

Language As Symbolic Logic

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The symbolic logic of the last century, the “new logic” of Boole, De Morgan, Frege, Peano, Peirce, Russell, Carnap and others, must be understood as representing a system (or systems) partially based, but not consistently, on the Western Indo-European languages. However coherent and “logical” this system, or systems, may be, it will have to be regarded as arbitrary and its propositional solutions as non-unique. The clue to this non-uniqueness lies in mathematics itself where different systems, particularly of algebra and geometry, may each be valid for a particular frame. This is reinforced at the other end, if one may regard symbolic logic as the link between the disciplines of mathematics and linguistics, by languages themselves, where syntax exhibits logical structures, differing slightly between related languages, but much more widely between language families.

From the following elementary propositions (and they are elementary not only for the brevity of this paper, but also because of my own hesitancy in the field) we may see that languages have logical structures of their own which contain as valid propositions in the universe of discourse as the so-called “laws of thought” of symbolic logic. The “vagueness, imprecision and trickery” of “natural” languages, which logicians often repeat, disappears after a little examination and is replaced by the observation that system A differs from system B.

English	Symbolic Logic
Barbarossa is Frederick I	Barbarossa = Frederick I
Barbarossa is a hero	Barbarossa \in hero
To sleep is to dream	To sleep \subset to dream
God is	E! God

Here = is “identical with”; \in (epsilon) is “is a member of a class, is a”; \subset is “entails” and E! is “exists”. Only by such precise symbolism logicians maintain, can we bring logic out of language. Actually, the Western European languages, e.g. English, to which logicians purport to bring order, express the matter quite as precisely, but somewhat differently. The relation is always the same, the distinctions lie in the terms. “Barbarossa is Frederick I” might be expressed as $A = B$ (where A and B are unit classes). Symbolic logic has a more technical way of indicating unit classes. Within its

calculus it is fairly easy to state that there is *at least one* member of a class, e.g.

$$(\exists x) : x \in A$$

which could be read as “There is at least one x where x is a member of A ”. For the logical concept that there is *only one* member of a class the formula is a little more complicated, that is,

$$(\exists x)(y) : (x \in A) \cdot [(y \in A) \supset (y = x)]$$

“There is at least one x , such that, for any y , x is an A , and if y is an A , then y is identical with x ”. Which is to say that the membership of class A is limited to one element, x .¹ English proper nouns, that is, nouns preceded by the zero allolog of *the* or nouns preceded by *the* are logically unique, that is, unit classes in the particular universe of discourse: “John is Mr. Smith” (and $B = A$, “Mr. Smith is John”) or “John is the king” (“The king is John”, etc.). In “Barbarossa is a hero” the relation is not \in “is a” as Peano so naively assumed, but again “is” while “a” is an indicator of a non-unit class (noun = class—so this can be symbolized by something like $A = a'$ “unit class—is—member of non-unit class”). The third proposition, “To sleep \subset to dream”, where \subset presumably = “entails” again arises from an ignorance of “natural” language. Here the two terms, or classes, are, in *extension*, equal, both being infinitives. If one may quote here the motto of the Dominican order, *Laborare est orare*, “To labor is to pray” one may see at once that logical identity, not entailment, is involved. So the symbolic formula would read something like $a = b$. Only in the last “God is” might a case be made for handling the relation “is” as something else. But logically this might be expressed as $a = (A)$ where (A) could equal an unexpressed first term.

One has to go only so slightly afield as Classical Latin and Russian to find similar propositions stated in a slightly different way. *Socrates est philosophus* would represent the two formulations of English $A = B$ and $A = a'$ (“Socrates is the philosopher”, “Socrates is a philosopher”). Russian would be the same as Classical Latin for the above Сократ философ but the Russian logicians would write “есть” between the two terms if they were of equal value (in this case, both animate), while if one were animate and the other inanimate, “Socrates is a rock” “Сократ—камень” they would use a dash. Here again the two presumed relators are actually a difference in the order of terms or classes.

¹Cf. Susanne K. Langer, *An Introduction to Symbolic Logic*, pp. 120-121.

Passing to other language families the situation is much stranger. In Mongol, for example, the whole problem of predication cannot arise, for “the sky is blue” is simply an equation of classes, “the sky blueness is”. Here is resolved a long-standing problem of logicians, the “older logic” tending to rely on predication, while the “new logic” emphasizes the relations of terms. To go still further afield we have only to recall Whorf’s remarks on Hopi, which has no nouns and hence no classes, at least in our sense. But a logician’s nightmare would be a physicist’s dream (viz. “it electrons”).

Even the most classic and tradition-supported of all syllogisms is not immune to harassment by symbolic logicians and linguists alike.

All men are mortal
Socrates is a man

Socrates is mortal

In symbolic logic the relationships are expressed a little differently as,

men < mortals
Socrates ∈ man.

Here < means that all members of a class are included in the following class. But linguistically “is” and “are” are not a trick to confuse logicians, but rather express an identical relation. The difference is that Socrates and man are different classes of nouns. This syllogism, translated literally into Russian, results in the following:

Все люди смертны
Сократ человек
Сократ смертен

Here the syllogism, if it is retained in three sentences, and by definition a syllogism must, is an impossibility.

“All люди are mortal.
Socrates is a человек

∴

Socrates is mortal.”

² Cf. Benjamin L. Whorf, *Language, Thought and Reality*, pp. 57-64.

Logicians forget the fact that люди and человек are in extension identical, one being a plural category of the other. So it seems that one has to add a fourth proposition stating that the two terms are equivalent.

Here, as elsewhere, many of the logicians' problems arise from a confusion of levels (and in this they are worse than linguists). They talk much of *extension*, the range of applicability of a term and *intension*, the content or meaning of a term. Logic is really possible only on the former level for only there can we deal with logical structure. In the realm of intension a logic, if attempted, would be basically trivial and, in a sense, would defeat its own purpose, which is the orderly arrangement of formal structures. All terms if understood as content or meaning would be different, and the best that could be achieved would be a sort of limited grammar of relationships. S. K. Langer (op. cit., p. 126) writes "the *systematization of general propositions* is the great contribution of logic to the concrete sciences. But general propositions, which are quantified propositional forms, always refer to members of a class, for it is only of such that we can say 'all' or 'some'. Obviously only propositions about *extensions* can be quantified." We have the identical situation in language where extension refers to the structural range of classes of morphemes, words and phrases. Intension would consist of "lexical meanings". It is this dichotomy of lexicon and structure that makes metaphor and paradox possible. To say "black is white" is, on the level of intension, impossible, but in extension where "black" and "white" are class equivalents, this is not only possible, but may even be considered profound, as are "the rich are poor" or "the weak are strong". This same extension also makes possible the grisly prospects of 1984, "war is peace" and "freedom is slavery". In short, when it comes to linguistic form we may say, to paraphrase Sapir, that ether and concrete are identical and that the cat walks with the hippogriff.

Only a fraction of the total problem, an elementary fraction at that, has been presented here. But enough has been said, I think, to indicate that symbolic logic has no stranglehold on truth, no monopoly in "the laws of thought", which, if they can be observed at all, can be observed only through language, "natural" or special (i.e. mathematics). If logicians must admit a multiplicity of systems, linguists, in their turn must, if language is a logical structure, learn to formulate their points of structure on a more mathematical basis

than most have done in the past. Linguists could even learn from the syllogism. It is probably true, as Bloomfield said (*Language*, p. 170), that “each sentence is an independent linguistic form, not included by virtue of any grammatical construction in any larger linguistic form.” But there are relations between sentences and the relationship is in the extension of logic or the identity of form classes in language.

These statements are frankly Whorfian as all future statements on this important new frontier of science must be. (Cf. Whorf, op. cit., *Languages and Logic*, and *Language, Mind and Reality*, pp. 233-270). What is touched upon here is the specific concept of language as symbolic logic and the relationships of different logics to each other. Linguistics, suggesting different frames of logical structure and the consequently differing analyses of the universe, is at the very pivot of this new frontier. In one direction stretches philosophy, mathematics and logic, to which language is tied by *extension*, by the applicability of its points of structure. In the other direction language is bound by its *intension* or content to anthropology and sociology, which alone can furnish its “meaning”.