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**SOME OBSERVATIONS ON THE  
CONNECTIONS BETWEEN SEMIOTICS, LOGIC  
AND LINGUISTICS**

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The right manner of describing the relations: a) between semiotics and logic, b) between semiotics and linguistics would be to distinguish various meanings of the words 'semiotics', 'logic' and 'linguistics' and then to consider, separately for each of those meanings, the mutual relations between the three disciplines. I cannot do this, however, for more than one reason. Firstly, this would require much more space than I have at my disposal here. Secondly, at least with regard to 'semiotics', it would not be easy to define the term. Thirdly, even if this was done, it might soon turn out that the obtained results have become obsolete. Semiotics, in particular, although rooted in Antiquity and vigorously developed during the Middle Ages, has recently undergone changes so considerable that it can be perceived as a discipline *in statu nascendi*. The same applies to linguistics, which actually finds expression in terminological differentiations, for instance in the juxtaposition of traditional to modern (or, according to some, theoretical) linguistics, or in the discrimination, occasionally observed in the Polish language, between *językoznawstwo* and *lingwistyka*. Finally, with regard to logic, several phenomena crucial to the issue discussed herein have recently been noted, for instance the vigorous development of systems of non-standard logic; the steadily growing interest in pragmatic logic; the constant influx of important research results in the field of modal logic; developments in the fields of epistemic logic, deontic logic or tense logic, which are all crucial

to the logical analysis of natural language, and many others. In short, for nearly two decades we have witnessed striking changes in the disciplines concerned with language and sign. After a long, a very long, break, the time has come when logicians and linguists, representatives of the two sciences most closely concerned with investigating language, have begun to bridge the gap. The first period of such rapprochement in European culture occurred in Antiquity and, discounting some rare exceptions, the last big change before the present one took place in the Middle Ages.

When the idea of unified science was developing in the 1930s, Charles Morris perceived that the significance of semiotics lies "in the fact that it is a step in the unification of science, since it supplies the foundations for any special science of signs, such as linguistics, logic, mathematics, rhetoric, and [...] (aesthetics)" (Morris 1938). Today, when linguists regularly and on a massive scale apply the techniques and conclusions of contemporary mathematical logic in their research, while logicians have broadened their interests to include natural language, one could say, not entirely in jest, that the current predicament of semiotics is to watch out that linguists and the logicians do not completely swap their roles; because then the previous, inauspicious state of affairs: the separation of interests, would return and again a *sui generis* no-man's land would stretch between the fields cultivated by each of the sides.

In the history of logic, the already-mentioned development of non-standard inquiries, which has occurred in recent decades, is not the first opportunity for linguists to revise their traditional views on language. The first such opportunity occurred much earlier: it was during the birth of mathematical logic. The model was provided first by the conceptions of Leibniz, later by De Morgan and Boole. From these grew the study of the foundations of arithmetic from the point of view of logic, especially logical analysis of the concept of number, and the target that emerged afterwards was to discover and solve the antinomy of the set theory. To fulfil those research aims was a work of more than one generation: the first steps were made by Frege, Peano and Schröder, the next by Whitehead and Russell. Others who must also be mentioned are members of the Polish school, including Łukasiewicz, Leśniewski, Chwistek, Ajdukiewicz, Kotarbiński and Tarski, and members of the Göttingen school: Hilbert, Ackerman, Bernays and Behmann.

Within the scope of this then-new logic, that opportunity for a revision and amendment of the theory of language — an opportunity not seized by linguists at that juncture — was provided by two issues. The first of

those was symbolic, that is, the formal, character of logic, which made it possible to carry out inferences by means of arithmetical operations; this was a method of calculus which guaranteed that unobserved assumptions would not sneak into the deduction. This opportunity was grasped by linguists much later, only in the 1950s, as a call to formulate rules clearly and explicitly. The second opportunity was provided, in logic, by the theory of relational sentences initiated by De Morgan and Ch. S. Peirce under the influence of Leibniz's conceptions, and the theory of propositional functions. This opportunity was grasped even later than the first, for instance in the works of generative semanticists, McCawley, George Lakoff and others, e.g. in the form of sentence (S) parsing into a predicate and arguments.

In 1924, Russell (Russell 1924), commenting upon the implications of his theory of logical types within the theory of natural language, pointed out that the scheme of a subject-predicate sentence and the suggestions of traditional semantics, according to which one word denoted one object, a proper name — an individual entity and an abstract name — a universal, were misleading. He maintained that not every abstract name denoted a single universal and not every judgement consisted of a subject, copula and predicate. Words, according to Russell, belong to the same logical type, but their meaning may belong to various logical types; not every type can have its meaning represented by means of an isolated symbol. For instance, the attribute YELLOW, in natural language denoted by an isolated word *yellow*, should be, in Russell's view, represented by means of a propositional function "*x* is yellow;" in the case of symbols representing relations it is similar. It is easy to notice that Russell made a differentiation here between the surface structure and the deep structure of a linguistic expression, and that all those many years ago he was already doing it in a similar manner as it is done now in the transformational generative grammar (we may forgive him for not using the now-fashionable terms "surface structure" and "deep structure"). This example of a delayed influence of research in logic on a linguistic theory is not an isolated case; the limitations on the meaningfulness of sentences put by Russell on the theory of types echoed in some of Chomsky's observations on the so-called deviant sentences, illustrated, for instance, by the sentence *Sincerity may admire the boy*.

Semiotics is an interdisciplinary field based mainly on the twin foundations of logic and linguistics. However, it does not adopt all the aims of these two particular sciences. For instance, unlike logic at a certain time, it is not too interested in constructing the concept of number or analysing logical foundations of mathematics; and in the same way, it is not interested

— again: unlike linguistics of a certain period — in developing practical techniques for recording the languages of vanishing tribes as fast as possible. What it does adopt are common features of logic and linguistics, as well as psychology, sociology, philosophy and many other sciences, as ones interested in studying, most generally, language in itself and sign in itself. (Parenthetically: if, following Hahn (1987), logic is considered to be a science concerned with the ways we speak, then logic is a part of semiotics; if semiotics is treated as broadly as in Morris's program, it encompasses not only logic, but also many other sciences; if, following Carnap (1934) in his *Logische Syntax der Sprache*, philosophy is considered to be a logical analysis of concepts and sentences of the language of science, then philosophy becomes a part of semiotics. Of course, the relations between the denotations of the concept of semiotics and the concepts of logic, linguistics, philosophy, psychology etc. fluctuate depending on the current issues and aims of each of those sciences.)

Let us, however, close this parenthesis, in order to realise that what is really important is quite another thing: semiotics constitutes a *sui generis* round table, at which representatives of diverse disciplines may gather to debate whatever is shared by all these disciplines with regard to the issues of language and sign. This offers semiotics an important opportunity. It is on these very grounds that the levelling-out of divergences may occur, and indeed has occurred before. Cases in point are the already-mentioned retardation of linguistics in relation to logic or the opposite situation, when the development of intensional logic, modal logic or tense logic lagged behind the linguistic theory in considering the problems and offering solutions; yet when logic finally took up these issues, it created and still creates a theory which fulfils higher requirements of precision and adequacy than those managed by the linguistic theory.

What I have in mind is the example of the logical theory of PRAGMATICS and its comparison with the relevant findings of the linguistic theory, which are much earlier and belong to its mundane and generally accepted conclusions. Practically the first more precise analysis of the key concept of pragmatics, the so-called token-reflexive expressions, was given by Reichenbach (1947). The next analysis, constituting a considerable step forward in the explication of the same concept (although here called "indexical expressions") was given by Bar-Hillel (1954). Three years later, Prior (1957), concerned with modal logic and tense logic, brought in a lasting contribution to the theory of pragmatics. Outstanding scholars that could also be cited here are Von Wright, Hintikka, Kripke and others. Yet the first complete and only precise theory of pragmatics was proposed by Richard Montague

(1972). He constructed a system of pragmatics which, similarly to the model theory (the modern version of semantics), uses the concepts of truth and satisfaction, but not only with regard to a given interpretation, i.e. in a given model, but also with regard to the so-called context of use, i.e. the pragmatic situation. In order to interpret the language he had constructed, Montague defines the so-called points of reference, i.e. a set of all the complexes of relevant aspects of those contexts of use. If, for instance, in some language the sole marks of the token-reflexive character, i.e., indexical features, are the occurrence of the operator of grammatical tense and of the first person singular, then the point of reference will be an ordered pair comprising a person and a real number, understood as a speaker in the process of saying a given utterance. Secondly, for each point of reference Montague defines a set of objects existing with regard to that point of reference. Thirdly, he defines the meaning, i.e. the intension, of each predicate and individual constant of that language. In order to do this for constant  $c$ , for each point of reference it is necessary to define a denotation, i.e., extension of that constant with regard to the given point of reference, for instance for the expression "it is green" with regard to the moments of time it is necessary to define the set of objects which at the given moment are considered to be green. Fourthly, the interpretation of the language's operators is given, ascribing to each operator a relation between points of reference and sets of points of reference. The individual constant shall denote the possible individual object, and the one-argument predicate constant — the set of possible individuals with regard to the given point of reference. The concepts of truth and satisfaction, which are central to pragmatics, are expressed by Montague by means of the expressions: "a sentence (i.e. a formula with no free variables) is true with regard to the given point with such-and-such interpretation" and "a possible individual object satisfies the above formula with regard to the given point of reference with the same interpretation." The possible individual objects are also quantified at the same time. An extension of the formula at a given point of reference is the set of sequences satisfying this formula at this point, and the extension of an individual constant or an individual variable at a given point of reference is a function ascribing the possible individual object to each sequence in the given domain.

I do not want to take up my Readers' attention with the second issue presented by Montague, which is the structure of intensional language. Montague's predecessors in that domain were Church (1951), Carnap, Kaplan (1964), Howard, Scott and others, but their systems, unlike Montague's, did not make unlimited quantification of ordinary individuals possible, whereas

the applicability of a system for a theory of natural language is very limited without it. On the other hand, almost all the above authors use the concept of possible worlds.

Yet Montague's research, although praiseworthy in itself, has been mentioned here because in two aspects it provides an excellent illustration of a situation at the crossroads of semiotics, logic and linguistics.

One of the central concepts, the concept of the context of use, was already a leading semiotic concept in Morris and in the so-called Oxford ordinary language school, and much earlier, although under a different name, in medieval semiotics, in the reflections upon the so-called suppositions. It is true that before Montague, it did not find a precise formal explication in the framework of the theory which developed the model-theory semantic techniques so as to include all the possible contexts of use. Nevertheless, even in those earlier semiotic theories the concept of the context of use was explicated in such a way that it was possible, by applying it, to point out many crucial relationships between very old concepts — that is between what is now called "surface structure" and what is now called "deep structure." (I am aware that here I am arguing against the zealots who believe only in science's newest fads and think that, for instance, the ordinary language school did not even have a presentiment of the existence of underlying deep structure, because they think it was discovered only by the proponents of transformational generative grammar or of generative semantics.)

I hope that this example has demonstrated one of the areas that falls into the domain of semiotics. It constructs key concepts and formulates crucial problems pertaining to the theory of language and sign; the former explains and the latter attempts to solve, often descriptively and informally, in an introductory manner so to speak. Seeking those concepts and problems, semiotics often reaches out to the neighbouring areas, those of logic, philosophy, linguistics, psychology and other sciences. Its aim is to extract the core: all that pertains to the nature of language and sign, from the shell of ontological or epistemological reflections in logic or philosophy, or, in traditional linguistics, from the crust of technical and particular reflections upon the informal description of language. In exchange, semiotics highlights some concepts and problems pertaining to the theory of sign and the theory of the most broadly understood language, and suggests them to other sciences — which, in turn, sometimes focus on only a section of the issue, for instance constructions of artificial language as an idealisation of the language of science or grammatical description of natural language. Thus, semiotic interpretations constitute a bridge between the discussion

upon linguistic issues on the grounds of, for instance, logic and linguistics. They also provide an impulse for further consideration of those issues on the grounds of every science interested, for whatever reasons, in language. This is because semiotics turns the attention of other disciplines to important common issues in this area.

I think (this is actually my personal hypothesis, which I do not feel able to substantiate here) that if it were not for the earlier semiotic analysis of the role of the context of use, the formal theory of this concept would not have emerged in logic, and even if it did, like Athena leaping out of Zeus's head, its influence on the formulated, modern linguistic theory would probably be limited. This, by analogy, seems to be suggested by, for instance, the fact that the main theme that percolated from Montague's studies to linguistic works was the conception of possible worlds (which, incidentally, were conceived by Chwistek a long time before Church or Hintikka), whereas ideas which were absolutely the most crucial in Montague's system found very little response among linguists. Experience teaches us, however, that at some time in the future, linguistics will probably focus on those issues, too — this is suggested by the striking parallelism in the order in which certain tendencies appear in linguistics and in logical semiotics. For instance, generative semantics, and with it the postulation of the predominance of semantics over syntax or of the inseparability of the two, evolved in contemporary linguistics after a very long period of the primacy of syntax. Similarly, until Tarski's (1933) discovery, Carnap (1934) and many other logicians and philosophers had been of the opinion that logical syntax of language constitutes the entire logic of language; afterwards, semantics regained its rights in logic and philosophy. This happened over thirty years before the renaissance of semantics in theoretical linguistics, before the studies by McCawley (1972), G. Lakoff (1970) or D. Lewis (1972) were published. The question is whether this interval of three decades could be something of a rule. In Lewis's article *General Semantics*, a fundamental role is played by a conception published by Ajdukiewicz (1935) in his "Die syntaktische Konnexität" — a study which, in my opinion, was much ahead of the then-current state of knowledge. Ajdukiewicz wrote, among others, that the sequence of arguments played a significant role in the structure of a compound expression, of which a particular example was the difference between the grammatical subject and predicative; but that this sequence was not identical with the external order in which those arguments appeared in a given expression — that, generally speaking, it was not a purely external quality — but was based on the features of the entire expression derived from



its meaning. Ajdukiewicz added that only in symbolic languages and in some natural ones was the purely external order of arguments responsible for their sequence. No wonder that a proponent of generative semantics responded to these thoughts, containing as they do the differentiation between the surface structure and deep structure, as well as views regarding the importance of the semantic factor. What is surprising, and a matter for discussion, is that Lewis selected this particular conception, not the later one, proposed by Ajdukiewicz in 1958 in his paper at the International Linguistic Symposium in Erfurt (1959). Ajdukiewicz himself underlined that his earlier conception of syntactic coherence referred to an artificial, purely positional language he had constructed; this resulted in obvious limitations in the applicability of his theory. Moreover, in that later work Ajdukiewicz proposed a formal notation of semantic categories, whereas in the earlier one he had used only the concept of syntactic category, which might seem less useful to Lewis, who was, after all, constructing "general semantics."

I am mentioning this not in order to argue with this particular work by Lewis, but for two other, more general reasons. Firstly, a timely (or not much delayed) transfer of ideas from one discipline to the other is, in my opinion, one of the roles fulfilled by semiotics in reference to other disciplines concerned with language; in the above case, such transfer occurred from logic to linguistics. Secondly, the other role of semiotics is to analyse concepts used by various disciplines from the meta-scientific point of view, and to show the way towards a unification of the meaning of those concepts; in this particular case, those are the concepts of 'semantic category' and 'syntactic category'.

Husserl was the one to introduce the term 'semantic category', but he defined it with regard to the syntactic role of an expression in a sentence; so in fact what he meant was a syntactic category. Semantic categories, however, need to be distinguished with regard to what the expressions denote. Ajdukiewicz notes those differences as follows: from the syntactic point of view, the sentence connective 'or' is a functor which serves to construct a sentence by means of two sentences  $\frac{S}{SS}$ , whereas from the semantic point of view it is a functor which denotes a one- or two-argument function which ascribes logical values as correlates to the logical values:  $\frac{V}{VV}$ . Syntactic categories are a different thing than semantic categories, and the meta-language of syntax differs from the meta-language of semantics. The first does not encompass the object language as its part, while the latter does. An adequate definition of truth and denotation can be given only in the meta-language of semantics, and only in semantics is it possible to move



from sentences about expressions to sentences about objects referred to by those expressions. This is also possible in pragmatics, whose language, apart from the names of expressions and their designates, contains the names of the users of language. I am afraid that Husserl's terminology in the semiotic part of his reflections bred some later misunderstandings, and I think the semiotics should mend the damage it did. Regrettably, this very important issue can only be signalled here.

I have a feeling that the difference between the views of transformational-generative syntacticians and transformational-generative semanticists (Chomsky 1957, 1964, 1965) is not as deep as they themselves seem to think. Even if we accept the assumption that in the tree diagrams, or phrase markers, their terminal elements — that is particular words — are names of expressions and not names of broadly understood extra-lingual objects, and that as a result the language of analysis used by the syntacticians is, formally speaking, a syntactic meta-language — the concepts of 'functional labels' and 'categorical labels', like all concepts derived from traditional grammar, decidedly evoke semantic associations as well, because in fact these are semantic-syntactic categories. The same applies to the concept of competence. I agree with Strawson, who observes that it would be difficult to assume that familiarity with meanings might have no influence on the native speaker's ability to grasp those "underlying grammatical functions and relations of elements in sentences" (Strawson 1969-1970). In short, linguistic theory advanced by syntacticians seems to be mixed, syntactic-semantic, in nature while, for parallel reasons, the theory proposed by generative semanticists is semantic-syntactic. The difference consists, among others, in where the emphasis is placed, which is why I reversed the components of the above terms. And finally, since pragmatic aspects cannot be eliminated from either of these theories, in essence they are both semiotic theories; and there is nothing surprising in this, considering that they are grammars of natural language.

The words "generative semantics" evoke associations — because, after all, the theory of associationism does explain some linguistic phenomena — with the concept of logical form. The great misfortune of contemporary linguistic theories were that they reached for concepts as ambiguous and long surrounded with confusion as 'structure' and 'form', the latter sister of the concept of the so-called 'internal form of a concept' recurring from time to time in philosophy. At the same time, those theories indiscriminately used metaphors and personifications ("the rules generate") and failed to avoid hypostases ("logical form"). One gets the impression that the language of contemporary linguistic theories emerged at the crossroads of varying

intentions and, as a result, of differing terminological conventions. It seems to have grown from the desire to describe the structure and contents of the thoughts of the speaker who utters a sentence; the desire to describe the phases of discovering the meaning of a sentence, that is the process of understanding it by the recipient; the desire to graphically present relationships between the elements of the surface structure of a sentence, and also elements of a sentence which is a paraphrase of the former and represents its deep structure; the desire to graphically present relationships between the elements of the first and second sequence, and between each of them and the intermediary sequences; finally, from the desire to describe a certain technical scheme of computer operations. It is an ugly language, and a misleading language. At least some of the blame must be laid on mathematicians and formal logicians, who, ordinarily forced to yield to unrelenting formal discipline, upon leaving the domain of the language of strict symbols feel entitled to liberty and nonchalance — and so express their longing for poetry and life's beauty by allowing themselves free rein in recklessly using metaphors. Semiotics ought to tackle the linguistic theory's most important concepts. As to the concept of logical form — on the one hand, it is hard not to sympathise emotionally with its promoters; yet on the other hand, it is equally hard not to agree with Quine (1972), who rightly noted that logical analysis does not consist in bringing the logical form, that is the logical structure concealed in a sentence, to the surface. To formalise this we apply one of the many possible symbolic notations and we select the one which is best suited to the present aim: we paraphrase the given expression in a manner most convenient under the given circumstances. The one and only paraphrase does not exist — the point is which of the possible ones to select. Yet it might seem that the adherents of the so-called natural logic assume that all synonymous sentences have a single, identical logical form ascribed to them (incidentally, according to some formulations, logical form is supposed to be identical with meaning, according to others it represents the meaning, and according to yet another formulation, it is a part of the meaning together with meaning postulates and other logical apparatus). Whatever the logical form actually is — it is supposed to be just one. Yet if this were the case, it might be expected that an English sentence which is ungrammatical — for instance the sentence *It is possible that Sam will find a girl and he will kiss her* (Lakoff 1970: 621-622) — as a result of the incorrectness of its logical form will be ungrammatical, deviant, in other languages too, and for the same reason: the faultiness of its logical form. However, in Polish an exact translation of this sentence is a perfectly

grammatical expression. This is an empirical argument against a section of the theory of logical form, and an argument in support of further improving this concept. Following Quine, I therefore declare myself against absolutism and subscribe to the view of J. D. Fodor (1970) that we do not possess satisfactory rules of translation from the natural to the formal language.

In connection with the above, semiotics faces the task of further analysing the concepts of paraphrase and translation. The latter was the topic of a noteworthy analysis by Ajdukiewicz (1934, 1958, 1967a), among others in one of his two studies published posthumously, containing a very interesting syntactic-semantic interpretation of sentences in a purely inflecting language, based on the conception of a syntactic position. Ajdukiewicz was not familiar with works in the area of contemporary transformational-generative grammar; hence it is very striking indeed that he arrived at similar ideas along a different path. He developed a system (1959, 1961, 1967a, 1967b), in which to show the syntactic structure of a sentence or other compound expression not having operators or bound variables, it is enough to mark syntactic positions of particular words by means of numerical indicators, regardless of the order in which those words are written. It is then possible to determine and write symbolically, to which semantic category each of those words belongs, and thus to determine such relations as, for instance, subject — predicate, by giving the numerical indicator of the syntactic position and the symbolic indicator of the semantic category for each of those expressions. Further on, Ajdukiewicz defined the concept of a connotation of an expression as a function defined for the final syntactic positions of this expression, defining the unequivocal ascription between those positions and denotations of words occupying those positions. For instance, connotation of the expressions "round and red" is a finite class of ordered pairs:  $\langle(1,1) — \text{round}; (1,0) — \text{and}; (1,2) — \text{red}\rangle$ . The connotation unequivocally defines the denotation; the name of the denotation is, in this case, the symbolic notation:

round	and	red
$(1,1)$	$(1,0)$	$(1,2)$

Ajdukiewicz also gave the definition of the relationship of the main operator to its arguments. This definition implies that syntactic structure of a correctly constructed expression is unequivocally defined already by semantic categories of its first-order elements.

In the 1930s, Ajdukiewicz formulated another theory of natural language as a deductive system with axiomatic, deductive and empirical rules. It was

then that he noted the creative character of this language ('creativity' in the terminology of transformational-generative grammars).

I have mentioned the theory of language based on the concept of syntactic position for several reasons: it is interesting in itself; it satisfies theoretical inclinations of both the syntacticians and the semanticists from the transformational-generative grammar camp; it is an example of an extensionally equivalent theory of language alternative to transformational-generative grammar; it avoids undesirable semantic associations in the area of its syntactic concepts, as well as syntactic associations in the area of its semantic concepts; finally, it is an example of connections between logic and semiotics. This is because the central idea of Ajdukiewicz's theory originated from logical reflection on the topic of artificial language, language in the logical sense, language treated as an idealisation of natural language, whereas the development of this idea refers to language in the linguistic sense.

Connections between semiotics and logic are close and undeniable, but the boundaries are fluid and hard to delineate clearly. I include the area of logic known as the logic of language to semiotics and call it logical semiotics; the latter includes also some parts of logical methodology. Which, if any, parts of formal logic, sentential calculus, logic of induction etc. ought to be included in semiotics is a topic for debate; perhaps those would be only some meta-logical considerations upon the topic of one or another part of the so-called logistics. The debate could also be broadened to include non-standard logical systems. Yet in my opinion this debate would be futile, as it always is when a conflict of competences has arisen; and in the meantime the field would lay untilled and there would be work to do. Hence I have limited myself to underlining, out of superficial necessity only, the connections between logic, semiotics and theoretical linguistics, and to pointing out some of their shared tasks, upon a few examples; all this to demonstrate that semiotics offers the followers of diverse disciplines an opportunity to come out of the tight compartments of classifications according to occupation or specialism.

## **Bibliography**

1. Ajdukiewicz, Kazimierz (1934) "Sprache und Sinn." *Erkenntnis* 4: 100-138.
2. Ajdukiewicz, Kazimierz (1935) "Die syntaktische Konnexität." *Studia Philosophica* 1: 1-27.

3. Ajdukiewicz, Kazimierz (1958) "Trzy pojęcia definicji." *Studia Filozoficzne* 5(8): 3-16.
4. Ajdukiewicz, Kazimierz (1959) "Związki składniowe między członami zdań oznajmujących." *Studia Philosophica* 6(21): 73-88.
5. Ajdukiewicz, Kazimierz (1961) "A Method of Eliminating Intensional Sentences and Sentential Formulae." *Atti del XII Congresso Intern. di Filosofia*, V. Firenze.
6. Ajdukiewicz, Kazimierz (1967a) "Intensional Expressions." *Studia Logica* 20: 63-86.
7. Ajdukiewicz, Kazimierz (1967b) "Proposition as the Connotation of Sentence." *Studia Logica* 20: 87-98.
8. Bar-Hillel, Yehoshua (1954) "Indexical Expressions." *Mind* 63: 359-379.
9. Carnap, Rudolf (1934) *Logische Syntax der Sprache*. Vienna: J. Springer.
10. Chomsky, Noam (1957) *Syntactic structures*. The Hague: Mouton.
11. Chomsky, Noam (1964) *Current Issues in Linguistic Theory*. The Hague: Mouton.
12. Chomsky, Noam (1965) *Aspects of the Theory of Syntax*. Cambridge: The MIT Press.
13. Church, Alonzo (1951) "A Formulation of the Logic of Sense and Denotation." In *Structure, Method, and Meaning: Essays in Honor of Henry M. Sheffer*, Paul Henle, Horace M. Kallen, Susanne K. Langer (eds.). New York: The Liberal Arts Press.
14. Fodor, Janet Dean (1970) "Formal Linguistics and Formal Logic." In *New Horizons in Linguistics*, John Lyons (ed.). Baltimore: Penguin.
15. Hahn, Hans (1987) "Logic, Mathematics and Knowledge of Nature." In *Unified Science*, Brian F. McGuinness (ed.). Dordrecht: Reidel.
16. Kaplan, David (1964) *Foundations of Intensional Logic*. Los Angeles: University of California.

17. Lakoff, George (1970) "Linguistics and Natural Logic." *Synthese* 22: 151-271.
18. Lewis, David (1972) "General Semantics." In *Semantics of Natural Language, Synthese Library* 22: 18-67.
19. McCawley, James D. (1972) "A Program for Logic." In *Semantics of Natural Language, Synthese Library* 40: 498-544.
20. Montague, Richard (1972) "Pragmatics and Intensional Logic." In *Semantics of Natural Language*, Donald Davidson, Gilbert Harman (eds.). Dordrecht: Reidel. A 1967 lecture.
21. Morris, Charles William (1938) "Foundations of the Theory of Signs." In *International Encyclopedia of Unified Science* 1, 2. Chicago: Chicago University Press.
22. Prior, Arthur N. (1957) *Time and Modality*. Oxford: Clarendon Press.
23. Quine, Willard Van Orman (1972) "Methodological Reflections on Current Linguist Theory." In *Semantics of Natural Language*, Donald Davidson, Gilbert Harman (eds.). Dordrecht: Reidel.
24. Reichenbach, Hans (1947) *Elements of Symbolic Logic*. New York: Macmillan Co.
25. Russell, Bertrand (1924) *Logical Atomism*. London.
26. Strawson, Peter Frederick (1969-1970) "Grammar and Philosophy." *Proceedings of the Aristotelian Society LXX*. Methuern & Co. Ltd.
27. Tarski, Alfred (1933) *Pojęcie prawdy w językach nauk dedukcyjnych*. Warszawa: Towarzystwo Naukowe Warszawskie.