simply wrong; all those who now try to till the field outside the castle walls are simply radicals. Neither deserves serious attention. Thus defenders of today's established logic see the *real* history of logic beginning with Frege.

Still, Frege's revolution was not the first in logic, and today's logic no longer lacks serious challengers. The Stoic logicians may very well have thought of themselves as shifting from Aristotle's logical paradigm to their own. Thirteenth-century logicians certainly began a revolution, which eventually moved logic from the preservation of Peripatetic formulae to the exploration of the science of language. Humanist logicians of the Renaissance revolted against the established Scholastic logic and replaced it with a logic of invention and rhetoric. Nineteenth-century algebraists rejected the established mix of Scholastic, Humanist, and empiricist logic in favour of a logic modelled on the formal features of mathematics. The algebraist revolution never succeeded in establishing its own dominion (perhaps like many now-forgotten failed revolutions before it), for in the midst of the algebraic revolution Frege initiated a different revolutionary research programme that soon swamped all rivals and established itself as the normal logic of the day.

Frege's revolution succeeded for the same reason that any successful scientific revolution succeeds. Frege rebelled not just against the algebraists (who, at any rate, had not yet accumulated much power), but against *all* previous logic—"traditional logic." The revolution succeeded because it was able to reveal a number of anomalies in traditional logic, because it provided a logical theory that had far more explanatory power than any previous theory, and because it was exceedingly progressive, leading to a very large number of new research programmes (in semantics, modal theory, mathematics, cybernetics, linguistics, etc.). The result of that revolution was the entrenchment of the now standard first-order predicate calculus as the established, correct theory of logic. Now, according to our Kuhnian picture, a new paradigm or research programme will maintain its hegemony as long as it is progressing. Eventually, however, it will begin to flounder and stagnate. Unresolved paradoxes and anomalies will re-emerge. Critics and rivals will proliferate. This period of crisis will ultimately give way to all-out revolution. Frege's logic has been fairly stagnant for the past two decades or so. Whatever progressive energy remains in its research programme is devoted to problems that are far more mathematical than logical (this is easily confirmed by reading the *Journal of Symbolic Logic*). The established logic has become dogmatic and inflexible. It is taught to students as received truth rather than as a potent research tool. For the past quarter of a century, critics have ever more frequently pointed to unresolved problems and weaknesses in the logic. Rival theories (free logic, intensional logic, informal logic, paraconsistent logic, generalized quantifier theory, branching quantifier theory, fuzzy logic, relational algebra, and a variety of other theories in formal semantics) have demanded hearings in larger numbers and louder voices. In spite of the continued hegemony of mathematical logic in the schools, that logic has been rejected in recent years by growing numbers of researchers.

While there are sometimes trivial reasons for this rejection, there are some important reasons as well. Foremost among these are the following: (1) it is based on a theory of logical syntax that is remote from natural language syntax; (2) while it is far more powerful in terms of its ability to model inferences than is traditional logic, there are, nonetheless, simple inferences beyond its scope; and (3) it is unnecessarily complex. Alternative, nonstandard versions of mathematical logic have been offered in response to (2); informal logic has been offered, in part, as a response to (1) and (3) (and perhaps [2]). Moreover, it is not only philosophers and mathematicians who are interested in the well-being of logic; the issue is of great import for the linguists who are seeking to show that there are language universals, syntactic and semantic characteristics common to *all* natural languages. Many of these researchers have been looking to formal logic for insights. Some cognitive psychologists now believe that the core of rational human thought is reflected in the kind of inferences that have always interested logicians. One of the most active areas of research in artificial intelligence involves attempts to develop a machine programme for translating from one language—say, English—into another—say, Spanish. This would make computers responsible for the job of translation, which is now done slowly (and expensively) by humans. All attempts to develop such a programme have so far failed, but many now believe that what is required is a "mediating language" into which any natural language could first be translated, and which would then be translated back into the second natural language. Such a mediating language could not be any given natural language, but an artificial language that exhibits all features common to all natural languages. Since systems of logic can be viewed as artificial languages, they are prime candidates for the role of mediation. Finally, the old (but perhaps newly appreciated) crisis in education has led large numbers of education theorists to argue that the missing ingredient in education is the imparting of "critical thinking" skills. In each case, these theorists have come to look at logic (orthodox or otherwise) as the tool the students must acquire in order to be able to think critically.

Yehoshua Bar-Hillel's challenge of a quarter century ago is still unmet by standard logicians.

> I challenge anybody here to show me a serious piece of argumentation in natural languages that has been successfully evaluated as to its validity with the help of formal logic. I regard this fact as one of the greatest scandals of human existence. Why has this happened? How did it come to be that logic, which at least in the views of some people 2300 years ago, was

> supposed to deal with evaluations of argumentations in natural languages, has done a lot of extremely interesting and important things, but not this? (Quoted in Staal, 1969: 256)

Keeping in mind that Bar-Hillel was referring to both traditional and mathematical versions of formal logic, my view is that what is needed in philosophy, linguistics, cognitive psychology, and other disciplines is a system of formal logic that is (1) natural (in that it is based on a theory of logical syntax close to natural-language syntax), (2) as powerful as (or more powerful than) the standard system now in place, and (3) provided with a symbolic algorithm that is easy to learn, simple to manipulate, and effective.

Such a system of logic has been devised in recent years by Fred Sommers and his colleagues. Like most pre-Fregean systems, it is a logic of terms, a logic first begun by Aristotle and fully envisaged (but not completed) by Leibniz. Those who have abandoned formal logic have, perhaps unwittingly, closed the door not only to mathematical logic (which surely does not meet their needs) but to this revised traditional formal logic (which just might be found satisfactory). Philosophy, especially, cannot abjure formal logic completely.

Sommers's logic is intimately connected with, and indeed grew out of, his work on language structure and ontology, which began in the late 1950s (see especially 1959, 1963a, 1965, 1971). He showed that between any pair of ordinary language categorematic terms is a semantic relation that either allows them to stand as subject- and predicate-terms of a meaningful categorical sentence or prevents them from so standing (the so-called U and N relations, respectively). Some terms share all of the same U and N relations (e.g., 'blue' and 'red'); these are "categorially synonymous." Any term and its logical contrary (its negation)—for instance, 'red' and 'nonred'—are categorially synonymous. (Note that, while the contrast between 'blue' and 'red' is semantic, the 'red'/'nonred' contrast is syntactic.) Suppose one could write down all the (nonformative) terms of a language such as English, connecting pairs of terms (or pairs of categorially synonymous groups of terms) with straight lines. It turns out, according to Sommers, that the resulting diagram would be regular, subject to certain structural restrictions. It could be viewed as the "sense structure" of that language. Moreover, whatever the language, the structure is always the same—an inverted finite binary tree (thus "The Ordinary Language Tree"). This way of looking at language provides a variety of insights into the nature of sense, ambiguity, and so on. But, from a philosophical point of view, its greatest value lies in the fact (which Sommers came to establish as his main thesis) that ontology shares the structure of language—language and ontology are isomorphic. His arguments to support this thesis are grounded on his notion that, given any term and any individual object, either that term can be said to apply sensibly to that object (i.e., can be meaningfully affirmed or denied of it) or it cannot. A term that can so apply to an object is said to "span" it. All the objects spanned by a given term constitute a "category" of individuals (relative to that term). Any individual spanned by a given term is also spanned by any term categorially synonymous with that term. Thus a term and its negation span the same individuals. Categories of individuals stand, then, in a one-to-one correspondence to groups of categorially synonymous terms. This, and the fact that all relations between categories are governed by the same structural constraints as those for terms, guarantees that the structure of categories (the ontology, according to Sommers) is the same as the structure of language. Language, constituted by the senses of categorematic terms, and ontology, constituted by categories of individuals, are isomorphic.[1] The "tree theory" is a powerful analytic tool, applicable to a wide range of problems, and it has, in fact, been applied to issues in philosophical psychology,[2] theology,[3] philosophy of science,[4] and philosophy of language, among others.[5]

At the heart of Sommers's theory are two theses of a particularly logical nature: (1) terms as well as sentences can be negated, and (2) all sentences can be logically construed as categoricals. Neither of these theses is compatible with the prevailing logical orthodoxy. Sommers was well aware of this. By the mid-1960s, he had come to formulate explicitly how his own logical view differed from those of Frege and his followers. In "On a Fregean Dogma" (1967), Sommers rejects outright a view held firmly by Frege and Russell, writing, "There is . . . no good logical reason for saying that general and singular statements must differ in logical form" (47). The insistence that a singular (e.g., 'Socrates is mortal') and a general (e.g., 'Men are mortal') differ in logical form rests on the assumption that the general (but not the singular) predication involves quantifiers. 'Men are mortal' is true just in the case when 'mortal' is true of whatever 'man' is true of. In contrast, 'Socrates is mortal' is true just in the case when Socrates is mortal. The assumption made here is itself dependent on an even more fundamental assumption: predication cannot be to plural subjects. When we say that men are mortal, we are not predicating 'mortal' of *men* but of each individual of whom 'man' is true. The presumption is that all predication is logically singular. It is for 'Socrates is mortal'. It is construed so for 'Men are mortal'. This presumption is the Fregean Dogma. Note that what Sommers does not deny is the *grammatical* difference between singular and general predications. His aim is to preserve the traditional notion that, from a logical point of view, predication is indifferent to the singular/plural (general) distinction. His attack goes to the heart of Fregean logic, which, as we have seen, rests four-square on the notion that singular and general terms are fit for quite distinct logical roles.

Exposing an assumption as a mere dogma is of no consequence in the absence of an acceptable alternative account that dispenses with that dogma. Sommers's task, then, is to show how one can construct a logic that does not formally differentiate between singular and general statements. Sommers proceeded independently of Quine in doing this. The first step is

the "dequantification" of general statements (represented by the four standard categoricals). Each is treated as saying something about S's, differing only in what is being said about them. An A statement says of S's that they are P; an O statement simply denies this, saying of S's that they aren't P. An E statement says of S's that they are nonP; an I statement denies this, saying that S's aren't nonP. Thus the logical contrariety between A and E is accounted for by the logical contrariety between a term and its negation. "One reason logicians have ignored the possibility of using plural predication for a dequantified interpretation of the four categoricals is their refusal to accord logical recognition to contrariety as a distinct logical relation between terms" (1967: 50). In offering this reading of the categoricals, Sommers insists on distinguishing *what a statement says* from its *truth conditions*. Such a distinction is either blurred or explicitly rejected by Fregean logicians, but they do so at their peril. After all, it is indeed a truth condition of 'Men are mortal' that each man be mortal. But what 'Men are mortal' says is simply that men are mortal. One of the truth conditions of 'Men are mortal' is that Socrates is mortal, but clearly the statement does not *say* this. The statement affirms mortality not of each man, nor of the class of men, but of men (49, 61-62). Predication is not a reflection of truth conditions; it is a mere linking of pairs of terms (recall that Plato saw no difference here).

Sommers's next step is to account for formal inferences involving categoricals construed as dequantified. Two rules suffice. "Inversion" says that affirming/denying one term of another is equivalent to affirming/denying the second term's logical contrary (its negation) of the first's logical contrary. For example, 'Men are mortal' is equivalent to 'Nonmortals (immortals) are nonmen'. This, along with the innocuous assumption that the logical contrary of the logical contrary of a term is the term itself ('non-non-P'='P'), suffices to establish the usual relations of conversion and obversion (and contraposition). Mediate inference is accounted for in terms of inversion plus the rule of "transitivity," which says that affirmative predication is transitive. Thus, any term affirmed of a second can be affirmed of any term of which that second term is affirmed. For example, if S's are nonP and Q's are S, then Q's are nonP. Inversion and transitivity can be applied directly to syllogisms to determine validity. For example, consider Ferion: 'No M are P, some M are S, so some S aren't P'. This is first paraphrased, via applications of inversion, as: 'M's are nonP, S's are M, so S's are nonP'. Next the inference is put in transitive form (again via inversion), thus: 'S's are M, M's are nonP, so Ss are nonP'. Since transitivity guarantees that the conclusion follows from the premises, the syllogism is valid.

The simple testing procedure outlined above suggested to Sommers an algorithm that allows for fast, direct testing of syllogistic validity by algebraic manipulation. Each statement is formulated as a fraction, with the subject-term as the numerator and the predicate-term as the denominator.

Denial and term negation are both represented by a negative unitary exponent. The algorithm exploits the fact that an inference is valid if and only if the product of its premises algebraically equals its conclusion. The system can apply to syllogisms containing existential statements (construed now as predications with 'things' as subjects) and to syllogisms involving singular statements.[6]

As we have seen, Sommers's primary goal in "On a Fregean Dogma" (1967) is to establish the logical homogeneity for singular and general predications. However, in doing so he recognizes an important logical difference between singular and general *terms*—a difference first noticed by Aristotle. When the subject of a predication is singular, the contrast between affirming a given term of it and denying the logical contrary of that term of it collapses. For example, 'Socrates is poor' is logically equivalent to 'Socrates isn't nonpoor'. This special feature of singulars turns out to play a key role in the term logic that Sommers will subsequently develop.

In "On a Fregean Dogma," we see the beginnings of a programme of logic. We also see most clearly here how that programme is tied to the earlier ontological-linguistic theory.[7] The crucial distinction between denial and term negation (i.e., contradiction and contrariety) is again emphasized. And Sommers begins the process of displaying the fundamental presumptions of Fregean logic that he will reject: Frege's dismissal of the subject/predicate distinction, the absorption of term negation into statement negation, the analysis of general statements (and, after Quine, singular statements) in quantificational terms. Still, "On a Fregean Dogma" represents a programme, in the early state of development, for term logic, taking all statements as logically tying (predicating) one term to another. But the programme is not completed there. In the discussion that followed Sommers's presentation of "On a Fregean Dogma," several contemporary logicians (Kalmar, Quine, Dummett, Lejewski) expressed both incomprehension (especially regarding the denial/negation distinction) and reservation. In particular, they made it clear that the programme would have to be extended to handle relationals. Sommers admits that the scheme offered "is not meant to be a logical instrument of any generality." But he goes on to express his confidence that while extending such a system to relationals may present "formidable" technical difficulties, it is not impossible (78).

In "Do We Need Identity?" (1969a), Sommers returned to the special feature of singular terms mentioned above. He had attributed to Aristotle the insight that while a logical contrast holds between the affirmation/denial of one term of a second and the denial/affirmation of the logical contrary of the first term of the second when the second term is general, no such contrast holds when the second term is singular. For example, 'Men are mortal' is logically distinct from 'Men aren't immortal'. If this example is difficult to see because of the shared truth of both

statements, consider instead 'Numbers are red' and 'Numbers aren't nonred'. These are clearly distinct. Indeed, the first is false while the second is true (as is 'Numbers aren't red' as well). But this logical contrast disappears when the subject is singular. For example, 'Socrates is mortal' and 'Socrates isn't immortal' are logically equivalent. Both are true (unless, again following Aristotle, there is no Socrates; see Sommers, 1967: 72-4).

Sommers's intent in "Do We Need Identity?" is to show how a logic of terms need not distinguish a special sense of 'is'—the so-called 'is' of identity—from the ordinary 'is' of predication. This will turn on the logical feature of singulars that divides them from general terms. Again, the identity sense of 'is' had been successfully urged on modern logicians by Frege (1892a). A statement such as 'Tully is Cicero' must have a predicate (function expression) that is incomplete and general, according to Fregean syntax. In 'Tully is verbose' this is the case: '. . . is verbose' is incomplete and general. But, while we might be tempted to think that '. . . is Cicero' is incomplete, it is certainly not general. Frege insisted that singular terms can never be predicated. The only recourse for him and his followers was to raise the logical status of 'is' in 'Tully is Cicero' from playing *no* logical role (for that is his way with the 'is' of predication) to playing the role of predicate. In such cases, 'is' would be a relational predicate affirmed of the ordered pair ⟨Tully, Cicero⟩.

Now any theory that would reject the distinction between the 'is' of identity and the 'is' of predication would have to allow for the predication of singular terms such as 'Cicero', and would thus treat "identity" statements as nonrelational. Such a theory is considered nonviable by Fregeans. Even Quine's Pegasizing procedure does not allow for singular predicates. 'Tully is Ciceronian' has a general, not a singular, predicate. For Sommers, not only can singular terms be predicated, they can (following the lead of the Scholastics and Leibniz) be the subject-terms of universal or particular statements—that is, they can be quantified (1969a: 501).

If singular terms can play all the same logical roles as general terms, there naturally arises the question of just what difference there is between them. Sommers's answer appeals to Aristotle's principle according to which the denial of a predicate of all/some S is logically equivalent to the affirmation of its contrary to some/all S. For example, 'Some man isn't wise' is logically equivalent to 'Every man is unwise', and, generally:

Every/some S is P = Some/every S isn't nonP

(keeping in mind that the 'n't' of denial and the 'non' of contrariety do not cancel one another). In the case where the subject is a singular term, as Sommers noted in "On a Fregean Dogma," the affirmation of a predicate *is* equivalent to the denial of its logical contrary. For example, 'Socrates is wise' is logically equivalent to 'Socrates isn't unwise'. By following the old course of universally quantifying such singular statements, and by applying

Aristotle's principle, we arrive at the following kind of equivalence (where 's' is a singular term):

Every s is P = Some s is P

In other words, we are led to Leibniz's notion that singular subjects can be treated as (logically) indifferent with respect to their universal or particular quantification. Singular terms in subject position have "wild" quantity (Sommers, 1969a: 502). This, then, is the true nature of the special logical feature enjoyed by singular, but not general, terms.

As it happens, since singular subjects have wild quantity, in such cases we are free to assign quantity as the (inferential) context requires in order to preserve validity. Thus, in the classic inference 'All men are mortal, Socrates is a man, so Socrates is mortal', formal syllogistic validity is guaranteed as long as the singular is given the same quantity in the premise and the conclusion (when the quantity is universal, the syllogism is a Barbara; when it is particular, the syllogism is a Darii). The syllogism 'Socrates is mortal, Socrates is human, so some human is mortal' is valid as long as the two singular subjects are assigned different quantities.

This way of treating singular terms has the effect of eliminating identity as a logically primitive notion. In contrast, as we have seen, standard mathematical logic must treat the logic of identity as a special appendix (since identity as a relation is a special predicate) to the first-order predicate calculus. While identity, for Sommers, is no longer primitive, it *can* be defined. We can define 'x is identical to y' ('x=y') as 'x is y' (where 'x' and 'y' are both singular). Such a definition conforms to the fact that identity is an equivalence relation. It is reflexive, since 'x is x' follows from the tautology 'Every x is x'. It is symmetric, since the equivalence of 'Some x is y' and 'Some y is x' guarantees the equivalence of 'x is y' and 'y is x'. And it is transitive, since 'x is y, y is z, so x is z' is valid (a Barbara or a Darii) when the major premise is universal and the minor premise and the conclusion share a common quantity (1969: 502-3).

The thesis that singular subjects have wild quantity can also be used to establish the so-called Leibniz's Laws: (i) indiscernibles are identical, and (ii) identicals are indiscernible. Regarding (i), given that y is indiscernible from x, what is true of x is true of y. Since every x is x it follows that y is x (i.e., by Sommers's definition, y=x). With regard to (ii), if x=y, then every x is y. Given that x is P, it follows syllogistically that y is P when the major and conclusion are both particular.

Sommers concludes "Do We Need Identity?" by listing the advantages of a theory that treats singulars and generals on a syntactic par, distinguished only by the wild quantity of the former when used as subject-terms. They are: (1) identity is derivable in traditional (i.e., syllogistic) logic, (2) a special, logically primitive 'is' of identity is unnecessary, (3) syllogistic can accommodate singular statements, (4) Frege's problems with

identity statements like 'The Morning Star is the Evening Star' dissolve (504).[8]

Latter-day logicians, such as Frege, Russell, and Quine, have rightly criticized traditional logic for its failure to achieve Leibniz's goal of a universal characteristic—a system of formal logic adequate for analysing inferences involving not just simple categoricals but, especially, compound sentences and relationals. Russell offered the typical diagnosis of traditional logic's failure: it was tied to the subject-predicate form. The great advances made by mathematical logic are attributed in no small measure to Frege's rejection of this old theory of logical syntax. Compound sentences, such as conjunctions and conditionals, do not have (even implicitly) a subject-predicate form. Relationals have more than two material constituents, so they cannot be construed categorically—that is, as subject-predicate in form. The same probably holds for singulars. The judgment is that traditional logicians simply ignored the logic of compound sentences and relational sentences because they could see no way to treat them categorically. The first of these failures is seen as especially important, since the logic of compound sentences ("truth-functional logic," "the propositional calculus") is taken to be *primary* logic. It is more basic than predicate logic (the logic of terms). The categoricals themselves are analysed only with the aid of sentential "connectives" (e.g., 'and' and 'only if').

In one sense, of course, even a cursory look at the history of traditional logic shows this to be false. Traditional logicians did not ignore the logic of compound sentences, relationals, or singulars. Boole and De Morgan certainly did not; nor did Leibniz; nor did the Scholastics; nor even did Aristotle. Still, the fact is that the old term logic never succeeded in building a viable logic adequate to these demands. In "The Calculus of Terms" (1970) Sommers sets out to construct a term logic that (1) construes all statements as logically subject-predicate in form, and (2) reduces all logical inferences to syllogistic. In carrying out this programme, he devises a simple, perspicuous symbolism, which is, like those of the nineteenth-century algebraists, arithmetic. Frege eschewed the use of mathematical symbols in logic, since he saw it as a source of confusion for logicians bent on the discovery of the foundations of mathematics itself. Neither the algebraists nor Sommers share Frege's goal for logic. As it turns out, they were right in following Leibniz's lead in mining arithmetic and algebra for familiar symbols and operations readily adapted to the needs of a logical algorithm.

To repeat, the syntactic principle at the heart of Sommers's "new syllogistic," the calculus of terms, is ternary. This means that all statements can be logically analyzed as consisting of two expressions (simple or complex) such that the second (the predicate) is predicated—affirmed or denied—of the first (the subject). The difference between the two kinds of expressions, and thus the overall logical nature of entire statements, is fully accounted for in terms of two basic notions: quality and quantity. Quality is taken as positive or negative opposition. Sommers recognizes three types of quality. Terms themselves are positive or negative with respect to their logical contraries. Thus, for example, 'massive' and 'massless' are opposite in term quality; so are 'red' and 'nonred', 'happy' and 'unhappy'. Logically, term quality is symmetric. "Which term of a pair we choose to call 'positive' and which 'negative' is a matter of logical indifference" (1970: 4). But it is important to recognize that we do not begin with neutral terms (e.g., 'red') and then define from them negatives ('nonred'). All terms come in logically charged—positive or negative—pairs. They have "polarity."[9] The fact that natural languages rarely mark positive terms, leaving them looking uncharged, neutral, should no more mislead the logician than an unmarked numeral (say '2' in '2−3=−1') would mislead the mathematician into construing it as either neutral or absolute, rather than positive.

Not only do terms *per se* have quality, so do entire predicates. Such quality (called "predicative quality") is displayed by the presence of positive or negative "term copulas" (Sommers, 1970: 5): 'is' and 'isn't'. Let 'S' be any subject expression and '+P' and '−P' be a pair of logically contrary terms. Either of these terms could be predicated of 'S', and in either case the resulting predicate could be either positive or negative. Thus:

(1) S is +P
(2) S is −P
(3) S isn't +P
(4) S isn't −P

As it turns out, we can think of a negative copula as cancelling out a negative term quality. And, in general, if we mark the copulas as + or − appropriately,

(1.1) S + +P
(2.1) S + −P
(3.1) S − +P
(4.1) S − −P

they reduce to

(1.2, 4.2) S + P
(2.2, 3.2) S − P

In other words, predicative quality and term quality can normally be treated indifferently as a single kind of opposition. It is the opposition between logical contraries, and Sommers refers to it as "C-opposition" (1970: 7ff).

The third kind of quality is predicative, indicating whether the predicate (whatever its quality or the quality of its term) is affirmed or denied. Such opposition is rarely marked in natural languages, and was only

dimly seen even by traditional logicians. It can be noted by the use of "predicative copulas" (Sommers, 1970: 5). Two sentences with the same subject and the same predicate, except that the predicate is affirmed in one and denied in the other, are contradictories. Predicative quality, then, affects the entire sentence. It is not to be confused with predicate quality, which applies to predicates alone and results in the opposition of logical contrariety—not contradictoriness. Predicative quality opposition is called "P-opposition" (8ff). A sentence like 'No A is B' displays negative predicative quality. Here, 'no' is a sign of P- (not C-) opposition. It is elliptical for 'Not: some A is B', indicating that the predicate, 'is B', is denied of the subject, 'some A'.

As in the case of quality, quantity is oppositional ("Q-opposition," Sommers, 1970: 8ff). A sentence affirming a predicate of all S or denying a predicate of some S is universal in quantity; a sentence affirming a predicate of some S or denying a predicate of all S is particular in quantity.

We now have three kinds of opposition: C, P, and Q. The first has been symbolized using + and − between the two terms of the sentence. We can also use + and − for P-opposition, displaying the sentence-wide scope of affirmation or denial by prefixing the sign to the entire sentence. This would give us the following schedule of the A, E, I, O categoricals—

A	+(all +S + P)
E	+(all +S − P)
I	+(some +S + P)
O	+(some +S − P)

—which is a QC schedule insofar as it makes no use of P-opposition, construing all four categoricals as affirmations. An alternative schedule would construe all four as having positive predicates:

A	+(all +S + P)
E	−(some +S + P)
I	+(some +S + P)
O	−(all +S + P)

This would, then, be a PQ schedule. A third kind of schedule would be PC, taking all quantity to be particular:

A	−(some +S − P)
E	−(some +S + P)
I	+(some +S + P)
O	+(some +S − P)

Alternative QC, PQ, and PC schedules with all four categoricals taken as denials, or all predicates as negative, or all quantities as universal, respectively, are also possible.

It would be of obvious benefit to be able to symbolize quantity in the way that quality has been symbolized. After all, quantity, like quality, is oppositional, which suggests a +/- notation. To determine which quantity is + and which - Sommers relies on the equivalences established by valid conversion. For example, I is convertible—that is,

some S is P = some P is S
+(some +S + P) = +(some +P + S)

This equivalence will hold algebraically only if 'some' is positive. E is also convertible—that is,

no S is P = no P is S
-(some +S + P) = -(some +P + S)
+(all +S - P) = +(all +P - S)

Such equivalences hold only when 'some' is positive and 'all' is negative.

The general form of any sentence, then, will indicate all three kinds of opposition.

+/-(+/-(+/-S)+/-(+/-P))

The first plus-or-minus is the sign of P-opposition, the second is the sign of quantity, the third and fifth mark term quality for 'S' and 'P', and the fourth marks predicate quality. Since the predicate quality and predicate-term quality collapse, we can simplify this as

+/-(+/-(+/-S)+/-P)

Taking our subject-term, as usual, to be positive (and, as in arithmetic, suppressing positive quality signs), this reduces to

+/-(+/-S+/-P)

with the three plus-or-minus signs representing P-, Q-, and C-opposition, respectively. Notice that what Sommers has done here is to show that the formatives of quantity and quality are uniformly alike in being oppositional in character. The so-called truth-functions can be treated as pairs of signs of quantity and quality. As a consequence, he is able to offer an answer to the question I raised in my introduction to this essay: What constitutes the distinction between formative and nonformative expressions? According to Sommers, "the formatives—including proposition 'constants'—are analogous to plus and minus signs of arithmetic" (1973a: 249). Logical formatives are oppositional in nature.[10] Indeed, "the representation of all logical signs

as signs of opposition is a consequence of the effort to realize Leibniz's program" (1976b: 41).

An example of a symbolized QC schedule would be

A	+(-S+P)
E	+(-S-P)
I	+(+S+P)
O	+(+S-P)

An example of a PC schedule would be

A	-(+S-P)
E	-(+S+P)
I	+(+S+P)
O	+(+S-P)

The fact that any categorical can be symbolized using just two of the three kinds of opposition shows that each kind of opposition can be defined in terms of the other two. Since singular statements have no overt quantity, we can display them on a PC schedule, defining quantity as a consequence. Let 's' be a singular term. We have, then, the following PC schedule:

A	-(s-P)
E	-(s+P)
I	+(s+P)
O	+(s-P)

Using Aristotle's principle that affirming a predicate of a singular is equivalent to denying its contrary—that is,

+(s+P) = -(s-P)

we see that in the case of singular statements A=I (and E=O), which means, when the schedule is construed as QC, that singulars have wild quantity.

Any denial can be converted into an affirmation by simply multiplying through (by -1). For example, 'No S is P' is symbolized initially as '-(+S+P)'. Multiplying through yields '-S-P' ('Every S is nonP'). The equivalence is valid according to Sommers's law for immediate inference:

> *If two statements L and M have the same logical quantity, then L entails M if and only if L=M.* (1970: 13)

Logicians in general tend to consider statements exclusively in their affirmative forms. The following schedule (1970: 13) displays the standard classical immediate inferences algebraically. In doing so, it makes frequent use of the mathematicians' practice of dropping plus signs whenever no ambiguity results (signs of quantity can never be dropped).

A	−S+P = −S−(−P) = −(−P)−S = −(−P)−(+S)
E	−S−P = −S−(+P) = −P−S = −P−(+S)
I	+S+P = +S−(−P) = +P+S = +P−(−S)
O	+S−P = +S−(+P) = +(−P)+S = +(−P)−(−S)

Subalternation does not satisfy the law of immediate inference. For example, 'Every S is P' (−S+P) and 'Some S is P' (+S+P) are neither algebraically equal nor similar in quantity. Nonetheless, a particular can be derived from the corresponding universal syllogistically once a tacit premise is supplied. In this case the missing premise is '+S+S'. Adding it to the premise '−S+P' yields a Darii syllogism. Sommers argues (1970: 20) that the option of such premises is benign and in no way forces unwanted existence claims.

> The classical term calculus is happily free of existential distinctions between universal and particular statements; nothing in the logic forces anyone to say that universal statements differ from particular statements in their existential import; we are perfectly free to consider all particular statements as having no existential import if we so wish. (1970: 20)[11]

To account for syllogistic validity, Sommers formulates the following principle, which will also apply to immediate inferences (1970: 19).

(P.1) An inference is valid if and only if (i) the sum of the premises equals the conclusion, and (ii) the number of particular conclusions equals the number of particular premises.[12]

Consider Barbara:

−M+P
−S+M
―――
−S+P

This is valid, considering that the sum of the premises equals the conclusion (−M+P−S+M = −S+P) and there are no particular premises or conclusions. All of the classical valid syllogisms (including weakened moods) can be

analysed as equating the sum of their premises with their conclusions and the number of particular premises with the number of particular conclusions.

Thus far, Sommers has in hand a simple algorithm for determining the validity of inferences involving simple categoricals (including singulars). The challenge to the power of his calculus is to incorporate compound statements and relationals. To incorporate compound statements, he makes use of a notion first explored in "On Concepts of Truth in Natural Languages" (1969b). Since his calculus is a calculus of *terms*, it is imperative that entire statements be construed as terms, just as Leibniz had seen, in order to subsume the logic of compound statements under the logic of terms. The term form of a statement is achieved by "nominalizing" the sentence used to make it. Let 'p' be such a statement; then the term 'state of affairs in which p' (or, alternatively, 'case of p', 'p-state') will be its nominalization. The statement 'p and q' is compound, a conjunction of two sentences. The truth of this is preserved in the following nominalized form: 'Some case of p is a case of q'. Nominalized statements are symbolized by placing them between square brackets. Our example becomes, then, '+[p]+[q]'. All the truth functions can be so construed, preserving Leibniz's insight and reversing the Fregeans' claim that the logic of compound sentences is more basic than the logic of terms. Here are some examples using nominalization.

Not p = −[p]
If p then q = All p-states are q-states = −[p]+[q]
p or q = Not both not p and not q = −[+−[p]+−[q]] = −−[p]−−[q]
If all men are fools, then some logician is unwise =
−[−M+F]+[+L−W]

Since terms, as well as sentences, can be compounded (by the use of operators such as 'and', 'or', 'only if'), the calculus can be extended as well to inferences involving compound terms (cf. Sommers, 1970: 22-23). For example, 'Some men are fat and happy' can be seen as predicating the compound term 'fat and happy' of 'some men', and the compound term can be construed, on the model of the conjunction 'p and q', as '+F+H', using an alternative bracketing to indicate the compounding of terms rather than (nominalized) sentences. The entire statement is symbolized as '+M+(+F+H)'. Keep in mind that statements like this, and '−[p]+[+[q]+[r]]', are categorical. They consist of just two terms. It just happens that in such cases at least one of the terms is compound—constructed from two other terms.

Relational terms are likewise construed as terms that have been constructed from other terms. For example, 'loves some girl' is taken as a (relational) term consisting of a relation ('loves') and an object ('some girls'). The objects of a relation are quantified; the relation itself is not. Though Sommers was far from clear about this in "The Calculus of Terms"

(1970), relations are qualified. Consider the statements

(a) Some boy loves every girl.
(b) Some boy fails to love some girl.
(c) Some boy is unloving (a nonlover) of some girl.
(d) Every boy sends some flowers to every girl.

These can be formulated as

(a.1) +B+(+L-G)
(b.1) +B-(+L+G) = +B+(-L-G)
(c.1) +B+(-L+G) = +B-(+L-G)
(d.1) -B+(+S+F-G)

Notice that (b) is equivalent to 'Some boy is unloving (a nonlover) of every girl' and (c) is equivalent to 'Some boy fails to love every girl'. Contemporary logicians account for differences such as those between (b) and (c) in terms of differences of scope for quantifiers.

Statements, compound terms, and relational terms are all syntactically complex. In using the calculus to analyse inferences involving such terms (in addition to elementary terms) Sommers specifies several principles that, in effect, allow for the iteration, association, composition, distribution, and so on, of the elements of such terms (1970: 23). For example, any complex term of the form '(+A+A)' is equivalent to '+A'; a particular subject can associate over a complex predicate (i.e., +A+(+B+C) = +(+A+B)+C, for example, 'Some man is fat and happy' = 'Some man who is fat is happy'); a universal subject can distribute over a complex predicate (i.e., -A+(+B+C) = +(-A+B)+(-A+C)). All but the first are algebraically sound.

In considering syllogistic inference in general, it is possible to formulate a principle that applies to all inferences, including those that involve complex (i.e., sentential, compound, or relational) terms. In effect, the principle is a description of the algebra governing (P.1) (1970: 26ff).

(P.2) From a statement containing universal M (-M) and a second statement containing a positive M (+M) derive a statement exactly like the second except that +M is replaced by the entire first statement without -M.[13]

A careful consideration of this principle shows that it amounts to saying that in any syllogistic inference middle terms are cancelled. And another way of looking at it is to see it as a version of the old *dictum de omni et nullo*: *What is said of all of something is said of what that something is said of* (or: *What is true of all M is true of any M*). The 'something' here is the middle term, what is said of it is the first statement without -M, and what

that something is said of is the second statement without +M. In "The Calculus of Terms," Sommers offers several examples of syllogistic inferences that illustrate the use of his system. A few simple examples will suffice for now.

(i) No M is S (Camenes)
Every P is M
So, no S is P

This is first symbolized as

(i.1) -[+M+S]
<u>-P+M</u>
-[+S+P]

Since we can convert any denial into an affirmation, this is simplified as

(i.2) -M-S
<u>-P+M</u>
-S-P

Validity is guaranteed because the sum of the premises equals the conclusion and the number of particular premises equals the number of particular conclusions (zero). Or, by (P.2), '-S' in the first premise has replaced '+M' in the second to yield '-P-S', which is then simply converted to yield the conclusion.

(ii) Every circle is a figure.
So, whoever draws a circle draws a figure.

(ii.1) <u>-C+F</u>
-(+D+C)+(+D+F)

Here, we require the analytic missing premise 'Whoever draws a circle draws a circle'. Thus:

(ii.2) -C+F
<u>-(+D+C)+(+D+C)</u>
-(+D+C)+(+D+F)

Note that '+F' has replaced '+C' in the second premise to yield the conclusion according to the *dictum de omni et nullo*.

(iii) Tully is Cicero
Tully is verbose

So, Cicero is verbose

Since 'Tully' and 'Cicero' are singular, they have wild quantity, allowing the assignment of quantity in each case as required for validity.

(iii.1)
-T+C
+T+V
+C+V

(iv)
If p then q
If q then r
So, if p then r

(iv.1)
-[p]+[q]
-[q]+[r]
-[p]+[r]

(v)
Some horses are faster than some dogs.
All dogs are faster than some men.
So, some horses are faster than some men.

Adding the analytic missing premise that 'faster than' is transitive, we get

(v.1)
+H+(+F+D)
-D+(+F+M)
-(+F+(+F+M)+(+F+M)
+H+(+F+M)

While application of the *dictum* to the first two premises yields '+H+(+F+(+F+M))', 'Some horses are faster than something faster than some men'. This, along with the missing premise, yields, again by the *dictum*, the conclusion.

The algorithm presented in "The Calculus of Terms" (and in Sommers, 1973a, 1973b, 1975, 1976a, 1976b, 1976c, 1978a, 1982, 1983a) shows, at the very least, that it is possible to construct a term logic that has expressive powers to match those of the standard predicate calculus, and without requiring a special identity theory. Moreover, Sommers's algorithm is simple to use and rests on a theory of logical syntax that appears to be much closer to that of natural language. In building his own calculus Sommers rejects the following Fregean theses (see 1970: 38-39; 1976d: 589-90):

(1) Singular and general statements have essentially different logical forms.
(2) The logic of statements is prior to the logic of terms.

(3) Relational statements are not subject-predicate in form.
(4) Compound statements are not subject-predicate in form.
(5) Syllogistic is in no way a basic form of inference.

One cannot but notice, when examining Sommers's account of term logic, that all statements, singular, general, relational, compound, and so on, contain some formative expressions, some signs of opposition. In effect, there are no atomic statements. Modern Fregean logicians accept as given a fundamental distinction between atomic statements (containing no logical signs) and molecular statements (containing one or more such signs). The distinction between the two logical views reveals a distinction between the Leibnizian and Fregean programmes in general. As we have seen, Leibniz took singulars to be on a logical par with general statements. Wild quantity and singular predication make this possible. In contrast, Frege took singular statements to be logically primitive, connecting a general term to a singular term in a primitive, undefined way, involving no logical formative. Such statements, then, are atomic. General statements are built up from these by means of logical formatives, among them the truth-functions, making the logic of (general) terms rest on the logic of statements. Sommers calls this "the key to Frege's revolution in logic" (1976d: 590; see also 1983a: 181-82). For the traditionalist, subjects and predicates can be distinguished from each other syntactically. There is a *prima facie* syntactical difference between a quantified term and a qualified term. Quantifiers and qualifiers are distinct logical formatives. For the Fregean, on the other hand, the difference is that between singular and general terms, between saturated and unsaturated expressions, between complete and incomplete expressions. And this difference is nonlogical. It is a matter of semantics, not syntax. It is material—not formal.[14]

The fact that all statements and all terms of a statement are charged, have positive or negative quality, and that quantity is likewise oppositional, guarantees that logically any statement can be viewed as a string of terms, each preceded by a (plus or minus) sign of logical opposition. In "Distribution Matters" (1975), Sommers shows that each such sign can be seen as a mark of the distribution value of the following term (once all external minus signs have been multiplied through). Thus, for logic in general, distribution does matter. Valid syllogistic inference requires that throughout a given inference extreme terms preserve their distribution values and middle-term pairs have opposite distribution values. In responding to Geach's attack on the doctrine of distribution, Sommers concludes that "there is a clear syntactical test for deciding the distribution value of a term in a proposition, and . . . there is no serious question that distribution values play a role as necessary conditions for valid inferences" (1975: 39-40).[15]

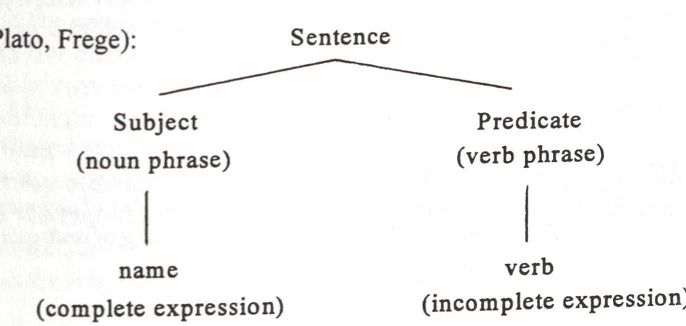
If it is granted that Sommers's calculus of terms is effective and that it matches the inference power of the standard logic now in place, one might still ask if it is natural. Does it come any closer in its syntax to the syntax of natural language? Perhaps one might even dare to ask (as we will in the chapter to follow): Does its account of inference reflect the ways in which we actually reason? Aristotle and all pre-Fregean logicians saw logic as aiming to lay bare the logic of natural language. While many traditional logicians took this to mean natural language in its broadest sense, some, including Aristotle, took it to mean natural language as used in theoretical science. In neither case did they take logic to be fit only for the description of an artificial language (viz., mathematics). Seventeenth-century logicians, such as the Port Royal logicians and Leibniz, often saw logic as concerned with the uncovering of a universal language, constituted by a grammar underlying and common to all natural languages. Any logician who claims that logic is concerned with *natural* language will tend to look for an algorithmic system that preserves salient logical features of natural syntax. In this sense, a logic is natural to the degree to which the theory of syntax on which it is grounded approximates the syntax of natural language. From this point of view, traditional term logic and modern mathematical logic differ markedly in their degrees of syntactic naturalness. Or, to put it another way, the two kinds of logic give radically different accounts of propositional unity. For the modern logician, the syntactic unity of a molecular statement is the result of operations on atomic statements, whose unity, in turn, is guaranteed by the predicational tie between a general term and an appropriate number of singular terms. In such basic cases, as we have seen, this tie is the result not of any binding agent (logical copula), but of the semantic nature of general and singular terms (the former being incomplete, the latter being fit to complete them). Indeed, in this Fregean view, atomic statements have no other logical syntax; they contain no formative expressions. In contrast, the traditional term logician holds that the unity of any statement ready for entry into logical inference is effected by the presence of formative expressions. In particular, pairs of terms are tied by a logical copula, resulting in a new complex term (which is either a sentence, a compound term, or a relational term). Sommers argues in "The Grammar of Thought" (1978) that each theory is consonant with a different theory of grammar. The modern theory of logical syntax "coincides with the constituent analysis into Noun Phrase and Verb Phrase which the modern linguist gives to sentences in natural language" (182). The traditional theory "coincides with the constituent analysis of Cartesian Linguistics" (184). By "Cartesian Linguistics," he means the account of natural-language grammar particularly associated with the Port Royalists.[16]

Now, it can be argued that many of the ideas in the modern linguists' theory are inspired more by their reading of modern logic than by the nature of natural language. But whether or not modern logical theory coincides with modern linguistic theory, the question remains: How close is the syntax of modern logic to that of natural language? The fact is that it is not very close at all. And this should not be surprising; after all, Frege

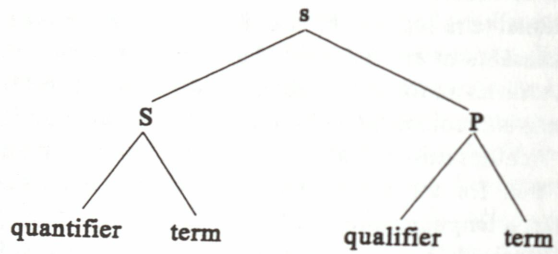
explicitly abandoned natural language as a source of syntactic insights when he chose to set logic the task of establishing the logical foundations of mathematics. In doing so, he looked to mathematics (particularly analysis) for his logical insights. While the traditional term logician took as the paradigm sentence for logic one with a quantified general term and a qualified general term (e.g., 'Some men are fools'), the Fregean took as a model a sentence in which a general term (viz., a verb, as Russell noticed) is predicated (without the intervention of a formative) of a singular term (e.g., 'Achilles runs'). Statements like the latter are hardly typical of ordinary language. Yet, for the mathematical logician, counselled by the intuitions of mathematics, a language adapted for the purposes of telling us what a thing does ('2 divides 14 evenly') is far more appropriate than one that facilitates saying how things are ('Men are mortal'). This difference is due in no small measure to the fact that mathematical discourse is carried out against a background consisting of an ontologically uniform universe of discourse—the set of mathematical objects (numbers, sets, etc.). Ordinary discourse, conducted in natural language, relies on a far less neat and homogeneous universe of discourse—the world or some part thereof.

In rejecting the traditional subject-predicate analysis (i.e., the quaternary theory), Frege sought to abandon all earlier theories of logical syntax. The irony here is that in so doing he left intact Aristotle's ternary theory and, at the same time, took on Plato's binary theory. As we have seen, the binary theory offers an analysis of the simplest kinds of statements (atomic in modern terms) in terms of a pair of syntactically/semantically distinct expressions, joined without the aid of a connecting formative—a mark of predication. This is a subject-predicate analysis with a vengeance. Sommers offers a nice account of the contrast here in "Predication in the Logic of Terms" (1990), and in doing so he implicitly acknowledges his own move from (in 1970 and elsewhere) a commitment to a quaternary theory to a commitment to a ternary one. He argues for a theory of logical syntax that parses a statement as consisting of a pair of terms connected by a term functor: "The term/functor style of analysis may be said to go back to Aristotle, who formulated sentences in a way that placed the functor *between* the terms" (1990: 107). I conclude this section with an illustration of how each of the three theories of logical syntax would provide a distinct "constituent" analysis of sentences in general.[17]

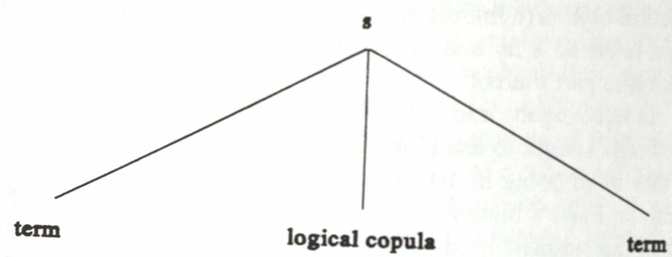
Binary theory (Plato, Frege):



Quaternary theory (Scholastics, Sommers 1970s and 1980s):



Ternary theory (Aristotle, Sommers 1990s):



As we shall see in the following chapter, logical copulae can be "split," permitting a quaternary analysis to be derived from a ternary one.

The Logic of Natural Language

It is not humanly possible to gather immediately from it what the logic of language is.

Wittgenstein

The fixation on first-order logic as the proper vehicle for analysing the 'logical form' or the 'meaning' of sentences in a natural language is mistaken.

P. Suppes

[The central idea in] my rejection of first-order logic as the appropriate instrument for the analysis of natural language . . . is that the syntax of first-order logic is too far removed from that of any natural language to use it in a sensitive analysis of the meaning of ordinary utterances.

P. Suppes

For better or worse, most of the reasoning that is done in the world is done in natural language. And correspondingly, most uses of natural language involve reasoning of some sort. Thus it should not be too surprising to find that the logical structure that is necessary for natural language to be used for a tool of reasoning should correspond in some deep way to the grammatical structure of natural language.

G. Lakoff

In 1982, Sommers published his long-awaited *The Logic of Natural Language*. It is a rich book, addressing a wide variety of logical topics. At its heart is a sustained attempt to offer, substantiate, and defend a logical programme contrary to contemporary Fregean orthodoxy. Both Strawson (1982) and Geach (1982) reviewed the book. Strawson called it a "rich, clever, and courageous book," and characterized Sommers as "an almost solitary champion, [who] raises the banner of traditional formal logic (TFL) and challenges the innumerable host of those who believe that quantificational or Fregean or modern predicate logic (MPL) has finally and rightly driven its ancient forerunner from the field" (786-87). In contrast, Geach hated the book, not least because he felt that Sommers had been either unclear or unfair to Geach's own published ideas. A bitter, but fascinating, exchange in the pages of the *Times Literary Supplement* ensued (Sommers, 1983b; Geach, 1983; Sommers, 1983c). In the remainder of this section, I offer a brief overview of some of the main ideas found in Sommers's book.

Sommers begins by laying out (in the introduction) the contrasts between TFL and MPL. TFL is "naturalistic" in that it seeks to preserve the syntax of natural language, finding itself only now and then forced mildly to regiment some sentences prior to analysing their roles in logical reckoning. MPL is "constructionistic," radically translating most statements into an artificial, nonnatural language in preparation for reckoning. Only TFL, therefore, can provide a model for how we actually talk and reason. Indeed, the contemporary logician no longer sees that if natural language is the typical medium for deductive reasoning then logic is, in an important sense, a part of cognitive psychology. Still, most logicians (and many philosophers, linguists, and psychologists) have abandoned TFL, recognizing in its traditional versions a system ill-equipped for a variety of logical tasks. "The negative verdict on the prospects for a viable traditional logic has had the effect of deflecting twentieth-century logic from its traditional task of characterizing the canonical fragment of natural language to the quite different task of constructing powerful but artificial logical languages" (1982: 11).

One way of seeing the crucial difference between TFL and MPL is offered by the fact that only the latter recognizes a contrast between atomic and molecular sentences (chapter one). This contrast, as we have already seen, is the result of the Fregean Dogma, the idea that singular and general terms are radically different for logic; sentences with general subject terms can be analysed only in terms of quantifiers and singular (pronominal) terms. General sentences are built up from more primitive singular sentences, logically primitive sentences, atomic sentences. Such a view assumes that singular terms can never be either quantified or predicated. TFL abjures such assumptions and, consequently, has no need for an atomic/molecular distinction. While the binary theory of logical syntax on which MPL rests sees the contrast between subject and predicate as semantic, TFL's quaternary theory of logical syntax accounts for the contrast in terms of the formal distinction between quantifiers and qualifiers. TFL has looked to the formal features of certain expressions (quantifiers and qualifiers) to determine the logical forms of sentences in which they occur. MPL has, instead, sought to treat the logical form of any sentence as an expression of its truth conditions.

Fregeans, without the traditionalists' recourse to the quantifier/qualifier distinction, must seek other, nonsyntactic (i.e., semantic) grounds for the distinction between subjects and predicates. In "The Two Term Theory" (chapter two), Sommers critically examines attempts at this by Geach and by Dummett. An example of an argument used often by Geach holds that in a sentence, 'SP', 'S' is the subject and 'P' the predicate if and only if the negation of 'P' results in the contradictory of 'SP' but the negation of 'S' does not. It follows, for Geach, that singular terms, but not quantified general terms, can be subjects. Thus, 'John' is the logical subject of 'John is tall' (since its contradictory is 'John is not tall'), but 'Some man' is not the logical subject of 'Some man is tall' (since its contradictory is not 'Some man is not tall'). Yet Geach's argument works only as long as singular subjects are not taken as quantified expressions. Sommers maintains the Leibniz-inspired wild quantity thesis, according to which singular subjects are indeed quantified. Moreover, in the traditional theory, the contradictory of a sentence is never achieved simply by negating the predicate-term, but results from denying the predicate of the subject. And this is equivalent (as term logicians from Aristotle to Sommers have seen) to simultaneously reversing the quantity of the subject and the quality of the predicate (i.e., negating the predicate). Since the implicit quantity on 'John' in 'John is tall' is wild, we can take it to be particular. In that case, the contradictories of 'John is tall' and of 'Some man is tall' are formed in exactly the same way, leaving Geach with no reason to reject quantified general terms like 'some man' as logical subjects.

Dummett, taking seriously Frege's radical asymmetry between names and function expressions, holds all logical subjects to be proper names and offers three conditions for a term being a proper name. Yet Sommers shows that, given that singular subject-terms (e.g., proper names) have implicit quality, Dummett's criteria hold equally well for both singular and general subject-terms. The three criteria are, jointly, necessary conditions for an expression, E, being a proper name (=logical subject).

They are (1) that from 'E is P' it follows 'Something is P' (i.e., existential generalization), (2) that from 'E is P' and 'E is Q' it follows 'Some P is Q', and (3) that from 'E is P or Q' it follows 'E is P or E is Q'. Consider (1): the Fregean must take existential generalization as an intuitively obvious rule of inference. But is it more obvious, more intuitive, than the singular/general distinction, which is partially explained in terms of it? Moreover, such an inference favours TFL since it is syllogistic, having the form (letting '*' mark wild quantity):

*E + P
*E + thing
+thing + P

Consider (2): this is just an expository syllogism:

*E + P
*E + Q
+P + Q

Consider (3): the 'or' is distributed over particularly quantified subjects. Syllogistically, '*E + (--P--Q)' = '--[*E + P]--[*E + Q]'. Thus, while (1), (2), and (3) hold for singular terms, they also hold for subjects in general.

Fregeans have worried so much about how to draw the subject/predicate distinction because they hold a theory of logical syntax that prohibits a simple syntactic account of the distinction. For the traditionalist, on the other hand, subjects are always quantified terms and predicates are always qualified terms. The quantifier/qualifier distinction is a clear, obvious, and purely syntactical one. Recourse to the singular/general distinction is not required.[18]

MPL is a pronoun-saturated language. Nonsingular statements are paraphrased canonically as sentences with quantifiers binding individual variable expressions. These expressions are the logical counterparts of natural-language pronouns, as Quine has so often reminded us. Consider a simple categorical, 'Every philosopher is wise'. In ordinary English, one finds no pronoun here, and there is no suspicion that hidden (logical) pronouns lurk somewhere beneath the surface. Yet MPL formalizes such a sentence as 'Everything is such that if *it* is a philosopher then *it* is wise'. Reference is not only singular—it is pronominal. Now, the undisputed fact is that natural language does quite often make use of pronominal reference. But it does not require all reference to be pronominal. Sommers's calculus of terms (in the 1970s and early 1980s) remained to some degree unnatural in that it failed to make any place for pronouns. But in chapters three, four, and five of *The Logic of Natural Language* he set out to account for natural-language pronominal reference.

For the modern logician, an expression such as 'some S' is not a referring expression at all. Recall Geach's argument that if it were a referring expression, one could legitimately ask which S is being referred to. According to these logicians, genuine referring expressions must be either definite descriptions or proper names (both of which can be cashed out in terms of pronouns). For term logicians, on the other hand, such an expression makes nonidentifying reference to an S. Sommers argues that "the fundamental form of reference is to be located in 'some S is P' and not in 'the S is P' or 'a is P'. . . . Expressions of the form 'some S' are the primary referring expressions of traditional formal logic" (59). According to the modern theory, the referent of a referring expression must be unique and must exist. Thus proper names and definite descriptions are paradigms of referring phrases. In the traditional theory, reference is the role played by quantified terms (logical subjects) and is to be distinguished from denotation, which is no kind of reference (being merely the extension of a term within the domain of discourse). Reference is determined by the quantity and the denotation of the subject-term. Thus 'some S is P' makes reference to an undetermined part of the denotation of 'S'. While the modern theory holds that failure of reference on the part of a referring expression precludes meaning, or truth-value, for the atomic sentence, for the traditionalist, failure of reference by an indefinite referring expression (e.g., 'some S') merely results in falsity. Sommers contrasts this kind of reference with what he calls "epistemic reference" (57). Suppose I say 'A boy is in the garden' and there happens to be only a girl. I purport, but fail, to refer to a boy in the garden. However, I do succeed in making a weak reference to a girl in the garden. My reference to a girl in the garden is epistemic. I refer here to something that I take to be a boy. Epistemic reference, like purported reference and unlike actual reference, is incorrigible. I may fail to refer to a boy in such a case, but I surely succeed in referring to what I take to be a boy (even if it turns out to be a girl or even nothing at all).

Quine (1960a: 113) has argued that definite singular terms can have indefinite antecedents. Pronouns are definite singular terms with indefinite (quantifier) antecedents. Modern logicians are correct in recognizing Quine's first point. However, the notion that pronominal reference (with a quantified antecedent) is primary reference is mistaken. Such logicians treat all pronouns as bound variables. Thus they require that the variable and the quantifier that binds it (its referential antecedent) occur within the same sentence. Yet pronouns in natural language do not always operate as bound variables, and, in fact, often do not occur in the same sentence as their antecedents.[19] Indeed, Quine's Predicate Functor Algebra shows that pronouns, as bound variables, are completely dispensable. Pronouns are

used anaphorically or catephorically to make or repeat reference to what has been or will be referred to. When the antecedent of an anaphoric pronoun is a universally quantified term, the subsequent pronoun merely repeats it. Thus, in 'Every man saluted the flag. They were all veterans', 'they' simply goes proxy for 'every man'. Referential pronouns have particularly quantified antecedents and make reference to what their antecedents referred to epistemically. Thus, in 'A boy is in the garden. He is trampling my peas', 'he' refers to what was taken to be a boy in the garden.

If pronouns are referring expressions (logical subjects), then they must share the syntax of subjects. They must be analysable as quantified terms. Sommers's solution is to treat pronouns as implicitly quantified terms ("proterms"), whose denotations are the referents of their antecedents. Since they make definite reference (even when their antecedents do not), their implicit quantity is wild. The pronoun 'he' in the example of the above paragraph can be analysed, then, as syntactically complex, consisting of a wild quantity and a proterm that denotes what was referred to by 'a boy'.

In his sixth chapter, Sommers reviews his account of how logic can dispense with identity as a relation. He shows how a nonrelational reading of identity statements is possible once singular subjects are permitted implicit wild quantity and singular terms are allowed to play the role of predicate-term. He also shows how the notion of wild quantity allows for the nonrelational, predicational construal of identity to be reflexive, symmetric, transitive, and consonant with the principles of indiscernibility of identicals and identity of indiscernibles. This last point raises an interesting question about the so-called Leibniz's Law. As I have said, there is no evidence that Leibniz himself ever formulated or even used the law as we now know it.[20] What he did formulate was a law of substitution, according to which any two terms that have the same denotation can be mutually substituted for one another *salva veritate*. Singular terms sharing a common denotation are just a special case of the general law. More importantly, the law is shown by Sommers to be nothing more than a Leibnizian version of the traditional *dictum de omni et nullo* (129-30).

Modern logicians are remarkably tolerant of a wide range of difficulties that surround the relational version of identity. This fact probably indicates just how strongly the standard system is entrenched in the schools. An alternative, nonrelational version of identity, one that avoids such difficulties, is unimaginable for most moderns. Sommers cites three examples, as follows. Frege took names as syntactically simple. Then, in order to account for how, for example, 'Tully is Cicero' is informative while 'Tully is Tully' is not, he had to introduce a degree of semantic complexity for names by giving them sense. Yet the wild quantity on singular subjects allows one to formulate these sentences as 'Every Tully is Cicero' and 'Every Tully is Tully'. The first has a nontautological form, 'Every A is B'; the second has a tautological form, 'Every A is A'. Tautologies are uninformative. Thus, the uninformativeness of 'Tully is Tully' is a matter of syntax rather than semantics.

Geach's relative identity thesis (cf. Geach, 1962) is fatally coupled with a claim that a sentence such as 'x is P' is analysable as 'x is the same P as x'. But this would mean that, for example, 'Socrates is a man' and 'Socrates is Socrates' are logically equivalent, since they are both analysable as 'Socrates is the same man as Socrates'.

Finally, there are worries about Kripke's (1972/80) thesis that a true identity is necessarily true. Sommers suggests that the notion of requiring *de re* here leads to the view that there are sentences of the form 'Every A is necessarily A' that are self-evident, a doubtful thesis at best.

In chapter seven, Sommers argues for his method of incorporating relationals into term logic. Traditional logic's failure to do so was due not to its syntax, but to (i) the absence of an adequate system of formal notation, and (ii) the failure to make explicit the logical forms of pronouns. Since both (i) and (ii) can be rectified by Sommers, his claim is that the advantages of the new system of logic over the traditional one are merely practical, rather than theoretical (140). For example, the equivalence between a relational sentence and any of its converses must be taken as an analytic truth (semantic rather than syntactic) for the traditional theory. The modern theory must also take such equivalences to be nonformal for atomic sentences (e.g., 'Plato taught Aristotle'/'Aristotle was taught by Plato'), but for nonatomic sentences the equivalences are always formal and are seen in the order of the variables following a polyadic predicate. Yet even the practical advantage that the new theory has over the old in dealing with relationals is merely apparent. Sommers suggests that once the traditional theory is provided with pronouns it can simply be used to map the forms of modern predicate logic. The practical differences between the two systems would then disappear.

Whether a term logic chooses to map modern forms or to introduce analytic converse theorems, the fact remains that term logic (contrary to the charge made by nearly all of its critics) can account for inferences involving relationals. Such inferences are syllogistic (often enthymemes with innocuous missing premises), and the general rule of syllogistic is always the *dictum de omni et nullo*, which simply allows a term affirmed of a universally quantified term to replace that term in any sentence in which that replaced term is predicated.

Sommers concludes the chapter by showing that the usual charge that the traditional logic failed with relationals because of its basis on the subject-predicate form is groundless. Indeed, the logical forms of the modern predicate logic are themselves covertly subject-predicate. Sommers then offers an ingenious method for mapping modern forms onto categoricals. It is a method that ought to be welcomed, even by his critics, as offering a pedagogically effective way to translate natural-language sentences into the canonical forms of the standard calculus.[21]

Kant held out for an absolute difference between categoricals and

compound sentences, while Leibniz argued that all assertions, including compounds, could be formulated as categoricals. Frege, on the other hand, reduced categoricals to compounds. The fact that reduction is possible in either direction suggested to Sommers (chapter eight) a thesis once held by Peirce.[22] The thesis is that categoricals and compounds are "analytically autonomous and structurally isomorphic" (159). Thus, conjunctions share the syntactic structure of I or O categoricals; conditionals share the structure of A or E categoricals. This isomorphism opens up the possibility of a uniform system of symbolic representation, where formatives are read as either term functions or sentence functions. Such a system stands in marked contrast to the modern standard amalgam of a sentential calculus and a predicate calculus (plus identity theory).

Sommers also advances in this chapter his claim that statements in I and O forms are "elementary" (160ff). Elementary statements are denotative of states of affairs and are not negative (i.e., denials). A and E forms can be defined from I and O forms. For example, 'Every S is P' =df 'No S is nonP' (= 'Not: an S is nonP', the denial of 'An S is nonP'). Furthermore, A and E forms are not state-denoting. Sommers argues for the last claim both in this chapter and in appendix B, but his arguments, as he admits, are not conclusive. At any rate, the notion of elementary sentences permits an easy account of truth, since the truth of any elementary sentence depends upon the existence of the state which it denotes. Sommers uses '[p]' for 'the state denoted by p'. So we can say that 'p' is true if and only if [p] exists. We will see later that by the 1990s he had come to an improved and clearer account of the logic of propositions and of truth.

In chapter nine, Sommers presents the formal algebra for his term logic. This is, in effect, the system derived from "The Calculus of Terms," supplemented with devices for incorporating pronouns. Pronoun antecedents are given indices, which in turn are used as the proterms of the subsequent pronouns. Consider, for example, 'A boy kissed every girl who loved him'. This has the form (where redundant positive signs of quality are suppressed and wild quantity is indicated by Sommers's '*'):

$$+B_i +(K -\langle G + (L *i)\rangle)$$

Since all formulae in this system are concatenations of positive and negative terms, rules of transformation and derivation are virtually rules of algebraic equivalence, addition, and subtraction. The key derivation rule, of course, is the *dictum de omni et nullo*, which is now formulated as

$$\begin{array}{c} -X+Y \\ \underline{\ldots X \ldots} \\ \ldots Y \ldots \end{array}$$

This is a general form for all syllogisms, and it reveals how conclusions result simply from the addition of the premises. The distributed X and the undistributed X cancel out and are replaced by Y. Several familiar inference patterns are seen to be merely instances of this general pattern (including *modus ponens* and Leibniz's Law [205]). Sommers's system here is simple and effective, and it leads him to make a far-reaching claim: "It is far more likely that the actual procedures we use in getting from the premises to the conclusion are closer to the model of cancellation than to the model of instantiation and generalization familiar to the practitioner of MPL" (206).

In chapter ten, "Truth and Logical Grammar," Sommers claims that while in modern predicate logic "we put our syntax where our semantics is" (207), the traditional formal logic "has no apparatus for regimenting sentences in a manner that makes truth conditions perspicuous" (208). For example, Russell's theory of descriptions would formulate sentences with definite description subjects so as to exhibit, among other things, the truth condition that the referent of the subject exist. Strawson accepted Russell's view that if the existence of the referent was materially implied by the sentence, then the sentence must be logically existential. He denied the existential form of sentences with definite description subjects, and, consequently, rejected the view that the relation between the sentence and the affirmation of existence to the referent was one of material implication. Sommers argues that Russell was correct in claiming that the relation here was one of material implication, but that Strawson was correct in denying that the implying sentence was logically existential. Sommers's solution is to take the inference from a sentence of the form 'The A is B' to 'The A exists' to be an enthymeme. The missing premise is 'Every B exists'. In general, any sentence with a singular or particular subject has existential import whenever it is appropriate to supply a missing premise affirming existence of whatever satisfies the predicate. Of course, it is not always appropriate simply to add such a premise, as when we wish to produce sentences about fictitious or other nonexistent entities. Sommers's claim is that the terms of a sentence are always used with a specific "amplitude" (212-13), where the amplitude of a term in a sentence is determined by the domain of application of that term. Thus we might, say, use 'horse' with amplitude in the domain of Greek mythology or in the domain of the actual world. A validity condition on inferences will then be that all the terms of the inference share a common amplitude.

Sommers uses the notion of amplitude to argue against Donnellan's (1977) claim that referential uses of definite descriptions have no existential import, to suggest that Kripke's (1972/80) theory of rigid designation is preferable to David Lewis's (1971, 1972, 1973) counterpart theory, and to eliminate standard puzzles about opaque contexts. In connection with this last, he argues that the terms of an embedded sentence need not share the amplitude of the terms of the embedding sentence. For example, consider

(1) Tom believes that some survivors reached the island.

(2) All survivors were logical positivists.
(3) Therefore, Tom believes that some logical positivists reached the island.

The reason this is invalid is not that it breaks anything like "Leibniz's Law," but that the middle term has different amplitudes in its two instances.

In the next two chapters, eleven and twelve, Sommers returns to the consideration of pronominalization, arguing for the thesis that "*proper names are pronouns*" (230). They are "special duty" pronouns. Moreover, since pronouns are always rigid designators, names are, as Kripke (1972/80) argues rigid designators as well.

> The proterm theory accounts for the rigidity of pronouns by pointing to the fact that the proterm of a pronoun is specifically designed to denote 'the thing in question', a fact that explains why new tokens of the pronoun continue to designate that thing or those things in every context of use, including modal contexts. (Sommers, 1982: 229)

Nonetheless, Sommers's theory of names is not Kripke's. In place of Kripke's causal chain theory, Sommers offers a "pronominal chain theory." In this theory, the reference of a name is fixed by the epistemic reference of an antecedent indefinite description. Nominal reference may be preceded by pronominal and descriptive reference. For example, in 'A boy is in the garden. He is trampling my peas. He must be Little Sherman', the two pronominal tokens refer to what was taken to be a boy in the garden, and the proper name is a special-duty pronoun introduced to do the job of the pronoun and to pick up its reference. Since proper-name reference is fixed by an epistemic reference by means of an antecedent indefinite description, a proper name could never be the initial link in a referential chain.

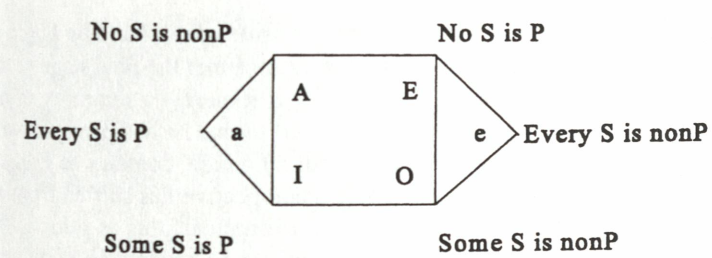
Sommers had earlier distinguished between pronouns whose references are fixed by definite descriptions used in nonepistemic contexts so that they are corrigible, and those whose references are fixed by antecedent ascriptions in epistemic contexts so that they are incorrigible. Thus, 'it' in 'Socrates owned a dog and it bit him' is a descriptive pronoun whose reference is fixed by 'the dog owned by Socrates'. In 'A dog is on the rock . . . well, it may not be a dog', the 'it' is fixed by 'a thing taken to be a dog on the rock'. It is an ascriptive pronoun. In pronominal chains, each pronominal link makes the same reference as, but is more comprehensive than, its predecessor in that it accumulates preceding descriptions (for descriptive pronouns) or ascriptions (for ascriptive pronouns). One of the questions Sommers wants to answer here is: Do proper names accumulate ascriptions throughout chains? His answer is that they do, since they are "modal free" terms (261). A term is modal free whenever whatever it is true of in the actual world is such that it is true of that thing in any other world in which that thing is said to exist. Thus, modal-free terms, including proper names, accumulate background ascriptions. Consider 'Hesperus is Phosphorus'. Each of these names, being a special-duty pronoun, has an accumulated ascriptive background. For example, 'Hesperus' might be 'a thing taken to be a star and called Hesperus and said to be the brightest superlunary body in the evening sky'. When we learn that 'Hesperus is Phosphorus' is true we simply add to the ascriptive background of 'Hesperus' whatever information might be found in the ascriptive background of 'Phosphorus'. 'Hesperus is Phosphorus' is necessary because the denotation of names is conventionally fixed (for all possible worlds). But it is informative (unlike 'Hesperus is Hesperus') because it provides new information about the ascriptive backgrounds of the names.[23]

Sommers distinguishes between ascriptive properties, which belong to a thing "in virtue of the way the thing is spoken or thought about," and descriptive properties, which belong to a thing "in virtue of what that thing is in itself apart from the manner in which anyone thinks or speaks of it" (268). For example, when I learn that Felix is a cat, I learn not how Felix is thought or spoken of, but what Felix is. When I learn that Hesperus is Phosphorus, I learn not what Hesperus is (e.g., self-identical), but how Hesperus is spoken of (viz., as Phosphorus). This ascriptiveness of identities is often mistakenly accounted for by saying that identities are about names rather than things. In Sommers's account, then, identities are not about names—they are about things—not in virtue of what those things are, but in virtue of how they are spoken of or thought about.

Sommers's early work on language and ontology led him to the distinction between the contradictory of a given sentence and the logical contrary of that sentence. Recognition of this distinction, not found in MPL, then led to a distinction between category mistakes and vacuous sentences.[24] In chapters thirteen and fourteen, he returns to this cluster of distinctions in order to review his theory of category structure and to show how it affects TFL. The modern logician takes, for instance, '4 is nonred' as 'It is not the case that 4 is red'. Accepting that '4 is red' is not true, the logician must then conclude, by the law of noncontradiction, that '4 is nonred' is either true (Quine) or without truth-value (Strawson, Ryle). In contrast, traditional logic, recognizing the difference between two kinds of negation (denial and term negation), can admit, without danger to the law of noncontradiction, both '4 is red' and '4 is nonred' as false. A crucial result of the failure to mark the logical distinction that Sommers has made is a complete confusion concerning the law of excluded middle. Sommers contrasts the standard law of excluded middle (called the sentential law of excluded middle—SLEM) with two other laws. SLEM demands that a sentence or its contradictory be true. The predicative law of excluded middle (PLEM) demands that a sentence or its logical contrary be true (e.g., 'x is P or x is nonP'). And the categorical law of excluded middle (CLEM) demands that a term be

predicable of a subject (e.g., 'x is P or nonP'). The Fregean equates all three of these. Yet Aristotle has shown, in chapter nine of *De Interpretatione,* that when the subject is undetermined with respect to the predicate-term, while SLEM and CLEM hold, PLEM does not. Now, PLEM entails CLEM, which in turn entails SLEM. SLEM always holds. But PLEM does not always hold; nor does CLEM. Statements for which PLEM fails are vacuous. A sentence will be vacuous whenever (i) it is a category mistake (e.g., '4 is red'), in which case CLEM will also fail, or (ii) its subject is empty (e.g., 'The present King of France is bald'), or (iii) its subject is undetermined with respect to the predicate-term (e.g., 'Hillary will be president in 2004').

Sommers has defined a primitive proposition as one containing only formatives that are intuitively plus or minus (286). All nonprimitives can be defined in terms of primitives. Thus, 'Every S is P' is defined as 'No S is nonP' (= 'Not an S is nonP'). And 'If p then q' is defined as 'Not both p and not q'. The distinction between various laws excluding the middle (and thus between category mistakes, other vacuous sentences, and nonvacuous sentences) guarantees that on some occasions nonprimitive sentences will be undefined. We can summarize this with the aid of a square of opposition on which primitives are displayed. Nonprimitives can then be attached in a way which shows that they are defined.[25]



Sommers's claim is that a and e are defined (as A and E, respectively) only as long as the sentences are nonvacuous (PLEM holds). When PLEM fails, both I and O will be false, A and E (as contradictories of O and I) will be true, and both a and e will be undefined. The traditional square makes use of what Sommers calls the diagonal law of excluded middle (DILEM), which requires that either I or e be true and either O or a be true. But DILEM will fail for vacuous sentences.

Sommers's theory of opposition accounts in a uniform way for the paradoxes of existential import for universals and the paradoxes of material implication. For the modern logician, when there are no S's, 'Every S is P' and 'Every S is nonP' are taken to be true. Thus the modern logician must say, paradoxically, that every unicorn is blue and that every unicorn is not blue. According to Sommers's account, when there are no S's, PLEM fails, so that 'Every S is P' and 'Every S is nonP' are undefined. Again, for modern logicians, when 'p' is false, 'If p then q' and 'If p then not q' are both true. Thus the modern logician must say, paradoxically, that if Earth is larger than Saturn it is larger than Mars and that if Earth is larger than Saturn it is not larger than Mars. According to Sommers's account, conditionals with false antecedents are undefined. This last point is easily seen once one recalls his argument that the logical forms of categoricals are shared by compounds—that categoricals and compounds are syntactically isomorphic.

In his final chapter, Sommers returns briefly to argue that terms such as 'exist' may (*contra* Kant) be predicated. Such terms do not characterize subjects, but they do locate them in some domain of discourse, and that is why they have unrestricted amplitude. He also argues here against Geach's claim that quantified phrases are not referring phrases. Geach consistently equates referring with naming. Quantified phrases, his argument goes, never name. This argument rests on the senseless contention that since (i) either all quantified phrases name or no quantified phrases name, and (ii) phrases of the form 'no S' cannot possibly name, it follows that no quantified phrases refer. The point, of course, is that phrases of the form 'no S' are not quantified phrases. 'No' is no quantifier. It is not primitive, but defined (in terms of denial and particular quantity, viz., 'no' = df 'not some').

It is important to understand that, in spite of its size, *The Logic of Natural Language* was not intended to constitute either the final stage or the culmination of Sommers's work in logic, nor is it merely a summary of his preceding work. In developing his calculus of terms, he had progressively refined and clarified his notion that natural language, contrary to Frege's claim, has a logic. In his book, Sommers's perspective has shifted from an earlier one, which took the formation of a formal calculus as prior to the attempt to fit it for application to natural language, to one that looks directly to natural language as a guide to the construction of the calculus. As well, an important lacuna in that calculus is filled by Sommers's account in the book of the logic of pronouns. Still, work on the logic of terms was not complete in 1982. In particular, Sommers had accounted for the logic of unanalysed statements in terms of a semantic theory that calls for statements to express states of affairs in the world. A statement is true just in the case when the state that it expresses is a fact—that is, exists in the world. In referring to this view in his preface to the softcover edition of *The Logic of Natural Language,* Sommers wrote, "I should now wish to shift some of the semantic positions taken in the book. On the other hand, the basic syntactical thesis seems to be firmly in place" (vii). Much of his attention since 1982 has been given over to the attempt to defend a correspondence theory of truth that is not burdened with the problems of ontology and

semantics implicit in his earlier account of truth.

The Truth

> *You will not find in semantics any remedy for decayed teeth or illusions of grandeur or class conflicts. Nor is semantics a device for establishing that everyone except the speaker and his friends is speaking nonsense.*
>
> *Tarski*

> *To say of what is that it is is to speak the truth.*
>
> *Aristotle*

> *I never let the facts interfere with the truth.*
>
> *Farley Mowat*

> *There is only one world, the "real" world.*
>
> *Russell*

Sommers's first attempt to defend the correspondence theory of truth was in "On Concepts of Truth in Natural Languages" (1969b). It was in this work that he offered his nominalizing procedure, which forms a term ("sentential term") from a sentence. Recall that this had been one of Leibniz's goals. A (sentence used to make a) statement both is *about* certain things and *specifies* a state of affairs.[26] Consider the statement made by 'Politicians are liars'. It is about politicians and liars. It specifies the state of affairs in which politicians are liars. Generally, if 'p' is a statement, then '[p]' is the state specified by 'p'. Since states are themselves things, one sentence can be used to say something about the state specified by another. Consider 'It is disturbing that politicians are liars'. This statement is about disturbing things and a state of affairs (the one in which politicians are liars). It does not, however, specify *that* state. It specifies the state in which it is disturbing that politicians are liars. Let us symbolize 'Politicians are liars' as 'p' and 'It is disturbing that politicians are liars' by 'q'. What 'p' specifies is [p]; what 'q' specifies is [q]; what 'q' says is that [p] is disturbing (i.e., [q] = [[p] is disturbing]). Here one statement is embedded in another (thus one state is embedded in another).

Leibniz had sought a way of turning entire sentences into terms in order to paraphrase so-called hypotheticals (compound sentences) as categoricals. According to Sommers, such statements are about states of affairs (more simply, states). A statement of the form 'If p then q' is about [p] and [q]. What it says is that all [p] are [q] (symbolically: '−[p]+[q]'). What it specifies is [−[p]+[q]]. What it is about are [p] and [q]. We have seen above that this process allows Sommers to incorporate the logic of statements into the logic of terms by giving a uniform formulation of compound statements and categoricals.

Not all statements that embed other statements are compounds. Consider 'Nixon believes that all politicians are liars'. It is obvious that the object of Nixon's belief is not a sentence. Nor is it a state of affairs. What Nixon believes (according to the above sentence) is that a certain state is a fact. Here we are approaching the theory of truth. "The relations between sentences, states, statements, and facts are at the centre of any theory of truth" (Sommers, 1969b: 281). Different sentences can be used to make a given statement. Thus, I can say 'Morgan is beautiful' and my wife can say 'Notre fils est beau', each of us producing different sentences but making the same statement. A statement specifies a state. But two different statements can express a given fact. Suppose it is a fact that on 30 March 1992 Morgan was born. I can express this fact by stating on 30 March that Morgan was born today. I can also express this fact by making the different statement on 31 March that Morgan was born yesterday. According to Sommers, "Only states of affairs will do for a healthy correspondence theory" (1969b: 279). Truth is defined in terms of correspondence as follows.

> i) A sentence is said to correspond to the state of affairs it specifies. If that state exists the sentence is said to correspond to reality. In that case it is true.
>
> ii) A statement corresponds to the state of affairs specified by any sentence that may be used to make that statement. If that state exists, the statement is said to correspond to reality. In that case it is a true statement. (1969b: 282)

After 1982, Sommers's account of a "healthy correspondence theory" was altered in very important ways. This was due primarily to the fact that he had come to reject the notion that states of affairs and facts are things *in the world*. Strawson (1950a) had rejected any version of the correspondence theory because such a theory would require the presence in the world of such things as facts, states, situations, and so on. Yet even untutored intuition tells us that what makes 'Some logicians are fools' true is not the presence of some fact (e.g., that some logicians are fools), but the presence in the world of foolish logicians. One might find foolish logicians, red stars, happy hookers, or green apples in the world, but one searches in vain for facts as the objective correlates of true statements. Having failed to locate facts in the world, Strawson rejected any correspondence theory, since, according to him, any such theory would require facts in the world to make statements true.

One of Sommers's aims in recent years (1987, 1990, 1993, 1994) has been to defend a version of the correspondence theory of truth that, nonetheless, takes seriously Strawson's observation that facts and the like cannot be located in the world. A second aim is to provide a plausible

account of how the logic of statements is, contrary to Fregean orthodoxy, merely a special part of the logic of terms. As it turns out, a proper understanding of what is special about statements is exactly what is required to account for the inclusion of statement logic within term logic. We will briefly survey here Sommers's attempts to achieve each of these goals.

Recall that in chapter eight of *The Logic of Natural Language* Sommers had characterized "elementary" statements as those having I or O forms, statements that say either that some such-and-such is so-and-so or that some such-and-such is not so-and-so. Such statements are easily reparsed as statements to the effect that something exists or does not exist. For example, 'Some logicians are fools' can be paraphrased as 'There are foolish logicians', a form favoured by modern predicate logic. Quine's dictum that to be is to be the value of a variable commits him to the view that, logically, we speak not of a thing's existence but of the existence of a thing which is so-and-so. Tarski (1935/36) had argued for the view that the truth of any statement is always relative to the domain of discourse under consideration. "We may put Tarski's insight in Quine's idiom: to be is to be denoted in the domain of interpretation" (Sommers, 1987: 300). To state that something is P is to claim that the domain relative to which the statement is being made can be characterized as having in it a P-thing. To deny that something is P—that is, to state that nothing is P—is to claim that the relevant domain cannot be characterized as having in it a P-thing. Such characterizations are "constitutive" (300). Consider the soup I made last night. It had lots of broth, carrots, peas, spices, garlic, chicken, and onions. It had no salt. I could characterize the soup as tasty and cheap. Such characteristics apply to the soup in virtue of what it is like as a whole. I could also characterize the soup as oniony but not salty. Such characteristics apply to the soup as a whole but in virtue of what does or does not constitute it. These are constitutive characteristics. A constitutive characteristic applies to a totality in virtue of what does or does not constitute it. Sommers holds that existence and nonexistence are not characteristics of things (say, the moon and Atlantis). "Existence and nonexistence are constitutive characteristics of domains" (300). Sommers's use of "domain" here is closely allied with his use of "amplitude" in *The Logic of Natural Language*. There are any number of possible domains of discourse. Which domain any given statement is made relative to is determined by context and the speaker's intentions. In normal conversation the domain is simply the actual world (as when I say 'Some politicians are honest'). Sometimes the domain is just a part of the actual world (as when I say to my daughter 'Everything is a mess' with the understanding that the domain is not the entire world but just her room). Occasionally, the domain at hand is a special totality (as when I say 'Some prime is even' taking the domain to be understood as just the set of natural numbers).

Now, true statements signify states of affairs (or facts). Since a state of affairs is the existence or nonexistence of something that is so-and-so, statements constitutively characterize the domain. Just as 'wise' nonconstitutively characterizes Socrates as being wise, 'Socrates is wise' constitutively characterizes the world as being wise-Socrates-ish. The statement is true just in the case when the state that it signifies obtains—that is, the world *is* so characterized. A state of affairs that obtains is a fact, so a statement is true just in the case when it signifies a fact. Facts are the objective correlates that make true statements true. Facts are what true statements correspond to.

The term 'red' signifies a nonconstitutive characteristic of things. It denotes whatever has that characteristic (say, apples, Mars, and fire trucks). The statement 'Something is red' signifies a constitutive characteristic of, say, the world. If the world is reddish (i.e., contains a red thing), then the statement is true. Just as 'red' denotes whatever has the characteristic signified by 'red', 'Something is red' denotes whatever has the characteristic signified by 'Something is red'. What 'Something is red' denotes is the appropriate domain—the world, say. Now, some expressions denote many things; others denote just one thing; still others denote nothing. For example, 'red' denotes many things; 'Socrates' denotes just one thing; 'the present King of France' and 'Atlantis' denote nothing. What, if anything, an expression denotes is dependent on what has the characteristic that that expression signifies. If nothing is so characterized, the expression is denotationally vacuous. A statement is an expression that signifies a (constitutive) characteristic. If a domain has that characteristic it is denoted by that statement. If no domain has that characteristic the statement is denotationally vacuous. A true statement denotes its domain of discourse; a false statement denotes nothing. For example, 'French' can be used to characterize Quine (falsely), but Quine is not in the denotation of 'French'. Likewise, 'Some logician is a professional basketball star' can be used to characterize the world (falsely), but the world is not denoted thereby.

The important point to keep in mind is that, while facts are what correspond to true statements and make them true (here, Strawson was mistaken), facts are not themselves constituents of the domain; they are not *in* the world (Strawson was right about this). Facts are characteristics *of* the world. It is a point that is easy to miss. As Sommers confesses,

> The mistake of looking for a notion of fact as something that exists in the world was made by Russell, Wittgenstein, Austin (in the famous debate with Strawson) and by most correspondence theorists. It was made by me in [*The Logic of Natural Language*] but the august company of those who are drawn to the correspondence theory but who fall into the error of looking for facts and states in the world mitigates the recanting of it. (1987: 304)

I will have more to say about truth in my final chapter, but, before turning to Sommers's account of how to incorporate statement logic into term logic,

we would do well to note some important formal distinctions involved in his truth theory.

We have seen that any term is either positively or negatively charged. So is any statement. It is important to distinguish between the state signified by a statement that claims the existence of a nonP thing and the state signified by a statement that claims the nonexistence of a P thing. (Again, remembering that existence and nonexistence properly characterize [constitutively] domains rather than things, and that what we actually mean here is presence or absence rather than existence or nonexistence.) Consider, for example, the following.

(1) Some snakes are pink.
(2) Some snakes are nonpink.
(3) No snakes are pink.

(1) characterizes the domain as pink-snake-ish; (2) characterizes it as nonpink-snake-ish; (3) characterizes it as un(pink-snake-ish). The first two statements positively characterize the domain; the third negatively characterizes it. The first two claim that the domain is characterized by the presence in it of certain kinds of snakes. The third characterizes the domain as failing to have in it certain kinds of snakes; the domain is characterized by the absence of such snakes.[27]

Let us turn now to Sommers's account of how statement logic is a proper part of term logic (as found especially in Sommers, 1993). We will see that it is closely tied to his theory of truth. Modern Fregeans have been in no doubt about the fact that the propositional calculus, the logic of unanalysed statements, precedes the predicate calculus, the logic of terms. In the schools, propositional calculus is taught before predicate calculus. And, indeed, the latter cannot be understood without acquaintance with the former. From the point of view of modern mathematical logic, the logic of unanalysed statements is primary logic. Term logicians, such as Leibniz and Sommers, reverse this order, taking the logic of terms to be primary logic and viewing the logic of statements as secondary. Historically, the term logic of Aristotle came before the statement logic of the Stoics. As both Leibniz and Sommers have seen, the first step in incorporating statement logic into term logic is to construe entire statements as terms. Leibniz was less than perfectly clear about just how to do this. Sommers, as we have seen, accomplishes it by taking statements to be complex terms signifying states of affairs.

Sommers has taken conjunctions and conditionals to share the logical form of I and A categoricals, respectively. For example, 'p and q' (where 'p' and 'q' represent unanalysed statements) is first paraphrased as 'Some state of affairs in which p is the case is a state of affairs in which q is the case'. This is then formulated as '+[p]+[q]' ('Some [p] is [q]'), an I form. 'If p then q' is paraphrased as 'Every state of affairs in which p is the case is a state of affairs in which q is the case'—that is, '-[p]+[q]', an A form. Here the unanalysed statements have been nominalized to create "sentential terms." Now, sentential terms are terms, but they are special in important ways. One consequence of this is that in certain specifiable ways the logic of statements does not appear to conform to the more general logic of terms. There are theorems that appear to hold for one but not the other. For example, 'If p then q' is immediately derived from 'p and q'. In other words, from '+[p]+[q]' we should be able to derive '-[p]+[q]'. However, in general term logic, an I sentence does not immediately yield the corresponding A sentence. Moreover, while an I and its corresponding O sentence are logically compatible (e.g., 'Some men are married'/'Some men are unmarried'), their nominal versions are not (i.e., '+[p]+[q]' ('p and q') and '+[p]-[q]' ('p and not q') are incompatible). Sommers's solution to these kinds of disanalogies leads to his account of how term logic is primary and properly includes statement logic.

Again, true statements, like any other term, signify properties, or characteristics. A term such as 'wise' signifies the property of wisdom; a term such as 'unmarried' signifies the property of being unmarried. True statements signify constitutive characteristics of the domains relative to which they are made. To make a statement is to use a sentence to make a truth claim. Suppose I state that some logicians are fools by using (appropriately) the sentence 'There are foolish logicians'. In so doing, I implicitly make a truth claim to the effect that the domain (presumably the actual world) has among its constituents foolish logicians. My statement signifies a (positive, in this case) constitutive characteristic of the world. ('There are no foolish logicians' would signify a negative characteristic.) The term 'wise' denotes whatever has the property of wisdom. The statement 'There are foolish logicians' denotes whatever has the constitutive characteristic that it signifies. Thus, if it is true it denotes the world. The statement that there are no foolish logicians is false; it denotes nothing. False statements are denotationally vacuous.

Any term that denotes nothing is denotationally vacuous. Such terms *express a concept*, since they are meaningful. But, as there are no unhad properties, they do not signify any property, and are both denotationally and significantly vacuous. However, no meaningful term is conceptually vacuous. The term 'wise' is meaningful; when used, it expresses the concept of wisdom or the sense of 'wise', signifies the property of wisdom, and denotes all wise things. The term 'king of France in 1985' is meaningful; when used, it expresses the concept of being a king of France in 1985. But, as nothing *has* the property of being a king of France in 1985, it is denotationally and significantly vacuous. Statements follow the way of terms. 'There are no foolish logicians' is meaningful. It expresses the concept (thought, proposition) that no logicians are fools. But this concept does not characterize the world. It is denotationally and significantly vacuous. On the other hand, 'There are foolish logicians' not

only expresses a proposition but signifies a property that characterizes the world. It signifies a fact. It is true.

Recall that an *elementary* statement has the form 'Something is P' or 'Nothing is P'. Elementary statements are the components of compound statements. Elementary statements signify elementary states. So, compound statements signify compounds (conjunctions, disjunctions) of elementary states. Thus, a conjunctive statement, 'p and q', signifies the state of the world that is both [p] and [q]. Let 'x-world' be a term that denotes a world that is [x], a world constitutively characterized by the characteristic signified by the statement 'x'. For example, since the statement 'There are foolish logicians' (= 'Something is a foolish logician') is true, it denotes a foolish-logician-world. Since what a statement denotes, if anything, is whatever has the characteristic it signifies, we are free to say that what nominalized statements (the term forms of statements) denote are worlds. Let 'W' be read as 'world'. We can read any (unanalysed) statement, elementary or compound, as a categorical concerning worlds. For example (letting 'x' stand for 'W that is [x]'):

> 'p' is read as 'some W is [p]'
> 'not p' is read as 'some W is non[p]'
> 'p and q' is read as 'some W that is [p] is a W that is [q]'
> (briefly, 'some p is q')
> 'if p then q' is read as 'every W that is [p] is a W that is [q]'
> ('every p is q')

We can take the statements of statement logic to be about the world. This contrasts with analysed statements of term logic—for example, 'There are foolish logicians'—that make truth claims about the world but are *about* things in the world (say, fools and logicians). This contrast between what a statement is about and what it claims is inert for unanalysed statements. Such statements, then, can be construed as being about what they denote—that is, the world. And, indeed, according to Sommers's account, such statements are uniquely denoting—they denote one thing, the world. Talk about some world that is [p] being a world that is [q], and the like, is merely a logical regimentation assigning an explicit quantity to what is actually a singular term (viz., 'world that is [p]').

It is the fact that (nominalized) statements are always singular, denoting just one thing, and that this one thing is always the same thing—the world—that Sommers uses to account for the disanalogies between statement and term logic that we saw above. 'Some A is B' (+A+B) does not generally entail 'Every A is B' (-A+B), but 'p and q' (+p+q) does entail 'If p then q' (-p+q), because the logical subject of 'p and q' is singular and thus has wild quantity (i.e., its particular quantification entails its universal quantification). Likewise, while 'Some A is B' (+A+B) and 'Some A is nonB' ('+A-B') are logically compatible, 'p and q' and 'p and not q' are not, since, there being but one world, it cannot be characterized as both [q] and non[q].

> The doctrine that *all true statements denote one and the same domain* (though signifying different facts) is the key to understanding why all of the "general categorical" statements of a terminized propositional logic are semantically singular. That all nonvacuous propositional terms denote the world fully accounts for the unique features of propositional logic as a special branch of term logic. (Sommers, 1993: 181)

Implicit in Sommers's theory of truth and the primacy of term logic is an uncompromising commitment to actualism: the only world is the actual world; there are no possible, fictitious, conceptual, or other worlds beyond the actual world. This is an ontology that takes what there is, the actual world, to consist of individual things and the properties that characterize them. It is a theory that contrasts sharply with the type most popular today among analytic philosophers, possibilism, which opts for a plurality of possible worlds, one of which is actual. Often, such theories result from the mistaken assumption that since some given property does not characterize any actual individual it must characterize some nonactual thing. Here one sees the result of ignoring the distinction made by Sommers between what a term expresses and what it signifies. Conflating these two results is taking the concept expressed by any meaningful term to be the property it signifies. From this it follows that, since there are no unhad signified properties, such terms are never denotationally vacuous. Given that they denote no actual things, nonactuals, possible things, are posited to serve as their denotata. Sommers's distinction between the concept expressed by any meaningful term and a property that may or may not be signified by that term allows a simple way to avoid the ontological complexities of a nonactualist ontology.

The Laws of Thought

> *Logic itself is a science that describes reasoning and does not merely provide formal materials for it.*
>
> Sommers

> *Syllogistic and propositional logic [appear to] express, at some level, a common structure of reasoning.*
>
> *Colwyn Williamson*

> *"Contrariwise," continued Tweedledee, "if it was so, it might be; and if it were so, it would be; but as it isn't, it ain't. That's logic."*
>
> *Lewis Carroll*

> *And don't mess with Mr. In-Between.*
>
> *Harold Arlen*

There is little doubt that logic is a *scientia sermocinalis*, as the Scholastics said, a systematic study of what we say. In this sense, logic is concerned with language, terms, statements, arguments. But the Scholastics also called logic a *scientia rationalis*, a systematic study of how we think when we think rationally. In this sense logic is concerned with rational thought. Aristotle seems to have believed that thought comes before language, so perhaps logic's primary concern is rational thought, while language, merely reflecting thought, is simply what logic deals with immediately. In this sense, logic's concern with language is justified by the fact that language reflects thought, logic's ultimate concern. Most Scholastic logicians appeared to believe that logic was concerned with thought and language at the same time; no priority was given. This seems to have been Leibniz's view as well, though he did make remarks that suggest the more Aristotelian view.

Whether thought and language were seen as co-ordinate or given an order of priority, the fact is that traditional logicians quite generally believed that there was *some* essential connection between the two and that, consequently, logic had a legitimate concern with our rational thinking. Recall that Boole called his great work of logic *The Laws of Thought*. Part of Frege's revolution in logic was the rejection of the idea that logic is in any way concerned with actual thinking: "Perhaps the expression 'laws of thought' is interpreted by analogy with 'laws of nature' and the generalization of thinking as a mental occurrence is meant by it. A law of thought in this sense would be a psychological law" (Frege, 1979: 17). The idea was that thinking is merely a succession of images (dim copies of sensations). To reason is to proceed through such a succession. Logic (laws of reason, laws of thought) can be nothing more than an investigation of the laws describing this sort of succession of images—that is, a matter of observation. Thus logic is simply a part of psychology. Such a view, which Frege associated most immediately with Mill, was known as *psychologism*, and Frege was intent upon excluding it from logic. "The laws in accordance with which we actually draw inferences are not to be identified with laws of valid inference; otherwise we could never draw a wrong inference" (Frege, 1979: 4). "The so-called deepening of logic by psychology is nothing but a falsification of logic by psychology. In the form in which thinking naturally develops the logical and psychological are bound up together. The task in hand is precisely that of isolating what is logical" (5). Thus, for Frege, the logician must "conduct an unceasing struggle against psychology" (6). For him, and then for his legions of followers, logic, the foundation of mathematics, can never involve the contingent. Logical truth is necessary and universal. In contrast, thinking, even when rational, is subjective, contingent. It takes place in the minds of individuals. Thus it is dependent on the nature of minds—contingent affairs. "If . . . by the laws of thought we understand psychological laws, then we cannot rule out in advance the possibility that they should contain mention of something that varies with time and place and, accordingly, that the process of thinking is different nowadays from what it was 3000 years ago" (5). While logic, then, could not be concerned with thoughts. it might be concerned with Thoughts, the objective, independent senses of statements. While our thoughts are the proper objects of study for psychology, Thoughts are not (253): "Thoughts are by no means unreal but their reality is of quite a different kind from that of things. And their effect is brought about by an act of the thinker without which they would be ineffective . . . and yet the thinker does not create them but takes them as they are" (Frege, 1967: 38). Frege's Thoughts, in contrast with thoughts, are not psychological. There is no room for psychology, the systematic study of thinking, in logic. Psychologism remains anathema to most logicians today.

Sommers, true to form, has gone against today's current in logic to defend a version of psychologism, one weaker than the Millian version. If logic is taken to be psychologically real (as Sommers claims), then one must first determine whether this is because it can be used to describe how persons actually *perform* when they think rationally or because it can be used to describe how persons would ideally think rationally—that is, possess the *competence* to think rationally. The former, descriptive, claim certainly seems stronger than the latter, prescriptive, claim. Consider the weaker claim. One way to relate logic to our competence to reason is to argue that such reasoning must be reflected in our natural language. In particular, the claim is that our competence to reason is nothing more than our competence to use language—our grammatical competence. When linguists in the seventeenth and eighteenth centuries (including Leibniz) and in the twentieth century (especially Chomsky) sought a *universal grammar*, what they were looking for was a set of universal, necessary constraints on *any* natural language. The idea here is that if all ideal-language users are constrained by a common set of grammatical rules, rules independent of whatever natural language is considered, then such rules must be necessary features of any natural language and somehow be intimately related to the very nature of the one species that uses such languages. If the universal grammar is constituted by the universal and necessary grammatical (syntactic) rules common to natural languages, then there can be no gainsaying the key position held by logical rules in such a grammar, for logical rules are themselves universal, necessary constraints on language. Logic must be a part of universal grammar (cf. Sommers, 1973b: 170).

Most modern logicians, and the linguists who follow them, have adopted the Fregean fear of tainting logic with psychology. Frege's own reluctance to allow logic to be guided by a psychology that in his day was poorly developed is understandable. But, in the case of today's logicians and linguists, it precludes even the possibility of considering psychologically real versions of logic. Even the contemporary logician tempted to construct a "cognitive logic," a logic that could account for rational competence, must hesitate at the prospect of abandoning the standard predicate calculus in the

absence of a viable alternative. Nonetheless, the plus-minus calculus of terms *is* a viable alternative. And nothing in it bars one from taking it to be a cognitive logic. The logic takes its cue, in part, from suggestions by philosophers such as Hobbes and Leibniz (Dascal, 1976) that both rational thought and language could be viewed as calculating—reckoning. "For words are wise men's counters. They do but reckon by them" (Hobbes, 1904: 25). This reckoning, Sommers has argued, takes the simple form of adding or subtracting terms (i.e., cancelling the middle terms of syllogisms). Confidence that such a logic reflects our competence to use natural language rests on the fact that the syntax of the logic is closer to the syntax of natural language than is the syntax of any other logic. Indeed, this logical syntax has been drawn from the syntax of natural language. So, for Sommers, "the suggestion that we reason by cancellation of elements that have opposed signs is a plausible candidate for a theoretical description of the deductive process" (1976d: 614). A logic of natural language, rather than a logic of an artificial, constructed language, "will illuminate the actual process of reasoning" (1978a: 42). Indeed, "any logician who is interested in a cognitive logic must adhere closely to natural syntax" (1983d: 40).

Even if the case has been made for considering logic to be descriptive of our competence to reason, the question remains whether logic is descriptive of our actual reasoning performance. Sommers's remarks seem to suggest that he is actually defending this stronger thesis. But the simple fact is that studies by cognitive psychologists tend to confirm the suspicion that our unschooled rational performances rarely match the level of our ideal competence.[28] At any rate, the intimate relationship (whatever its exact nature turns out to be) between language and thought cannot be denied. To keep one's language in order must surely be an aid to one's ability to think clearly. A threat to language, as Orwell saw, is a threat to thought.

Viewed from the narrower perspective of the twentieth century, Sommers's contributions to logic are clearly outside the mainstream. But this appearance of unorthodoxy obscures the fact that, from a broader perspective, his work represents the latest stage of a long development that began with Aristotle. This long tradition sees the logic of terms as primary logic. It also takes the syntax of canonical statements to be independent of any semantic singular/general distinction among terms, allowing any kind of term to play any categorematic role in a sentence. But old truths bear repetition, and Sommers has recovered from a past buried beneath a recent Fregean superstructure a number of fine old truths. Yet his mission has been more than just one of rediscovery. The old logic, in spite of its simplicity and naturalness, was simply no match for the Fregean alternative. The latter may lack the old logic's degree of simplicity and may contort ordinary statements into quite unnatural forms, but it enjoys an expressive power and breadth that most traditionalists hardly envisaged and others (Leibniz in particular) could only dream of. Even though he has carried out his work in an intellectual context saturated by Fregean assumptions, Sommers has achieved what term logicians before Frege could not. He has built a uniform, simple, natural, powerful algorithm for term logic. It is a universal characteristic. And while Aristotle began it, the Scholastic logicians refined it, Leibniz envisaged its simplification and generalization, and the nineteenth-century algebraists had a relatively clear vision of its algebraic nature, only Sommers has done it.

Notes for Chapter 3

[1] For a detailed discussion and summary see Englebretsen (1985c; 1990a, ch. 1) the literature surrounding the Tree Theory is fairly extensive. See the references cited in Englebretsen (1990a).

[2] E.g., Sommers (1965), Englebretsen (1972b, 1975).

[3] E.g., Sommers (1966), Englebretsen (1971a, 1973).

[4] E.g., Sommers (1970-71), Englebretsen (1971b).

[5] E.g., Sommers (1963b), Englebretsen (1972a).

[6] For more on Sommers's fraction algorithm see Friedman (1978a).

[7] For example, Sommers argues here that any two terms predicatively tied must be U-related and that the universe of discourse for any statement (or inference) is confined to the intersection of the categories determined by the terms involved.

[8] For more on wild quantity see Englebretsen (1986a, 1986b, 1987a, 1988b). On wild quantity and Leibniz's Law see Englebretsen (1984c). For more on identity, see Englebretsen (1981d). On syllogistic with singulars see Englebretsen (1980b).

[9] For more on logical polarity see Englebretsen (1987a, ch. 14).

[10] Sosa (1973) tries to argue that Sommers's account of formatives would lead to the claim that, for example, 'hot' and 'cold', being opposed, are formatives. But this is simply to miss the important distinction between logical and nonlogical contrariety. 'Hot' and 'cold' are nonlogical contraries. They are not "opposed." 'Hot' and 'nonhot' *are* logical contraries, and their opposition can be accounted for in terms of term quality. Sosa also argues that Sommers's calculus is ineffective since "there are valid inferences that [it] would pronounce invalid" (256). Yet his counter-example (254) mistakes a syllogistic (mediate) inference for an immediate one.

[11] For a discussion of Sommers's use of premises of the form '+S+S' see Englebretsen (1979, 1981e).

[12] This is my much simplified version of Sommers's principle. In subsequent writings, he offered successively simpler and more concise formulations of the conditions for syllogistic validity.

[13] Again, this is a much more concise, simplified version of the one Sommers (1970) formulated.

[14] For more on this see Englebretsen (1986c).

[15] On the importance of viewing syllogistic as a logic of distribution values see the excellent study by Williamson (1971); see also Englebretsen (1979, 1985d).

[16] See Englebretsen's "Cartesian Syntax" (1990c).

[17] See Englebretsen (1989).

[18] See Englebretsen (1986a).
[19] For more on this point see Vendler (1967, ch. 2), Paduceva (1970), and Chastain (1975). A theory similar to Sommers's is found in Heim (1982, ch. 3).
[20] See Englebretsen (1984b, 1985e).
[21] See Sommers (1982, app. A) and Englebretsen (1982d).
[22] A fine account of this is offered in Dipert (1981).
[23] For a similar account of proper names see Lockwood (1971).
[24] See Englebretsen (1972c) for a clarification of Sommers's account of this distinction.
[25] A much more extensive examination of this device is found in Englebretsen (1984b).
[26] Other logicians, including especially Boole and Frege, had held similar views. Frege took every statement to refer to either the True (what makes the statement true) or the False (what makes the statement false).
[27] In ch.14 of Englebretsen (1987), I try to show that while, with respect to any term 'P', a given thing may be either P or nonP, with respect to any constitutive characteristic [p], every domain is either [p] or un[p]. In other words, the polarity of nonsentential terms is reversible but the polarity for sentential terms is not. This fact is the true basis for the contrary/contradictory distinction.
[28] For recent work on this question see, for example, Braine (1978), Evans (1982), Henle (1962), Johnson-Laird (1983), Johnson-Laird and Byrne (1991), Osherson (1975), Wetherick (1989), and Rips (1994).

CHAPTER FOUR

IT ALL ADDS UP

We cannot go back to the prison that would confine all logic to the Aristotelian syllogism, but it is possible to defend (a) something like the view that the form "Every X is Y" is more fundamental than either "For all x, f(x)" or "If p then q" and (b) the traditional ignoring (in inference by subalternation, etc.) of terms that have no application.

A.N. Prior

Plus/Minus

Certainement calculer c'est raisonner, et raisonner c'est calculer . . . . Lorsque je dis que les quantités sont ajoutées ou soustraites, et que conséquemment je les distingue en quantités en plus et en quantités en moins, je ne les confonds pas avec l'opération qui les ajoute ou qui les soustrait; et on voit comment, étant les mêmes en algèbre que dans toutes les langues, il n'y a de différences que dans la manière de s'exprimer: mais quand on nomme quantité positive l'addition d'une quantité, et quantité négative la soustraction d'une quantité, on confond l'expression des quantités avec l'expression de l'opération qui les ajoute ou qui les soustrait, et un pareil langage n'est pas fait pour répandre la lumière. Aussi les quantités négatives ont-elles été un écueil pour tous ceux qui ont entrepris de les expliquer.

Condillac

The concepts of addition and subtraction. The rudiments of logic.

Don De Lillo

In chapter three I offered a brief summary of the many contributions to term logic made over the past several years by Sommers. Such a summary cannot in any measure serve as a substitute for Sommers's own work, but I hope that it will kindle a degree of interest in it. As well, it is meant to show to some extent just how Sommers's logical ideas are actually the latest stage of a very long historical development that did not, contrary to the view of many contemporary logicians, end with Frege or retreat to a few "Colleges