

# Some Philosophical Aspects of Semantic Theory of Truth



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**Abstract** The semantic theory of truth, formulated by Alfred Tarski in the 1930s, is primarily a mathematical theory. On the other hand, it also has a considerable philosophical content. This paper presents the second aspect of this theory. It can be shown that several traditional philosophical issues pertaining to the concept of truth can be illuminated by Tarski's account of truth. It concerns, for instance, the idea of correspondence, the relation of truth and logic, the problem of the relativity/absoluteness of truth, etc.

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The semantic theory of truth (**STT**), developed by Alfred Tarski, has two separate but interconnected aspects.<sup>1</sup> Firstly, **STT** is a formal mathematical theory of a central concept of model theory, one of the most important branch of mathematical logic. Secondly, **STT** is also a philosophical doctrine that elaborates the notion of truth investigated by philosophers since antiquity. As the title indicates, this paper focuses on the second issue, that is, **STT** as a philosophical theory. Due to their significance for philosophical analysis of the concept of truth, some formal questions must be taken into account too.

However, the fate of **STT** as a mathematical theory and as a philosophical doctrine is different. Consider the following prophecy [12, p. 135]:

[...] you should ask yourself what your grandsons and granddaughters are likely to study when they settle down to their 'Logic for computing class' at 9.30 after school assembly. Will it be syllogisms? Just possibly it could be the difference between saturated objects and unsaturated concepts, though I doubt it. I put my money on Tarski's definition of truth for formalized languages. It has already reached the universal textbooks of logic programming, and another 10 years should see it safely into the sixth forms. This is a measure of how far Tarski has influenced the whole framework of logic.

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<sup>1</sup>I prefer the label "semantic theory of truth" over "semantic definition of truth" or "semantic conception of truth", though I will use, mostly for stylistic reasons, the second name too. First of all, **STT** cannot be reduced to a definition, because it consists of a statement defining truth and many other assertions. On the other hand, the name "semantic conception of truth" is too vague.

Clearly, Wilfrid Hodges in the quoted fragment says about **STT** as a mathematical theory. Independently whether he is right or not in his prophecy concerning the logical education of our grandsons and granddaughters, Tarski's truth-definition is en vogue amongst mathematical logicians and almost nobody denies its importance as an idea belonging to mathematical logic. If one wonders why I say "almost nobody", I recall what Alan Turing said once about **STT**: "Triviality can go no further" (see [31, p. 144]). Hao Wang grounds on this fact the following opinion: "There is a great difference of opinion on the importance of [Tarski's] contribution to this area [that is, the theory of truth—J. W.]" (ibidem, p. 144).<sup>2</sup> However, it is rather Wang's personal evaluation of the situation (I do not enter into his motives), and the real measure of the importance of Tarski's work as a mathematical enterprise is closer to Hodges' statement.

The fate of **STT** as a piece of philosophy is much more complex and there is really "a great difference of opinion on the importance of [Tarski's] contribution." It is, of course, no surprise, because being controversial is the mode of existence in the case of all interesting philosophical proposals, Tarski himself was convinced (at least, when he published his results about truth) that he contributed to philosophy [24, pp. 266–267]<sup>3</sup>:

Its [that is, 25—J. W.] central problem—the construction of the definition of true sentence and establishing the scientific foundations of the theory of truth—belongs to the theory of knowledge and forms one of the chief problems in this branch of philosophy. I therefore hope that this work will interest the student of the theory of knowledge above all that he will be able to analyse the results contained in it critically and to judge their value for further researches in this field, without allowing himself to be discouraged by the appearance of concepts methods used here, which in places have been difficult and have not hitherto been used in the field in which he works.

The moral to be derived from the end of the above passage is that according to Tarski, formal (mathematical aspects) aspects of **STT** are indispensable for its proper comprehension (see also later Tarski's papers, namely [28] and [31]).

Tarski's hopes about possible interests of philosophers in **STT** were correct. Most philosophers, who oriented philosophy toward logic and used logical tools in philosophical investigations, welcomed his ideas; In fact, it is difficult to find today a serious monograph concerning the concept of truth which would not refer to Tarski's truth-definition. The philosophical significance of the semantics theory of truth was recognized very soon. According to Alfred Ayer [2, p. 116]

Philosophically the highlight of the Congress [of the Scientific Philosophy in Paris in 1935—J. W.] was the presentation by Tarski of a paper which summarized his theory of truth.

Note that Ayer did not belong to the protagonists of the semantic definitions of truth.

Three important philosophers, namely Kazimierz Ajdukiewicz, Rudolf Carnap and Karl Popper, radically changed their earlier views under Tarski's influence (see [33]). Ajdukiewicz abandoned radical conventionalism which was among others a theory of language and meaning [1, p. 315]:

<sup>2</sup>Jean-Yves Girard is another critic of **STT** as a mathematical theory. See [8], section 2.3 of this book has "Tarksism" as its title and contains rather nasty comments on Tarski's on pp. 36–37, 213, 491–496, 499–500. In fact, Girard's criticism is also directed against philosophy behind **STT**.

<sup>3</sup>Page-references are to translations or reprints, if they are mentioned in References at the end of the present paper.

The objection [...] communicated to me by Tarski in a conversation [...] seems to show that the concept of meaning is not definable in purely syntactical terms without the use of semantic terms in the narrower sense.

A similar point was made by Carnap [4, p. X]:

Tarski, both through his book, and in conversation, first called my attention to the fact that the formal method of syntax and semantics must be supplemented by semantical concepts, showing at the same time that these concepts can be defined by means not least exact than those of syntax. Thus the present book owes very much to Tarski, more indeed than to any other single influence.

Briefly, Carnap, under Tarski's influence (or better, above all under Tarski's influence) passed from philosophy as logical syntax to philosophy as exact semantic analysis. There is no exaggeration, if we say that Tarski essentially contributed to semantic revolution in philosophy (see [34]).

Popper recalls [18, p. 322]:

[...] I met Tarski in July 1934 in Prague. It was early in 1935 that I met him again in Vienna in Karl Menger's Colloquium [...] It was in those days that I asked Tarski to explain me his theory of truth, and he did so in a lecture of perhaps 20 min on a bench (un forgotten bench) in the *Volksgarten* in Vienna. He also allowed me to see the sequence of proofs sheets of the German translation of his great paper on the concept of truth, which were than just begin sent to him from [...] *Studia Philosophica*. No words can describe how much I learned from all this, and no words can express my gratitude for it. Although Tarski was only a little older than I, and although we were, in those days, on terms of considerable intimacy, I looked upon him as the one man whom I could truly regard as my teacher in philosophy, I have never learn so much from anybody else.

How Tarski's ideas influenced Popper? Generally speaking, Popper began to defend realism in his approach to science, because he came to the conclusion that **STT** renewed the classical idea that truth consisted in the conformity between propositions and the objective reality. Thus, Tarski essentially contributed to the development of scientific realism.

These three examples together with Ayer's general assessment are perhaps the most spectacular single traces of the Tarski's influence on philosophy consisting in the full acceptance of his ideas. However, the philosophical role of **STT** is by no means limited to such measures. Almost every book (introductory or advanced) in semantics, philosophy of language or the history of analytic philosophy mentions this theory. Almost every discussion of such topics as the definition of meaning, semantic realism or scientific realism uses Tarski's ideas or at least alludes to them. Several important views in contemporary philosophy employ **STT**, for example, Donald Davidson's theory of meaning (see [6]) as based on truth-conditions or various semantic theories of induction (Carnap and his followers). Tarski's theory was more or less modified, like in [14] (Saul Kripke) or [9] (Anil Gupta, Nuel Belnap or replaced by other constructions as in [11] (Jaakko Hintikka); both modifications and replacements refer to **STT** as the solid starting point. There is no exaggeration in the statement that every post-Tarskian theory of truth (at least in analytic philosophy) is propter-Tarskian.

**STT** is also strongly criticized. Of course, it is not surprising that most non-analytic philosophers simply ignore the semantic definition of truth. Others regard it as a typical degeneration of the logical or computational (whatever it means) mind. I will not comment on such criticisms. However, I would like to explain why a discussion between philosophers belonging to various metaphilosophical camps is a very delicate matter. The main problem is that metaphilosophical options largely decide about substantial solutions.

Thus, if someone says that truth is entirely outside logic or semantics and its problem must be located in philosophical anthropology, there is a very little chance for a fruitful discussion between such controversies and a philosopher who believes in philosophy based on logical analysis. As a logical philosopher I do not say that other philosophy is wrong and has no value; I only indicate that, perhaps except explaining fundamental misunderstandings and disagreements, there is not very much to discuss. A consequence of this attitude which I regard as rational is this: it sounds as a restriction of criticism of **STT** to those? which arose within the analytical camp.

Returning to the past, Carnap with an astonishment noted [5, p. 61]:

When I met Tarski again in Vienna in the spring of 1935, I urged him to deliver a paper on semantics and on his definition of truth at the International Congress for Scientific Philosophy to be held in Paris in September. I told him that all those interested in scientific philosophy and the analysis of language would welcome this new instrument with enthusiasm, and would be eager to apply it in their own philosophical work. But Tarski was very sceptical. He thought that most philosophers, even those working in modern logic, would be not only indifferent, but hostile to the explication of the concept of truth. I promised to emphasize the importance of semantics in my paper and in the discussion at the Congress and he agreed to present the suggested paper. At the Congress it became clear [...] that Tarski's sceptical predictions had been right. To my surprise, there was vehement opposition to even on the side of our philosophical friends. [...] Neurath believed that the semantical concept of truth could not be reconciled with a strictly empirical and anti-metaphysical point of view. Similar objections were raised in later publications by Felix Kaufmann and Hans Reichenbach.

The point is that objections raised by the enemies of **STT** belonging to logical empiricism denied any philosophical significance of it. The criticism noted by Carnap assumed a very concrete philosophical basis, namely rather radical logical empiricism as far as the matter concerned the empirical basis of knowledge. Moreover, Neurath argued that the semantic account of truth reintroduces a very bad metaphysics into philosophy.

However, several authors argued later for the philosophical sterility of **STT** from a quite general perspective. For instance, Max Black (see [3]) tried to show that Tarski's theory of truth, although correct from the purely logical point of view, is neutral in fact with respect to old philosophical controversies over the concept of truth. A very radical criticism against **STT** was raised by Hilary Putnam (see Putnam [19–21]) who maintained that this theory is completely mistaken, which—although does not cause troubles for mathematical logic, yet fatally deceives philosophers (see [35] for defending **STT** against Putnam's objections). Another criticism was advanced by from the point of view of anti-realism based on constructive (intuitionistic) logic, for instance. Michael Dummett (see [7]). According to objections forwarded by anti-realists of Dummett's brand, meaning-conditions should be defined as related to assertibility, but not as associated with truth in a sense of Tarskian semantics.

The above brief and selected survey focuses on positive as well as negative influences of Tarski's ideas. Both axes reportedly show that **STT** belong to the contemporary philosophical equipment, at least in the camp of analytic philosophy and those currents, even inside the continental school, provided that they are ready to discuss various issues with colleagues working with use of logical devices. Some philosophers try to continue Tarski's ideas and develop them according to new challenges, for example, advanced by anti-realism, whereas other are at least stimulated by **STT** in their philosophical investigations, even resulted in alternative semantic accounts. One should remember that, for instance, anti-realistic semantics is still a semantic theory. In fact, Tarski's

talks (see [26, 27]) saved philosophical semantics in general, not only his version of it. Although in philosophy many unexpected happenings took place, the return to pre-semantic era, for instance, to the dominance of the syntactic approach in the style of early logical empiricism seems very unlikely. This general assessment of the role of **STT** in contemporary philosophy should be illustrated by more specified data. However, before focusing on a philosophical examination of **STT**, I will outline its formal shape.<sup>4</sup>

At the beginning of the present paper (see also footnote 1) I distinguished **STT** as a mathematical (logical) theory and a philosophical doctrine. I deliberately used the terms “theory” and “doctrine” as contrasts in their meaning. However, I abandoned this way speaking when I passed to a closer examination of tasks that any philosophical account (it is another convenient label) of truth has to confront (I also employ the expression “truth-theory” (“theory of truth”) as referring to philosophical theories of truth. Now there appears a question of the ambiguity of the word “theory”. Typically (at least in metamathematics) a theory is a set of sentences, in particular, definitions closed under a selected consequence operation. **STT** as a logical construction is a theory in this sense. It is based on definitions and lemmas which enable us to prove in the exact mathematical manner various properties of the set of true sentences, for instance, that this set forms maximally consistent set. It is also possible to embed **STT** into the weak second-order arithmetic with the axiom of arithmetic comprehension and assess its logical complexity (see [10]). **STT** as a philosophical theory belongs to different order of things. By a philosophical theory I understand a body of interconnected statements related to a set of philosophical and metaphilosophical constraints. For instance, materialism, idealism, rationalism or empiricism are such theories.

Some basic preliminary intuitions are as follows. Consider two stocks of ideas (for simplicity I limit informal as well as formal explanations for monadic formulas, that is, of the type  $P(\dots)$ , where an individual variable or an individual name occurs in the place of dots occurring in the symbol  $(\dots)$ ); the letter **U** represents the assumed universe of discourse; it is convenient to claim that **U** is infinite):

- (I) (General case): open formulas, satisfaction by an object from a given set **U**, non-satisfaction by an object from the complement of **U**;
- (II) (Special case): closed formulas (sentences), a special case of satisfaction relatively to a given set of objects belonging to a given set **U**, satisfaction by no object from a given set **U**.

Informally speaking, open formulas are neither true nor false, but satisfied or non-satisfied by some objects. For instance, the number 2 satisfies the condition “ $x$  is a prime number”, but the number 4 does not satisfy this condition. Yet we have an intimate connection of truth and satisfaction. Some substitutions convert open formulas into true sentences, but other ones—into falsehoods. This heuristics suggests to treat truth, resp. falsity, as

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<sup>4</sup>My presentation of **STT** uses rather contemporary settings than original Tarski’s version given in [24, 25] and [29]). The main issue concerns the explicit role of the concept of model and working with first-order languages.

a special case of satisfaction, resp. non-satisfaction. Since a (declarative) sentence is traditionally defined as a sentence which is true or false, we have a hint for defining truth.

Let  $A$  be a sentence (closed formula, that is not having free variables). Now, it is convenient to use sequences of objects, not objects as such. One can prove that  $A$  is either satisfied by all sequences of objects from  $U$  or is not satisfied by any sequences of objects (satisfied by no such sequence object). Tarski proposed to define truth as satisfaction by all sequences of objects and falsity as satisfaction by no sequence of objects. The above condition for truth is equivalent to saying that a sentence is true, if it is satisfied by at least one infinite sequence of objects or by the empty sequence of objects. Technically, since formulas can be of an arbitrary finite length, it is convenient to introduce infinite sequences of objects in order to obtain a general scheme for all possible syntactic cases. Moreover, because  $U$  is always associated with a structure of the type  $M = \langle U, P \rangle$ , where  $P$  is collection of predicates ( $M$  is a model), we have the following definition :

**(TrDef)** A sentence  $A$  is true in a model  $M$  if and only if it is satisfied by all infinite sequences of objects from  $U$  (or at least by one such sequence or the empty sequence; otherwise  $A$  is false in  $M$ ).

Thus, truth is defined in the above way is an outcome of an elegant analogy displayed by (II). In particular, **(TrDef)** satisfies Tarski's claim that a satisfactory definition of truth should logically entail the equivalence (at the moment I use its naive form)

**(TE)** A sentence  $A$  is true if and only if  $A$  (in symbols,  $TA \Leftrightarrow A$ ),

for any  $A$  belonging to a language  $L$ . This requirement is called the convention **T (CT)**. **(TE)** is frequently called the **T-scheme**. **(CT)** establishes the condition of the material adequacy for a truth-definition, also for **(TrDef)**.

The letter  $L$  in **CT** serves a new parameter in the entire construction. Hence **(TrDef)** should be completed as

**(TrDef\*)** A sentence  $A$  of a language  $L$  is true in a model  $M$  if and only if  $A$  is satisfied by all infinite sequences of objects from  $U$  (or at least one such sequence or the empty sequence; otherwise  $A$  is false in  $M$ ).

The relativisation to  $L$  is associated with the semantic paradoxes, especially with the Liar antinomy. It is generated by **(TE)** by substituting "this sentence is false" for  $A$ . In order to solve the difficulty, **(TE)** is transformed into

**(TE\*)**  $T_n(A) \Leftrightarrow [A]$ ,

where  $n(A)$  is a name of the sentence and  $[A]$  refers to a retranslation of  $A$  into a metalanguage. Let  $L$  be German, but English serves as a metalanguage. We consider a German sentence "Schnee ist weiss" and say (it is a special case of **(TE\*)**) that the sentence "Schnee ist weiss" of German is true if and only if snow is white. The expression "Schnee ist weiss" is a name of the German sentence occurring inside quotes, but the right hand of the equivalence in question is a translation of the German sentence. Consequently, if  $A$  belongs to an object-language  $L$ , **(TE\*)** and **(TrDef\*)** must be formulated in the metalanguage  $ML$ . Generally speaking, a semantic theory for  $L$  should be formulated in  $ML$  in order to avoid semantic paradoxes. It is very important to see that **(TE)** is not a truth-definition. **CT** states that every instance of the **T-scheme** must be derivable from

(**TrDef\***), but, except the case, when **L** is finite (languages are sets of sentences), we have no equivalence between (**TrDef\***) and (**TE\***).

To proceed more formally, consider a formalized language **L** for which truth (more precisely a set of true sentences) is defined. Due to arithmetization (or other similar technique), the syntax of **L** can be represented in **L** itself. However, the Tarski undefinability theorem (the set of true sentences of arithmetic of natural numbers is not arithmetically definable; **UT** for brevity) shows that semantics of **L** is not fully expressible in **L** itself. In order to define semantic relations, we need to use **ML** which has a greater expressive power than **L**. Perhaps the most important observation is that **ML** remains partly informal. Even if we formalize **ML**, we must use **MML** and the story reappears. Generally speaking, the hierarchy **L**<sub>1</sub>, **L**<sub>2</sub> (= **ML**<sub>1</sub>), **L**<sub>3</sub> (= **ML**<sub>2</sub>), ..., **L**<sub>n</sub> (= **ML**<sub>n-1</sub>), ... of languages has the following property: if **L**<sub>k</sub> is formalized, **L**<sub>k+1</sub> ( $1 \leq k \leq n$ ) has some informal features with respect to **L**<sub>k+1</sub> (= **ML**<sub>k</sub>). Thus, there occurs a necessary connection between formal and informal aspects of **STT**. Yet one point requires an explanation. According to Tarski, the truth-definition for **L** generated by **STT** can be given in the syntax of **ML**. Does it mean that semantics is reducible to syntax? Not at all. Tarski worked in the paradigm of logic on which set theory belonged to logic. In fact, the definition of truth via satisfaction proceeds in the set-theoretical framework. Thus, we can say at most that defining semantic relation for **L** assumes a set theory. Putting this fact into the contemporary fashion, if **T** is a first-order theory (principally every deductive theory can be expressed in the first-order language), its semantics can be constructed in weak second-arithmetic with the arithmetic axiom of comprehension, employed as a metatheory **MT** of **T**. However, this does not mean that we reduce semantics of **T** to **T**-syntax. Otherwise speaking, if **T** is completely formalized, **MT** does not admit such a treatment. As it was pointed out above, it is possible to stay with first-order object languages and the weak-second order arithmetic as the metatheory.

What about constraints of a successful theory of truth? Omitting earlier proposals answering this question, I recall conditions stated by Bertrand Russell. According to him (see [23]), any theory pretending to be the satisfactory account of the concept of truth must conform to:

- (A) the theory of truth must also explain the nature of falsehood;
- (B) truth must be taken as a property of beliefs;
- (C) truth is an external relation of belief to something existing outside them.

However, these conditions say too much on the one hand, but too little on the other. Too much, because (B) and (C) exclude some important ideas. The requirement (B) ignores other accounts of truth-bearers, but (C), selecting the correspondence theory as proper, rejects theories which consider truth as consisting in relations between judgments without making any reference to the external world; in particular, (C) excludes the coherence theory. On the other hand, Russell's constraints are too weak, if he intended to favour the correspondence theory. For example, if one says that truth consists in evidence of beliefs, one also offers an account which satisfies (C). In general, the Russellian conditions are unfair to the richness of problems usually investigated by truth-theories that are known from a very history of the subject.

Thus we need a more complex scheme of any philosophical truth-theory which intends to be historically faithful. Without ambition to completeness (the list is filtered by **STT**), I mention the following problems which should be touched by any philosophically

reasonable. By being philosophically I do not mean ‘correct’, but ‘deserving an attention in the world of philosophy’) truth-theory in philosophy:

1. What are the bearers of truth?
2. What are initial intuitions associated with a given truth-definition?
3. How to define truth?
4. How is truth related to logic?
5. If we classify truth-bearers into true and false, is this division exhaustive and disjoint (are there values apart from truth and falsehood or perhaps are there truth-falsehood-value gaps)?
6. Is this division stable, that is, do at least some truth-bearers sometimes change their truth-values (briefly: is truth relative or absolute)?
7. What is a truth-criterion and what about the relations of truth-criteria and truth-definition?
8. What is the relation of a particular truth-theory to its rivals?
9. How a given truth-theory can be defended against various objections?
10. What is the relation of truth to other philosophical problems?

As we see, there is a lot to do for a theory of truth. I will try to show how **STT** of truth is related to these questions, or at least to some of them.

(Ad1) **STT** assumes that truth-bearers are sentences in the syntactic sense. We have several other possibilities (see [22] for a survey). Sentences? Propositions? Statements? Judgments? These entities can be either linguistic units or objects expressed by linguistic utterances. By contrast, concepts are not truth-bearers, contrary to Hegelians. To have a convenient label, we can say that according to **STT** entities qualified as true or false are of the propositional syntactic category. This way of speaking has nothing to do with the question of the ontological nature of propositions, for instance, as abstract objects.

Tarski himself chose sentences as entities on which truth is predicated. But there is an additional very important point [25, pp. 166–167]:

It remains perhaps to add that we are not interested here in ‘formal’ languages in sciences in one special sense of the word ‘formal’, namely sciences to the signs and expressions of which no material sense is attached. For such sciences the problem here discussed [the problem of truth] has no relevance, it is not even meaningful. We shall always ascribe quite concrete and, for us, intelligible meanings to the signs which occur in the language we shall consider. The expressions which we call sentences still remain sentences after the signs which they occur in have been translated into colloquial language.

Thus a language **L** for which **STT** applies is always interpreted, even if it is formalized. Consequently an interpretation of **L** always precedes definitions of semantic concepts including truth. Thus we arrived at the problem of how ‘formal’ is related to ‘formalized’. The answer is that formal languages do not need to be equipped, contrary to formalized languages.

A common misunderstanding of Tarski’s views consists in attributing to him the opinion that **STT** applies to formal languages only. This mistake neglects what Tarski explicitly explained (see essays in [16] for a discussion), that truth-bearers are correct syntactic units of the propositional category having meaning. It does not mean that Tarski’s views about language and meaning have no weak points. In particular, he did not define the concept of meaning. In fact, he intentionally avoided this question and deliberately preferred to speak about interpreted languages as semantic items. For Tarski,



the concept of language was clearer than the concept of meaning (see [17] for an extensive presentation of Tarski's philosophy of language). Yet **STT** does not seem to be especially dependent on a particular theory of meaning. Another controversial point concerns **STT** and natural language. Tarski regarded natural language as universal, and thereby generating semantic paradoxes. Roughly speaking, natural languages do not block self-referential use of semantic predicates. The Liar sentence "This sentence is false" illustrates this fact, as it attributes the property of being false to itself. In Tarski's view, dividing natural language into strata (levels), like the object language, the meta-language, the meta-meta-language, etc. is inconsistent with its naturalness and universality. On the other hand, it is quite legitimate to define truth for fragments of natural language (see [28]). Finally, Tarski's view on the relation of truth and meaning differs from that of Davidson. Whereas the latter maintained that truth-conditions define the meaning of sentences, the former considered meaning as prior to truth (see [38]).

(Ad2) Tarski always stressed that his definition follows intuitions of Aristotle. He was influenced by Stagirite himself and by his teachers (see [16, 17]). However, Tarski's statement in his particular writings on truth differ. In [24, p. 152] he says:

[...] in this work I shall be concerned exclusively with grasping the intentions which are true, contained in the so-called *classical* conception of truth ('true—corresponding with reality), in contrast, for example, with the *utilitarian* conception ('true—in a certain respects useful').

Further (p. 155), he adds that

true sentence is one which says that the state of affairs so and so, and the state of affairs is indeed so and so.

However, the Polish original text has no exact counterpart of the expression "state of affairs". On the other hand, English (but not German) translation quotes famous passage from the Aristotle's *Metaphysics*:

To say of what is that it is not, or what is not that it is, is false; while to say that of what is that it is, or what is not that it is not, is true.

This quotation also appears in [28, p. 667] and is explained by statements "The truth of a sentence consists in the agreement with (or corresponding to) reality" and "A sentence is true if it designates an existing state of affairs". Tarski's comment (p. 267) is as follows:

However all these formulations can lead to various misunderstandings, for none of them is sufficiently precise and clear (though this applies? much less to the original Aristotelian formulation); at any rate, none of them can be considered a satisfactory definition of truth.

In [30, pp. 402–403] the above formulations are repeated together with similar critical remarks. Tarski subsequently says (p. 403):

The conception of truth which is found in its expression in the Aristotelian formulation (and in related formulations of some recent origin) is usually referred to as the *classical*, or *semantic*, conception of truth. By semantic, we mean the part of logic which, loosely speaking, discusses the relations between linguistic objects, e.g. sentences and what is expressed by these objects; the semantic character of the term "true" is clearly revealed by the explanation offered by Aristotle and by some formulations which will be given in our further discussion. One speaks sometimes of the correspondence theory of truth as the theory based upon the classical conception.

To sum up, Tarski, at the beginning, identified the classical and correspondence theory of truth, but later he expressed greater reservations with respect to explanations via expressions, like "agreement" or "correspondence" than to Aristotle's original formulation.

If we assume that **STT** follows Aristotle's intuitions, are they captured by **(TE\*)** of **(TrDef\*)**? The answer that the former seems fairly correct and justified by Tarski's own explanations. So the example 'the sentence "snow is white" is true if and only if snow is white', points out that because the sentence in question says that snow is white and it is so and so as this sentence says, it (the sentence) is true. What about the intuitive content of **(TrDef\*)**? We have two options; first, having some justifications in Tarski's explanations that is a mathematical trick, and second, that the official definition brings some intuitions. First of all, sequences of objects cannot be identified with facts. Moreover, the satisfaction by the empty sequence appears as an artificial construction (see [24, p. 195]). On the other hand, if the semantic truth-definition is a special case of the definition of satisfaction and the latter is based on explicit intuitions, it suggests that perhaps some intuitions are behind **(TrDef\*)** as well. I am inclined to take the last option; that whether an open formula is satisfied or not by an object depends of valuation of free variables. Such valuations are irrelevant in the case of sentences. Consequently every infinite sequence of objects can be ascribed to bound variables (note that individual constants can be eliminated by identity and existential quantification). The same can be expressed by saying that the empty sequence satisfies a sentence. What remains? The answer is that being true depends on how **L** is interpreted and, metaphorically speaking, how things are in **M** associated with **L**. And it precisely expresses what is established by the **T**-scheme. Informally speaking, truth depends on the domain which sentences to say about. (see [43]) to use the name "weak correspondence" or "semantic correspondence" in the case of **(TrDef\*)** and **(TE\*)** as something different from "strong correspondence", used, for example, by Russell in his definition of truth (the structure of a judgement or a proposition) which corresponds with the structure of a corresponding fact provided that this judgment is true. Thus I will consider **STT** as the classical truth-theory based on the weak concept of correspondence.

(Ad. 3) Tarski defined truth by a single formula (the definition satisfaction is recursive). He considered (see [26]) introducing truth by axioms, but rejected this possibility for philosophical reasons. More specifically, he was afraid of a criticism on the side of physicalism. This worry was associated with his scepticism mentioned by Carnap (see above). This motivation is presently completely historical. Tarski himself mentioned that taking all instances of **T**-scheme as axioms could be regarded as an axiomatization of the set of true sentences. Yet he was fully aware that such procedure would be trivial and leading to the infinite collection of axioms. Today, the axiomatization of the concept of truth is commonly applied (see [10, 13]) and also proposed in order to avoid semantic paradoxes. I will not enter into this issue.

Tarski's way has an important consequence because of his undefinability theorem. Assume, what is natural, that the collection **TRUTH** of all truths is infinite. By **UT** (see below), **TRUTH** is not definable by resources conceptually available within it. Yet saying that **TRUTH** exists appears to be philosophically tempted. The only way out admissible by set theory consists in conserving **TRUTH** as too big set (Zermelo-Fraenkel system), a class as distinct from sets (Bernays-Gödel-von Neumann) or a category. All these outcomes are formally correct but lead to not quite pleasant consequences, at least for philosophers who like having something to say on the set of all truths. However, set theory and **UT** seriously limit such theoretical ambitions. We can eventually say that **TRUTH** constitutes consistent deductive systems, which has no finite axiomatization, even by schemes. On the other hand, **TRUTH** is not compact, which means that although its

every finite subset has a model, the collection of all truths has no model. Consequently, the collection **MOD** of all models is not a set as well. The medieval theory of transcendentals assumed that truth coincides with being and that *ens* (and other *transcendentalia*, for instance, *verum*, that is truth), *omnia genera transcendit*. In a sense, considerations about **TRUTH** and **MOD** (it can represent the being) justify the medieval intuition about the transcendental of truth and being (see [40] for a more closer analysis). It is rather an unexpected application of **STT**.

Ad (4 and 5) Tarski proved that **STT** implies bivalence, which is the conjunction of metalogical principles of excluded middle and (non)contradiction. This means that this theory is inherently associated with classical logic. However, Tarski's proof is sometimes criticized contested as circular, as assuming classical logic in metatheory. It is possible to demonstrate that the above result can be constructively achieved (see [36]); the argument employs the fact that truth can be defined as satisfaction by the empty sequence). Now, the problem arises whether construction a la Tarski can be realized in the case of non-classical logic, in particular, one rejecting the presumption that every sentence is either true or false. Many-valued logics and logics with truth-value gaps provide standard examples. Paraconsistent logic, intuitionistic logic or quantum logic are further examples. Clearly, more or less modified Tarskian ideas have applications for non-classical logics but according to my knowledge no general results are available. For instance, some constructions use partial models also for excluding paradoxes, but only special cases are available.

Consider **T** as a modality. We read **TA** as "it is true that A". We have the following formulas **TA**, **T¬A**, **¬T¬A**, **¬TA**, **TA ∨ T¬A**, **¬T¬A ∧ ¬TA**. These formulas satisfy logical modal principles organized by a generalized logical square, for instance **TA** ⇒ **¬T¬A**. The conjunction **¬T¬A ∧ ¬TA** is logically possible (consistent) and opens room for other (than truth and falsity) logical values or truth-value gaps. We have also the principle **TA** ⇒ **A**, but its converse does not hold as a purely logical rule. Thus, we can add the formula **A** ⇒ **TA** and obtain the **T**-scheme as a new theorem, but it is not forced by logic. Adding the **T**-scheme results in cancelling **¬T¬A ∧ ¬TA** as a possibility. Moreover, **TA**, **¬T¬A**, **A** as well as **T¬A**, **¬TA**, **¬A** become equivalent, and the same concerns **TA ∨ T¬A**, **TA ∨ ¬TA**, **A ∨ ¬A**. Since we can now interpret **T¬A**, **¬TA**, **¬A** as expressing "A is false", the principle of bivalence is valid in the logic of truth with the **T**-scheme. This reasoning shows that **T**-scheme favours classical logic. Since **¬(TE\*)** ⇒ **¬(TrDef\*)**, rejecting **T**-scheme results in rejecting the semantic truth-definition. Yet, this conclusion does not preclude a revision of Tarski's definition for needs of particular logical systems. For instance, **TA** ⇒ **A** is a theorem of classical modal theory of truth, but a paraconsistent logician can accept its negation, that is the formula **TA** ∧ **¬A**, but its truth-condition requires a modification of **(TRDef\*)**. Incidentally, modal analysis of truth shows that the **T**-scheme is not a logical tautology, because the formula **A** ⇒ **TA** is not logically valid. If one were to say that modal logic is not a logic in the proper sense, we could still point out that there is a difference in the status of both components of the **T**-scheme: the formula **TA** ⇒ **A** is a formal modal theorem, but its converse is not.

(Ad 6) The classical concept of truth is commonly considered as absolute, that is, if **A** is true such eternally (for ever) and sempiternally (since ever). On the other hand, **(TrDef\*)** indexes truth by **L** and **M**. Does this relativisation deprive truth of its absolute character? This question is connected with such issues as bivalence, logical determinism

or many-valued logic. Without entering into details concerning this fairly complex stock of ideas, let me somehow dogmatically suggest (details are in [40, 43]) that we can model-theoretically prove that truth is eternal if and only if it is sempiternal. If so, the classical theory of truth in the semantic setting can be considered as associated with the absolute concept of truth. Even if this conclusion encounters reservations, the possibility of analysing the absolutism/relativism controversy within the philosophical theory of truth via (**TrDef\***) is a remarkable fact.

(Ad 7) Clearly (**TrDef\***) is a-criterial. This means that the definition in question does not generate any truth-criterion, though it says what truth is. If mathematics is taken into account, proof can be regarded as a measure of truth. However, there arises a problem. Let the symbol **Pr** denote the provability operator. By the Löb theorem, we have  $\mathbf{Pr}A \Rightarrow A$ , a theorem very similar to  $\mathbf{T}A \Rightarrow A$ . But, due to the first incompleteness theorem, the formula  $A \Rightarrow \mathbf{Pr}A$  cannot be consistently added to the provability logic. Hence, there is no counterpart of (**TE\***) with **Pr** instead **T**, that is, the scheme  $\mathbf{Pr}A \Leftrightarrow A$  and we must conclude that proof is not a complete truth-criterion even in mathematics. This fact can motivate various ways out, for instance, modifying the concept of proof (every true mathematical assertion can be proved in a formal system; this assertion does not contradict the incompleteness theorem) or replacing truth by proof, eventually with additional constraints, for instance, that proofs must be constructive. However, such proposals are restricted to mathematics. Another suggestion is like this. Consider an open formula  $Px$ . It can be transformed to the true sentence  $Pa$  via substituting  $x$  by the term  $a$  denoting an object which has a property  $P$ . Another way is to go through from  $Px$  to  $\exists x Px$ . Both strategies require some empirical or deductive steps based on some criteria. And these criteria are truth-criteria. Generally speaking, truth-criteria consist of procedures which justify satisfaction of open formulas by some objects.<sup>5</sup> Note that the proposed criterion does not work for satisfaction by all sequence of objects.

(Ad 8) Tarski grew up in the tradition of division of truth-theories into the classical theory and so-called non-classical theories of truth, namely the evidence theory ( $A$  is true, if is evident), the coherence theory ( $A$  is true, if it can be embedded into a coherent system without destroying its coherence), the common agreement theory ( $A$  is true, if specialists agree about its correctness) and the utilitarian theory ( $A$  is true, if  $A$  is useful). The non-classical theories are criteria, because they appeal to procedures assuring that something is true.

Tarski himself mentioned the last definition (see above) and the coherence account (see [30, p. 403]). He considered them as lacking of precision and did not discuss them as serious alternatives for **STT**. However, it seems that the coherence theory can be discussed with help of some logical ideas. Let us agree that consistency is a component of coherence. Thus, we defined a system **S** as coherent if and only if **S** is consistent and satisfies some additional requirements, for instance is comprehensive, has an empirical support etc. Anyway, we have  $\mathbf{S} \in \mathbf{COH} \Rightarrow \mathbf{S} \in \mathbf{CONS}$ . It means that consistency is a necessary condition for coherence. The provability operator **Pr** satisfies the condition (\*)  $\mathbf{Pr}(A \Rightarrow B) \Rightarrow (\mathbf{Pr}A \Rightarrow \mathbf{Pr}B)$ . By definition,  $\mathbf{Pr}(\mathbf{S} \in \mathbf{COH} \Rightarrow \mathbf{S} \in \mathbf{CONS})$ . This and the condition (\*) gives  $\mathbf{Pr}(\mathbf{S} \in \mathbf{COH}) \Rightarrow \mathbf{Pr}(\mathbf{S} \in \mathbf{CONS})$ . By the rule contraposition, we obtain  $\neg \mathbf{Pr}(\mathbf{S} \in \mathbf{CONS}) \Rightarrow \mathbf{Pr}(\mathbf{S} \in \mathbf{COH})$ . Finally, the second incompleteness theorem, asserting

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<sup>5</sup>This suggestion was made by Anna Kanik, a former student of mine.

that consistency is not generally provable, suggests that the coherence is not a general criterion of truth. Thus, at least under classical logic, there are truths, which satisfy (**TrDef\***) but cannot be tested by coherence. On the other hand, the above argument does not suggest that there are truths not subjected to any justification. Yet, no absolutely universal criterion of truth based on exclusively deductive resources seems to be possible. By analogy, one can argue that any criterion of truth appealing to this or that kind of justification, works in the concrete circumstances and cannot define the concept of truth in its full generality. If so, **STT** (or the classical theory) is the only known account of truth, which is actually universal.

Another issue involving the relation between various truth-theories concerns substantial and minimalist account (see [15] for an analysis of conceptions of truth from the point of view of this axis). The latter approach (the redundancy theory, the deflationary theory, etc.) reduces the truth-definition to the **T**-scheme. Under this view, **STT** is a minimalist theory. Tarski himself (see [27, p. 682–683]) discussed this question. His counterexample was the sentence “All consequences of true sentences are true”. To continue Tarski’s analysis let us assume that the minimalist translation of the above assertion runs “for every *B*, if *A*, and *B* is a logical consequence of *A*, then *B*”, we still need to explain the ground of truth in the case of universal closure (that is, sentences with the universal quantifier in front) and the meaning of the predicate “is a logical consequence”. Thus, **T**-scheme does not justify to assert that all consequences of true sentences are true. There are much more complicated cases, for instance, the sentence “There exist true but not provable sentences”, which seems to be not subjected to a minimalist translation. If so, **STT** is essentially richer than any minimalist theory of truth.

(Ad 9) I will address in this section three objections stated by Franz Brentano against the classical theory and try to show that **STT** meets them successfully (see [32]). Firstly, the concept of correspondence is obscure and cannot be explained satisfactorily. More precisely, in order to establish what a truth-bearer corresponds to reality, one must compare the former with the latter. But it is impossible, due to relata of such a comparison. However, this objection applies to the strong notion of correspondence, not to its weak form. The second objection is more serious. Assume that we define truth by a definition **D**. Yet **D** is a sentence. In order to have a good definition, **D** must be true. Now, the definition is either circular (if it uses itself) or falls into the *regressum ad infinitum*, because in order to formulate **D**, we must appeal to **D**’ related to **D**, etc. Thirdly, the concept of correspondence does not explain truth of negative sentences.

How things are in **STT**, relatively to the second objection (see also [28, pp. 680–681])? Obviously, the answer depends on the relation of **L** (for which truth is defined) to **ML** (in which truth is defined). Tarski observed that the latter must be essentially richer than the former. Using a more contemporary way of speaking, it holds for semantics of **L**, **which** is not fully expressible in its syntax. Consequently, the expressive power of **ML** must be greater if the concept of truth is to be defined. In particular, **ML** has to have resources to define the concept of satisfaction. According to Tarski, (**TrDef\***) is expressible in the syntax of **ML**. This explanation is slightly misleading, because the satisfaction is defined in set theory. The crucial point is that (**TrDef\***) for the concepts of truth and of satisfaction is defined recursively. Although one should assume that the metatheory of truth is consistent, consistency is a syntactic property. Thus circularity does not occur in the entire procedure. The same concerns the *regressum ad infinitum*.

However, another interesting point appears. Clearly, if **L** is formalized, **ML** is not, at least not entirely. Consequently, the content of **ML** exceeds the content of **L**. One can observe that this phenomenon leads to the situation that semantic properties of poorer and thereby less problematic theories are defined in richer and thereby more problematic conceptual systems. In the case of **STT** this circumstance is somehow limited by the mentioned fact that the weak second-order arithmetic is sufficient for (**TrDef\***), but the phenomenon in question is very intriguing from the philosophical point of view. The problem of negative sentences has a simple solution in **STT**, because they are true (or false) under the same definition as positive ones.

(Ad 10) According to Tarski [28, p. 686]:

[...] We may accept the semantic theory of truth without giving up any epistemological attitude we may have had; we may remain naive realists, critical realists or idealists, empiricists or metaphysicians — whatever we were before. The semantic conception of truth is completely neutral toward all these issues.

These words seem to block any serious involvement of **STT** into traditional philosophical debates and controversies. Two remarks are in a row here. Firstly, if we look at the stock of terms used in the above passage, we can ask whether Tarski's evaluation might be generalized. My impression is that terms “naive realists”, “critical realists”, “idealists” or “empiricists” refer to views concerning the philosophy of perception; even “metaphysicians” can be taken as referring to philosophers speaking about the reality of what is perceived. Secondly, even if one claims that Tarski employed the labels in question as exemplifications of his general and somehow negative attitude to philosophy, we should ask whether he was right.

Independently of Tarski's intentions, it is easy to give an example of a philosophical problem closely related to **STT**, namely the semantic realism/semantic anti-realism debate. Generally speaking, (semantic) realists use **STT** but (semantic) anti-realists reject this account to truth (see [37]). This issue concerns the mutual relation of the condition of truth and condition of assertibility. Generally speaking, the realist says that the meaning of a sentence (**MS**) is given by its truth-conditions (**TC**), whereas the anti-realist argues that **MS** is given by its assertibility-conditions (**AC**). Thus we have two equalities:

- (i) **MS = TC**;
- (ii) **MS = AC**.

However, (i) and (ii) are still too vague. In fact, we should transform (i) and (ii) into

- (iii) **(MS = TC) ∧ (TC > AC)**;
- (iv) **(MS = AC) ∧ (TC = AC)**,

respectively. In fact, the realist says that truth-conditions exceed assertibility-conditions but the anti-realist identifies truth-conditions with the assertibility conditions.<sup>6</sup> How does **STT** work here? It justifies (iii), but refuses (iv). If, as Dummett maintains, the conditions of assertibility are governed by intuitionistic logic, it does not generate sufficient and necessary conditions for asserting any mathematical sentence. The point is that the

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<sup>6</sup>I model these formulas on the earlier mentioned debate between Davidson (realism) and Dummett (anti-realism). My own view (also expressed in [38]) is that meaning of a sentence exceeds its truth-conditions. However, the points (iii)–(iv) suffice for further analysis.

incompleteness theorem constructively holds for the Heyting arithmetic, that is, the Peano arithmetic based on intuitionistic logic. If so, the anti-realist cannot say that there are true, but unprovable sentences, but the realist can do so by appealing to **STT**.

Although I accept the semantic theory of truth as *the* correct account of the concept of a true sentence, I am very far from saying that its philosophical uses are unproblematic and the only correct. For instance, my analysis of the issue of realism/anti-realism should be taken as an analysis of what follows, if **STT** is assumed. My main intention in the present paper consists in demonstrating that Tarski's semantic ideas are not philosophically sterile.

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