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THE BASICS OF DENOTATION

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INTRODUCTION

In one of my earlier articles (Koj 1966: 45—64) I presented a hypothesis¹ that systems of pure semantics constructed by logicians may be presented as theories explaining fragments of empirical pragmatics, i.e. pragmatics practiced by linguists, psychologists and sociologists. According to this hypothesis, terms of pure semantics can be defined in conditional definitions by using selected adequate pragmatic terms.² Regardless of these definitions, terms of pure semantics have additional characteristics in semantic axioms. The axioms of pure semantics and the conditional definitions should result in pragmatic theses regarding some of the phenomena discussed in pragmatics.

This hypothesis is tempting, but it must be verified. There is essentially only one way to do it. We have to present pragmatic theses and the system of pure semantics combined as described above: pragmatic theses result from the theses of pure semantics, and semantic terms are defined in the conditional definitions by using pragmatic terms.

The first difficulty encountered when trying to verify the proposed hypothesis is that essentially, there is no such thing as pragmatics being a set of related theses put forward in a relatively precise way (so that these theses could be linked with theses of pure semantics expressed using logical

¹A simplified version of this hypothesis was presented in my article "Wspaniała samotność logiki" (Koj 1968).

²For more on the terms used, cf. "Dwie koncepcje semantyki" (Koj 1966) and *Introduction to semantics* (Carnap 1946: 9—11).

terminology) and sufficiently justified empirically.³

The first step towards verifying the hypothesis must be to adopt a relevant set of pragmatic theorems, and this will be the aim of the present article. I shall provide only a few pragmatic hypotheses, trying to give them such a form that allows them to be linked with theses of pure semantics. It is impossible to conduct an additional empirical proof of these pragmatic hypotheses here; I will leave this matter to competent scholars, in this case to psychologists. It is also impossible to fully specify all used pragmatic terms, because — as it is always the case with empirical sciences — defining is not separate from empirical studies. The studies conducted in the relevant fields of science so far are insufficient to provide definitions which would meet the requirements of logic.

Pragmatics is a very broad discipline which deals with various relations between man and sign. Therefore, it is advisable to first decide what kind of pragmatic relations would be taken into account to link pragmatics with pure semantics as easily as possible.

Without going into detail at this point, we could say that pure semantics deals with the most broadly understood relation of assigning words to fragments of reality. Let us call all these types of relations 'denotation'. It seems that if pure semantics deals with denotation, it would be best to take into account those pragmatic theses which speak about something very similar, namely about pragmatic denotation. The latter is a relation having at least one more domain than semantic denotation, the said domain being the set of people.

As I have already mentioned, the pragmatic theorems in question will have an empirical nature, which does not mean that they will have already been verified. Moreover, we can even expect that as the first attempts to specify certain regularities, they are likely to be much more simplified hypotheses and will require at least modification during empirical verification. The fact that the hypotheses are non-verified makes them highly uncertain, which is an obvious flaw. However, the normal course of events is to first formulate the hypothesis as precisely as possible before trying to verify it. Consequently, it does not seem necessary to refrain from presenting the hypotheses in question until they have been verified.

DENOTATION AND COMMUNICATION

³Recently, this fact was underlined by W. Mejbaum and R. Wójcicki in their article titled "Program metodologii pragmatycznej" (Mejbaum, Wójcicki 1967).

The basic pragmatic fact is human communication. If people refer expressions to certain fragments of the extralinguistic reality, they do primarily — if not exclusively — in order to be able to communicate with each other about these fragments of reality. In short, expressions denote in order to make the process of communication possible. The above statement is generally not challenged. Moreover, it should be observed that if expressions denote pragmatically, essentially for the sole purpose of allowing people to communicate, the characteristics of denotation are determined by the requirements of the communication process. Consequently, we can define the characteristics of denotation, taking into account the requirements of communication. In order to determine the most important characteristics of pragmatic denotation, first of all, we have to examine the necessary conditions of communication, as they contain what is most essential for this process and as they are also what determines the most important characteristics of denotation.

The process of communication is not equivalent to successful communication. Sometimes it results in understanding, and sometimes in lack of understanding or even misunderstanding. In this article, when discussing communication, we will focus only on such communication that meets all conditions leading to actual understanding, that is, fully correct communication. The reason for this restriction in the scope of our study is as follows. Pure semantics provides theorems concerning the semantic characteristics of languages, in which there is no place for imperfections such as ambiguity, vagueness, etc. Pure semantics deals with languages that are perfect in some respects. It is rather unlikely that pragmatic theorems describing unsuccessful communication, i.e. describing various deviations from the ideal correctness can be linked to pure semantics theorems. Those pragmatic theorems which describe the conditions of a fully correct process of communication have a much greater chance for it.

What are these necessary conditions for correct communication? First, we have to agree on some terminological issues.

For the purpose of the present discussion, a person expressing himself/herself orally or in writing, or in any other way, will be called the sender, while a person who is listening, reading or looking at gestures will be called the recipient. The user of a sign is either a sender or a recipient. The expression itself will be called a sign, while the object, feature or event which the user has in mind will be a denotatum. According to the above definitions, a sign may be a name (the denotatum being an object or a feature) or a sentence (the denotatum being an event). The term denotatum is thus taken in its broad meaning. At the same time, it is clear that the

concept of sign has been narrowed down to categorematic expressions. For our purposes, there is no need for a broader concept of sign. We should also add the common definition of communication; that is sending signs (together with expressions) in such a way that the recipient of these signs thinks the same about the same as the sender.⁴ This general concept of communication is also a bit narrowed down. It takes into account only the fact that signs evoke thoughts, without considering beliefs, emotional states, etc.

In order to fully understand communication, we must first exactly define what we refer to as the concept of thinking about something. It is hard to say much about it in a definitive way. Instead, we can indicate several doubts that have not been solved so far. First of all, we do not know any methods which would allow us to establish, without doubt, what a given person is thinking at a given moment. We are able to establish it only partially and only with a limited dose of probability. Still, many statements about thinking have been made based on unreliable introspection. We will not, however, be dealing here with establishing what an examined person is thinking about at the given moment. These issues are important for verifying the hypotheses proposed here, but as we are leaving this verification to competent psychologists, they will remain beyond the subject of our discussion. What is important for this article is to define thinking about something from the formal point of view; that is as a relationship between man, denotatum and time, which is reflected in the following statement: at moment t person v thinks about denotatum y .

The above definition of communication, the terminological assumptions and every-day observations of the process of communication lead to some simple conclusions regarding the necessary conditions of communication:

- (a) the sender uses a sign;
- (b) the recipient perceives the sign;
- (c) the sender and the recipient think the same about the same denotatum.

The above conditions (a) — (c) lead to even simpler necessary conditions. Since the person who produces the sign must perceive the sign when sending it (cf. Carrol 1964: 45—46, 77; Miller 1963: 172), namely to control the production of the sign, we can replace (a) with a more general condition:

- (a') the user of the sign must perceive the sign.

Condition (b) is obviously covered by (a'), as the recipient of the sign is a user of the sign. The sender has already been discussed. If both users are to

⁴Among the many similar definitions of communication it suffices to have in mind those by F. de Saussure (de Saussure 1983).

think the same about the same thing, they definitely must think something about the denotatum, which gives us:

(b') the user of the sign must think something about the denotatum.

In order to clearly state that (a') and (b') are necessary conditions of communication, let us say it once again, formulating a relevant conditional phrase, in which (a') and (b') are elements of the consequent:

(1) If someone treats something as a sign of a certain denotatum (takes part in the process of communication), he must perceive this sign and must think something about the denotatum.

The necessary conditions (a') and (b') lead to equally obvious conclusions. In order for the process of communication to be effective, only those objects can be used as signs which can be constructed and perceived by the available means. Moreover, a denotatum can be only an object about which we are able to think something in the process of communication, in particular when perceiving the sign. This is a necessary condition of communication, which will be further discussed in sections 3—6.

THE TIME OF USING A SIGN AND THE TIME OF THINKING ABOUT THE DENOTATUM

One can clearly see the vagueness of condition (1). In particular, it is unclear whether the person taking part in the process of communication in a given moment must at the same time perceive the sign and think about the denotatum. It is not clear whether the effectiveness of communication depends on the time when the sign is perceived and when the users think about the denotatum.

There are several possibilities in this matter. Either an object is a sign at the moment in which it is perceived and in which one thinks about the denotatum, or an object is a sign when it is perceived, and the thinking comes later, or we first think and then perceive a sign. Let us consider the latter possibility. Thinking about the denotatum does not precede the perception of a sign by the recipient, as it is the perception of the sign that evokes the thought. It is also unlikely that a sender first thinks, then formulates a sign without thinking, and then suddenly perceives it. When sending a sign, the sender constantly controls its production, probably by comparing it with the thought which it is meant to express. In the event of any mistakes, he makes relevant corrections. This control requires thinking about the denotatum during sending, as it is rather not about thinking how the sign should look and then comparing the produced sign with the remembered design.

Due to the required control of the sign production, it is also rather unlikely that one first makes the sign and perceives it during this process, and only then thinks about the denotatum. For what would the sender be guided by when designing and producing the sign? The only possibility is thinking about the denotatum before or during the sending of the sign.

Naturally, it does not follow from the above that the sender cannot think about the denotatum when he is not sending the sign. The sender is perfectly capable of doing that. He can also perceive the sign while not thinking about the denotatum. In this latter situation, however, he perceives the sign as just a physical object or event which does not serve communication.

In the case of spoken signs, we are dealing with the need to follow the pace of the utterance. If the thought about the denotatum came after perceiving the sign, the reception of the next signs could be distorted. For while thinking about the denotata of previous signs, we would find it difficult to accurately perceive the later signs. This would lead to a backlog in thinking or perceiving. We observe this when we listen to a speech in a language in which we are not fluent. Memory is overloaded with images of signs, before we manage to think about their denotata. We tend to forget some of these signs or lose some elements of thoughts about their denotata. We commonly call it loosing the thread.

The situation is similar with the reception of written signs. Therefore, in order to effectively communicate (control the utterance and follow its thread) one should think about the denotatum at the moment when one perceives the sign.

Associationists have a different point of view. They believe that perceiving a sign is associated with the thought about the denotatum which comes a bit later (Szober 1924). This view has been criticised many times. I agree with the critical arguments and I shall briefly quote them with some additions.

Ajdukiewicz claimed that introspection does not let us identify the two different moments in which we perceive a sign and think about the denotatum (Ajdukiewicz 1960: 114). This argument, regardless of its value, is less useful here, where the point of discussion is whether the need for effective communication implies the need to think about the denotatum at the time when it is perceived.

As we know, one cannot produce as many simple and relatively short expressions as there exist objects, phenomena and events. In order to communicate all these matters, people had to invent languages which allowed them to use complex expression. According to Ajdukiewicz (1960: 114) and

Kotarbińska (1957: 62), associationism is not consistent with the commonly known fact that when encountering a new complex expression for the first time we are able to immediately understand it, as long as we know its components. There is no need to repeatedly associate a complex expression with the situation to which it refers to in order to understand it. Consequently, associationism cannot be reconciled with the observed facts resulting from the need to communicate.

Ossowska (1925: 258—272) points out that associating the perception of a sign with thinking about the denotatum does not guarantee explicitness of expressions, defined as linking an expression with the same thought in the sender's and recipient's minds. Thus understood, explicitness is an obvious condition for effective communication.

In reply to Ossowska's critical remarks, Szober (1925: 258—272) says that not all associations can determine the meaning of a word — only those that are established by *usus*. It seems that this reservation modifies Szober's original associationism and transforms it into a biological conception. For there is probably no other way to force the learners of a language to obey the so called *usus* than rewarding them for the correct usage of language (for correct reactions to language stimuli and apt linguistic reactions to non-linguistic stimuli) and penalising them for incorrect usage. The rewards and penalties may be simply effective and ineffective communication. Obtaining language skills by way of rewards and penalties is not simple association (based on existence in the same space and time, similarity and contrast), but rather referring to the mechanisms of a conditioned response discussed in biological conceptions (Kotarbińska 1957: 80).

In biological conceptions, a sign is a conditioned stimulus replacing an unconditioned stimulus. When the conditioning is strong enough, the reaction to the conditional stimulus is as quick as the unconditional one (Pawłow 1938). Thus, if we identify thinking about the denotatum with a cognitive response for an unconditional stimulus, then the conditional stimulus — in this case a sign — will evoke thoughts about the denotatum as quickly as the unconditional one. Becoming aware of an unconditional stimulus is at the same time a type of cognitive response to the stimulus. Therefore, becoming aware of a sign (conditional stimulus) is at the same time thinking about the denotatum. A similar opinion, namely that the time of perceiving a sign is identical with the time of thinking about the denotatum, in biological conceptions, can be found in Kotarbińska's work (Kotarbińska 1957: 82).

Closing the dispute with associationists, I would like to stress that this

is not about proving that we always perceive a sign when thinking about its denotatum. I am only proving the statement that in a fully effective process of communication, the time of perceiving a sign is identical with the time of thinking about its denotatum. But we can suppose that often communication is not fully effective, e.g. when one of the users does not know the language well. Probably the more effective a communication is, the more identical these times become — naturally, provided that other conditions of correct communication are met.

Intentional sign theories identify the time of perceiving a sign (when it is treated as a sign) with the time of thinking about the denotatum. This can clearly be observed in Ajdukiewicz's thought. He even identifies the thought about a sign with the thought about the denotatum, stating that the very thought that constitutes a use of the relevant expression as an expression of the Polish language consisted in thinking the thought that Charlemagne lived in the 9th century (Ajdukiewicz 1960: 115).

In the context of the above, we can transform (1) into a more complete statement:

(2) If at a given time a person treats object x as a sign of denotatum y , then the person is perceiving the sign and at the same time is thinking something about y .

Theorem (2) is one of the premises for drawing conclusions on denotation. In order to facilitate the drawing of these conclusions from (2), we have to give it a different external form. Instead of the phrase 'at a given time a person treats object x as a sign of denotatum y ,' we will from now on use the abbreviation ' $Z(t, v, x, y)$ ', in which the variable t varies across a set of any time periods, variable v varies across a set of written signs or sounds, and y across a set of any objects, including written signs and sounds. This particular span of variables leads to conclusions of the same general nature as (1), at least as regards nominal signs.

The domain of y is not divisible into subsets of objects of various logical types. Due to the generality of the set covered by y we are dealing with only one type of nominal signs. If we divided y into several subsets differing in terms of logical type, we would have as many names from different syntactic categories as there are types making up the domain of y . Consequently, we would have to divide the denotation theorems of a sign into a relevant number of repetitions.

Due to the general nature of y , we cannot use any logical system using type theory as the basis for formalisation. Consequently, the basis for further discussion in this article will be the system of logic proposed

by Quine in his work *Mathematical Logic* (Quine 1951), which does not acknowledge types. This decision is also due to some more particular and technical premises, which are, however, irrelevant to this discussion.

Further simplifications of (2) are as follows. We replace 'the person is perceiving the sign' with ' $D(t, v, x)$ '. The phrase 'at the same time [the person] is thinking something about y ' shall be extended to the following form: 'in moment t person v is thinking that ... y ...', where any sentence (or sentential function) containing name y can appear after 'that'. In order to verbally express the fact that people also think about events, which are general sentences and which are described without the use of names, I shall generalise the above expression even further, to get: 'in moment t person v is thinking that ...', where the dots can be replaced with a declarative sentence (or sentential function) of any acceptable construction. An abbreviation of this type of expression will be ' $M(t, v, \dots)$ ' or ' $M(t, v, p)$ ', where p is a sentential variable.⁵

Theorem (2) is further shortened by introducing quantifiers in the place of words 'a [person]', 'at a given time', etc. Sentence conjunctions are replaced by logical sentential connectives. At the same time, these simplifications make the sense of (2) more precise, as the ambiguous conjunctions of natural language are given a more precise meaning by their counterparts in Quine's system.

If we additionally agree, in order to further facilitate this discussion, that when a person (v) thinks about an object (y), then v ascribes a characteristic (z), for instance, a relative characteristic to the object, i.e. classifies y to set z , and in the end (2) is replaced by:

$$(3) Z(t, v, x, y) \rightarrow D(t, v, x) \cdot \Sigma z M(t, v, y \in z)$$

NON-IDENTICALNESS OF PERCEIVING A SIGN AND THINKING ABOUT THE DENOTATUM

Identifying the time of perceiving a sign with the time of thinking about the denotatum leads Ajdukiewicz, in a way, to identifying the perception of a sign with the thought of the denotatum: "Let us consider the thought that constitutes the use of the expression "Charlemagne lived in the 9th century"

⁵Providing an exact definition of the expression $M(t, v, p)$ would require defining the concepts of sentential variable and sentence, which entails the need to build a relevant fragment of syntax of the language that I am now informally characterising. I would rather not do this at this point, as I will be dealing with that in later parts of the work of which this article is part.

as an expression of the Polish language. On the one hand, this thought can be characterised as a thought which is the experience of a certain sensory content, and on the other hand, it can be characterised as thinking the thought that Charlemagne lived in the 9th century” (Ajdukiewicz 1960: 115). This statement must be interpreted with great caution. The point is that the same thought can be expressed by using different expressions. This is necessary from the perspective of effective communication. When one expression is not understandable for the recipient, one has to introduce another expression representing the same thought. Furthermore, due to difficulties with understanding excessively long and complicated utterances, one has to use abbreviations. For example, it is unimaginable to have arithmetic useful in calculus, e.g. in school, which would be written entirely in primary symbols, solely using the false connective, a general quantifier and the symbol of set membership (primary signs in Quine’s system). For the purpose of communication, one has to use synonymous expressions, i.e. expressions having different forms but evoking the same thoughts. As perception of different forms differs, we cannot assume that thinking about a denotatum is equivalent to perceiving a sign. If it was so, then while perceiving different signs of the same denotatum we would have to think something else about it each time. This, in turn, would exclude the existence of synonymous expressions. But this simple thought that the perception of a sign is not identical with thinking about the denotatum cannot be represented using simple equivalence:

$$(4) Z(t, v, x, y) \rightarrow \sim [D(t, v, x) \equiv \Sigma z M(t, v, y \in z)]$$

As a sign is perceived simultaneously (as a sign) with thinking about the denotatum, (3) and (4) would immediately lead to a contradiction, assuming that signs exist. This fact highlights that (4) does not reflect the intentions in question. For (4) states that it is impossible to perceive a sign and think about its denotatum simultaneously. And the point is that they are different yet simultaneous events.

The core of the theorem which we want to adopt is the concept of different events. This concept is a negation of the concept of identicalness of events. It obviously differs from the known concept of identicalness of objects.

The concept of identicalness that is needed here does not have to be entirely general. It is enough for it to be relativised in terms of person and time. It is enough for it to state that two events are identical for someone

in moment t . It seems natural to describe this relativised identicalness of events in the following way: for person v , event p is identical in time t with event q , if thinking about p by person v in time t is equivalent to thinking about q by this person at the same time. If we mark the relativisation to time t and person v under the equal sign (at the same time stressing that we have in mind a relativised identicalness, referring solely to events), the definition will look as follows:

$$D_1 \ p \underset{t,v}{=} q \equiv [M(t, v, p) \equiv M(t, v, q)]$$

Back to the main subject, I would like to remind the readers that we are trying to formulate the following statement: when x is the sign of y , then perceiving sign x is not identical, in terms of thinking, with thinking about denotatum y , i.e. the following theorem:

$$(5) \ Z(t, v, x, y) \rightarrow \sim [D(t, v, x) \underset{t_1,v}{=} \Sigma z M(t, v, y \in z)]$$

If perceiving a sign is not identical, in terms of thinking, with thinking about the denotatum, then neither is an entirely conscious perceiving of a sign. The latter perception may surely be identified with thinking about the denotatum. Thus, thinking about a sign is not identical, in terms of thinking, with thinking about the denotatum. This weaker version of (5) will be useful to us later. Let us assume that a fully conscious, and thus verbalised (at least in thoughts) perception of a sign, i.e. simply thinking about the sign, is not identical with thinking about the denotatum. This weakened (5) brings us even closer to the original theorem of Ajdukiewicz.

I will present the weakened version of (5) as follows:

$$(6) \ Z(t, v, x, y) \rightarrow \sim [\Sigma z' M(t, v, x \in z') \underset{t_1,v}{=} \Sigma z M(t, v, y \in z)]$$

Theorem (6) is also not the final form of the thesis on the difference between the conscious perception of a sign and thinking about the denotatum. What was said about a sign as a whole applies also to its parts and the verbal context in which it appears. Perceiving a part of a sign can also not be identical in terms of thinking with thinking about the denotatum. It also cannot be identical with a fragment of thought about the denotatum. If there was such identicalness, it would be impossible to exchange a part of a sign without changing the thought about the denotatum. Consequently, it would be impossible to replace an entire sign with a synonym, as the impossibility

of exchanging parts comes down to the impossibility of exchanging the whole composition of these parts.

The situation is similar with the verbal context of any sign x . The verbal context of x is also composed of signs, which can be replaced by synonyms without changing the thought about their denotata and the denotatum of x . Therefore, perceiving the verbal context of x cannot be identical with thinking about the denotatum of x .

A sign may be understood specifically as a given painting over a surface in space and time or as a given disturbance of air in space and time. A sign can also be understood in a more abstract way — as a class of specific inscriptions or sounds. Thinking about a denotatum cannot be identified with neither perceiving concrete signs, nor perceiving classes of signs. As a matter of fact, we do not perceive classes of signs, but rather their concrete examples. Anyway, in both cases, the result of this identification would be to eliminate synonymous expressions necessary in the process of effective communication.

Therefore, we have to additionally modify (6), making the reservation that thinking about parts of signs, their contexts, classes and elements, cannot be identified with thinking about the denotatum. This modification would give us the following result:

$$(7) Z(t, v, x, y) \cdot (zCx \vee xCz \vee z \in x \vee x \in z) \rightarrow \sim \Sigma z'z'' [M(t, v, z \in z') = M(t, v, y \in z'')]]_{t_1, v}$$

(7) reads as follows: if in time t , for person v , x is a sign of object y and z is a part of x or x is a part of z , or z is an element of x , or x is an element of z , then thinking by person v in time t that z has a certain feature (thinking about z) is not identical, in terms of thinking, with thinking by person v in time t that y has feature z'' (thinking about y). Theorem (7) includes the concept of part C , defined by using the concatenation sign and concerning only the case when both the whole and the part are expressions.⁶ If (7) included a general concept of part, it would be impossible to think about atoms and particles, as atoms and particles are parts of every sign. Defining the concept of part by using concatenation, we come to a very

⁶The definition of the said concept of part is as follows: $zCy = \Sigma z, u (y = x \wedge s \vee y = z \wedge x \vee y = z \wedge x \wedge u)$.

' \wedge ' is a symbol of concatenation. Concatenation is a relation which appears exclusively between expressions, which is guaranteed by the following assumption: $x \wedge y = s' \rightarrow x, y, z$ are expressions.

narrow definition of part, which covers only inscriptions and phonemes.

DURATION OF THINKING ABOUT A DENOTATUM

When defining a sign, we agreed that it will cover only written or spoken expressions which we use in the process of communication. However, this limits our subject of discussion to signs in the actualist sense, excluding those in the potential sense. A sign in the potential sense is an object which can be used in the process of communication. A sign in the actualist sense is the one actually used for communication in a given moment. We have taken into account the more basic concept of sign, i.e. the actual sign. The concept of a potential sign is definable by a sign in the actualist sense in the so called conditional definition.

An object may be a sign in the potential sense for a very long time. The time when it becomes a sign in the actualist sense is much shorter. It is the time in which the user of the sign actually thinks about the denotatum and perceives the sign. This period does not cover any earlier or later fragment of time, in which the user would think about the denotatum or perceive the sign. It is, so to say, the shortest time, in which we are able to think about the denotatum. Thus, if in time t , for person v , expression x is the sign of object y , then if in this particular moment person v is thinking that y has feature z , there exists no such part of t in which person v would manage to think that y has feature z . We mark this finding in the following way:

$$(8) Z(t, v, x, y) \rightarrow \{M(t, v, y \in z) \rightarrow \sim \Sigma t_1 [t \neq t_1 \cdot t_1 P t \cdot M(t_1, v, y \in z)]\}$$

P stands for 'is a part of'. Here, the concept of part is more general than before, when I used the symbol C . It is not defined using the concatenation sign. This concept will not appear further in this text, therefore I shall not describe it in detail.

LINEAR ORDER OF THINKING

Theorem (8) specifies which type of signs we are considering. It suggests further theorems. If x is a sign only in such short periods, it seems natural to adopt a hypothesis that in these short periods one thinks exclusively about the denotata of x , that there is no time left for thinking about anything else. This hypothesis has far-reaching consequences, thus it should be examined in detail. It says that it is impossible to think two different thoughts in the

short periods described by (8). Some psychologists and logicians seem to negate this. I shall name only three such authors: Łukasiewicz, Witwicki and Rubinsztein. After a closer study of their views, it turns out, however, that it was only a seeming negation. Witwicki (1925, 282—284) and Rubinsztein (1962, 597—598) say, in relation to the matter of the divisibility of attention, that there is a possibility of perceiving several things at a time. Here, however, it is about the possibility of having several thoughts at a time. There is, so far, no contradiction between the thesis on the divisibility of attention and our thesis. The arguments presented by Łukasiewicz also do not concern our hypothesis. Łukasiewicz (1910, 31—39) allowed for thinking two contradictory, and thus different statements. He even allowed for simultaneous believing in both of them. However, the time span in which this could take place was much longer than the one defined in (8). What Łukasiewicz had in mind was not the current thinking (in his terminology — belief), but rather the disposition to believe something. It would be fitting to agree with Łukasiewicz that we can believe contradictory statements: we first think about one, and then about another. The disposition to believe the first one while actually experiencing the other statement is maintained.

The thesis that it is impossible to think about several statements simultaneously can be backed up by one version of the thesis on the unity of speech and thought. The hypothesis on the full unity of speech and thought was explicitly proposed by Watson (1931, 225). He claimed that thinking consists in micro-movements of organs of speech. His thesis has never been commonly accepted. However, similar hypotheses are intensively tested through experimentation. For example, Sokołow (1966) found that there is a close link between the activity of the organs of speech and thinking. He established that when we are reading or solving a problem, that is when we are thinking, some electrical stimuli can be found in our organs of speech. Thus, the hypothesis on the connection between thinking and the stimulation of the organs of speech becomes very likely, at least when it comes to more specific thinking, expressible in words. It is possible that other, less specific types of thinking, are more loosely connected with stimulation of speech organs. For example, they can involve the stimulation of muscles responsible for movement or stimulation outside the brain which could be undetectable. Here, however, we are talking exclusively about thinking strictly related to using signs, i.e. discursive thinking. For this type of thinking, it seems justified to adopt the hypothesis on a close connection between speech and thinking, without stating anything about other types of thinking. In addition, I would like to point out that our hypothesis does not identify thinking with

the stimulation of speech organs.

It is obvious that we say one word after another. Speech has its linear order. Written signs are essentially ordered in the same way. We may assume that the stimulation of speech organs corresponding to verbalising words is ordered in the same way as the similar, though much stronger stimulation of these organs during normal speech. If the latter is linear, we can say the same about the corresponding stimulation during thinking. Consequently, we may suppose that thinking is also linear, i.e. that it is impossible to have several different verbalised thoughts at the same time during communication. Thus, if in time t for person v expression x is a sign of object y and in the same time t person v is thinking that y has feature z , and in time t_1 person v is thinking that object w has feature z' , and in addition either $y \neq w$ or $z \neq z'$, then $t_1 \neq t$. This gives us the following theorem:

$$(9) Z(t, v, x, y) \rightarrow [(y \neq w \vee z \neq z', \{M(t, v, y \in z) \rightarrow \sim \Sigma t_1 [t \neq t_1 \cdot t_1 P t \cdot M(t_1, v, y \in z)]\})]$$

The hypothesis that it is impossible to think two different statements at the same time can also take another, more elaborate form. Namely, instead of stating that one can think about two different objects or features in different periods of time, we can just say that statements thought simultaneously are identical in terms of thinking (we are naturally still talking about short periods described by (8)). A stronger hypothesis would be as follows: if in time t for person v object x is a sign of object y and person v is thinking in time t that y has feature z and in addition person v is thinking at the same time that object w has feature z' , then both these thoughts are mentally identical. This supposition takes the following form:

$$(10) Z(t, v, x, y) \rightarrow \{M(t, v, y \in z) \cdot M(t, v, w \in z') \rightarrow [M(t, v, y \in z)]\} =_{t_1, v} M(t, v, w \in z')$$

One of the forms of the hypothesis that it is impossible to think several statements simultaneously was adopted by Szober (1924: 2—3). It can also be derived from de Saussure's theorems on the linear ordering of language and on language as a psychical phenomenon.

CONSEQUENCES OF THE ABOVE THEOREMS

In the second paragraph, I said that a denotatum can be both an object and an event; a sign can thus be either a name or a sentence. In the third

paragraph, I defined y as a variable across a set of any classes. Consequently, at the beginning I restricted the concept of sign to names and I only stated the necessary conditions for using a nominal sign. The symbol representing the relation of using a nominal sign was the letter Z . This operation, narrowing down the scope of the concept of sign, was necessary, as there is no system containing logical constants and the set membership sign, in which there would be variables varying across a set composed of objects (classes) and events, i.e. there is no such system in which variables would be nominal and propositional at the same time (Koj 1963: 235). However, we can still achieve the initial generality by introducing theses analogous to (3), (7), (8), (9), and (10), concerning denotata that are events or states of affairs. In order to achieve this goal, I shall simply replace the nominal variable y in (3) and further theses with the entire propositional function. This way, I have a characteristic of the necessary conditions of correct usage of sentential signs, symbolised by Z_z . From now on, the use of nominal signs will be referred to as denotation in the narrow sense.

Here are the theses corresponding to (3), (7), (8), (9), and (10). I will not comment on them, as all comments to hypotheses (3), (7), (8), (9), and (10) apply to them as well.

- (11) $Z_z (t, v, x, y \in z) \rightarrow D(t, v, x) \cdot M(t, v, y \in z)$
- (12) $Z_z (t, v, x, y \in z) \cdot (wCx v xCw v w \in x v x \in w) \rightarrow \sim[M(t, v, w \in z') = M(t, v, y \in z)]$
- (13) $Z_z (t, v, x, y \in z) \cdot M(t, v, y \in z) \rightarrow \sim\Sigma t_1[t \neq t_1 \cdot t_1Pt \cdot M(t_1, v, y \in z)]$
- (14) $Z_z (t, v, x, y \in z) \rightarrow [t = t_1 \cdot M(t, v, y \in z) \cdot M(t, v, w \in z') \rightarrow (y = w \cdot z = z')]$
- (15) $Z_z (t, v, x, y \in z) \rightarrow [M(t, v, y \in z) \cdot M(t, v, w \in z') \rightarrow M(t, v, y \in z) = M(t, v, w \in z')]$

Theorems (3) and (7) — (15) have several consequences. I shall now discuss some of them. For example, they give us a version of the psychological law of noncontradiction concerning discursive thinking (in the following theses \bar{z} is a complement of class z):

- (16) $Z (t, v, x, y) \rightarrow \sim[M(t, v, y \in z) \cdot M(t, v, y \in \bar{z})]$
- (17) $Z (t, v, x, y) \rightarrow \sim[M(t, v, y \in z) \cdot M(t, v, \bar{y} \in z)]$
- (18) $Z_z (t, v, x, y \in z) \rightarrow \sim[M(t, v, y \in z) \cdot M(t, v, \bar{y} \in z)]$

$$(19) Z_z(t, v, x, y \in z) \rightarrow \sim[M(t, v, y \in z) \cdot M(t, v, y \in \bar{z})]$$

Theorems (16) — (19) are a direct consequence of the hypothesis on the linear character of discursive thinking.

It follows from (3) that:

$$(20) Z(t, v, x, y) \rightarrow \Sigma z M(t, v, y \in z)$$

It follows from (11) that:

$$(21) Z_z(t, v, x, y \in z) \rightarrow M(t, v, y \in z)$$

Theorems (20), (7) and (10) entail:

$$(22) Z(t, v, x, y) \cdot (zCx v xCz v z \in x v x \in z) \rightarrow \sim \Sigma w M(t, v, z \in w)$$

And from (21), (12) and (15) respectively we get:

$$(23) Z_z(t, v, x, y \in z) \cdot (uCx v xCu v u \in x v x \in u) \rightarrow \sim \Sigma w M(t, v, u \in w)$$

$$(24) Z(t, v, x, y) \cdot (yCz v zCy v y \in z v z \in y) \rightarrow \sim Z(t, v, z, z')$$

Combined together, theorems (20) — (23) constitute the principle of transparency, according to which when using a sign, we are thinking about the denotatum and not about the sign, its parts, its context, etc. I discussed this principle in more detail in another article, where I drew several conclusions from it and where I proved the impossibility of semantic antinomies (Koj 1963: 246—251). In order to avoid repeating myself, I shall present the principle of transparency without further comments. I shall only quote the theorems resulting from this principle and excluding the possibility of semantic antinomies in their pragmatic versions (i.e. relativised to people and time):

$$(25) Z(t, v, x, y) \cdot zCy \rightarrow \sim Z(t, v, z, z')$$

$$(26) Z(t, v, x, y) \cdot yCz \rightarrow \sim Z(t, v, z, z')$$

$$(27) Z(t, v, x, y) \cdot z \in y \rightarrow \sim Z(t, v, z, z')$$

$$(28) Z(t, v, x, y) \cdot y \in z \rightarrow \sim Z(t, v, z, z')$$

$$(29) Z(t, v, x, y) \rightarrow \sim xCy$$

$$(30) Z(t, v, x, y) \rightarrow \sim yCx$$

- (31) $Z(t, v, x, y) \rightarrow \sim x \in y$
- (32) $Z(t, v, x, y) \rightarrow \sim y \in x$
- (33) $\sim [Z(t, v, x, y) \cdot Z(t, v, y, z)]$
- (34) $\sim [Z(t, v, x, y) \cdot Z(t, v, y, w)]$
- (35) $Z(t, v, x, y) \cdot Z(t_1, v, y, z) \rightarrow t \neq t_1$
- (36) $\sim Z(t, v, x, x)$

Similar theorems are applicable for the use of a propositional sign.

CONCLUSIONS

In the article mentioned in the introduction (Koj 1966) I proposed a hypothesis, according to which concepts of pure semantics practiced by logicians can be defined using concepts of descriptive semantics, by means of conditional definitions. The appropriately selected and axiomatically adopted theorems of pure semantics should lead to the pragmatic theses listed above.

The theorems of pure semantics should then become elements of a theory explaining some pragmatic facts. Depending on the selection of these pragmatic facts, pure semantics would have to change, in particular when taking into consideration a broader set of pragmatic facts than before. Using pragmatic facts, it would even be possible to falsify semantic theories. Namely, there would exist ways to determine that while some theories of pure semantics explain some facts, they do not explain all of them.

I have made the first step towards the realisation of this programme. I managed to formulate several pragmatic theorems in a way which allows for a definitional and inferential connection with the theses of pure semantics. I have already made this step in my article on the principle of transparency. Here, I mainly aimed to clearly show that the pragmatic theorems derived from the principle of transparency are indeed empirical hypotheses. For this matter is not entirely obvious. In Husserl's works, the principle of transparency is simply binding, is adopted *a priori*. The empirical character of pragmatic theses is also questioned by those who believe that using signs is always conditioned by the knowledge of conventional laws of pure semantics, or law adopted *a priori* (Martin 1959, XI: "semantical notions reappear as pramatical ones."). Then pragmatic laws would have to be set by finding which rules of pure semantics are adopted by the person who uses the sign and whether these rules are indeed laws of pure semantics. In the case of the conventional laws of pure semantics or laws adopted *a priori* the latter operation cannot be empirical.

In this article, I have tried to show that pragmatics, which includes the principle of transparency, is not a derivative of pure semantics as a description of the realisation of previously formulated and experienced laws of pure semantics. Quite the opposite. When using a sign, we must fulfil certain conditions determined by the aim — that is communication — and by the possibilities given to us by our sensory apparatus and the way of processing information, called thinking. Therefore, the laws governing signs, including semantic laws, are consequences of laws governing human cognition, in particular the laws governing thinking.

The aim of this article has been achieved to some extent, as I have managed to link several subjects never linked before. I have managed to show that the problem of intentionality of signs is partly (simultaneous perception of a sign and thinking about the denotatum) related to the sender's control of his utterance and to the speed of decoding the utterance by the recipient. Generally, the problem of intentionality of signs proved to be a consequence of the problem of successful communication. Further, it was revealed that the mental non-identicalness of perceiving a sign and thinking about the denotatum (the right understanding of the thesis on the intentionality of signs) is a result of the fact that during communication we must often replace signs with their synonyms. All these topics proved to be related to the psychological law of noncontradiction and to the principle of transparency, which is further related to the problem of semantic antinomies.

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