WHAT MAKES LOGICAL TRUTHS TRUE?

Constantin C. BRÎNCUŞ

ABSTRACT: The concern of deductive logic is generally viewed as the systematic recognition of logical principles, i.e., of logical truths. This paper presents and analyzes different instantiations of the three main interpretations of logical principles, viz. as ontological principles, as empirical hypotheses, and as true propositions in virtue of meanings. I argue in this paper that logical principles are true propositions in virtue of the meanings of the logical terms within a certain linguistic framework. Since these principles also regulate and control the process of deduction in inquiry, i.e., they are prescriptive for the use of language and thought in inquiry, I argue that logic may, and should, be seen as an instrument or as a way of proceeding (*modus procedendi*) in inquiry.

KEYWORDS: empirical interpretation of logical truths, ontological interpretation of logical truths, semantic interpretation of logical truths, the nature of logical truths

I. Introduction

According to E. Nagel,[1] there are three main interpretations of logical principles.[2] One interpretation holds that logical principles are necessary truths which are descriptive of the most general structure of everything both actual and possible; the second interpretation maintains that they contingent, although very reliable, empirical hypotheses, and the third interpretation takes them to be void of factual content and, thus, arbitrary specifications for the construction of symbolic systems. No doubt, these interpretations are based on some assumptions, more or less problematical. Very roughly, the first interpretation seems to assume that we have *a priori* knowledge about at least some facts, i.e., about at least part of the real structure of the world. The second interpretation assumes that all principles involved in inquiry are empirical generalizations, although some of them are not directly subject to experimental refutation. Finally, the third interpretation assumes that if a principle lacks factual content then it is arbitrary, even though it

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[1] Ernest Nagel, "Logic without Ontology," in *Naturalism and the Human Spirit*, ed. Yervant H. Krikorian (New York: Columbia University Press, 1944), 211.

[2] The term 'logical principle' is sometimes understood as referring to certain logical truths or logical laws. In this paper, however, I take 'logical principle' and 'logical law' to be synonymous with 'logical truth.' Although there could be made certain distinctions among these terms, for the purposes of this paper, I will not focus upon them.

has an identifiable function in inquiry. Due to the strong arguments against them, all these three presuppositions are, as I will argue below, if not false, at least very problematical. In this paper, by disentangling the lack of factual content from arbitrariness, I will argue for, what may be seen as, a certain version of the third interpretation, according to which logical principles are propositions made true by the meanings of certain terms – the so-called logical terms – from a definite *linguistic framework*.[3]

The rationalistic assumption of the first interpretation seems very problematic due to the strong arguments against the existence of synthetic *a priori* knowledge *about facts*. Moreover, from an empiricist perspective, the *validity* of synthetic propositions is always subject to empirical tests and even if it holds in n cases, there is no logical guarantee that it will hold also in the *n+1* case, no matter how large *n* is; it follows that no proposition which has factual content can be necessarily true. Hence, once the rationalist view of knowledge is forsaken, i.e., the idea that reason considered independently can offer knowledge about facts, as A. J. Ayer[4] emphasized, the empiricist philosopher has to account for the logical principles in one of the following ways: "he must say either that they are not necessary, in which case he must account for the universal conviction that they are; or he must say that they have no factual content, and then he must explain how a proposition which is empty of all factual content can be true and useful and surprising." In other words, the empiricist has to decide whether logical principles are about the world, and, thus, not necessary or if they are necessary, but not about the world. This amounts, I believe, to a decision between the second and the third interpretations which Nagel mentioned, with the necessary emendations.

Regarding the structure of this paper, I will proceed as follows: I will first put forward certain methodological remarks with respect to the evaluation of the proposed interpretations. Second, in sections two and three, I will briefly present and critically evaluate two recent arguments for the ontological interpretation of logical principles (proposed by G. Sher and T. Tahko). In the forth section I will critically analyze three main instantiations [J. St. Mill, Quine, P. Maddy] of the idea that logical principles are empirical hypotheses. In the fifth section, I will present and argue for the idea that logical principles are true in virtue of the meanings of the logical terms from a certain *linguistic framework,* adopted for certain purposes of inquiry, purposes which also justify them. I will end by defending the proposed interpretation of two objections.

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[3] I use the expression 'linguistic framework' in Carnap's sense, namely, a system of expressions together with the rules that govern their use (see section IV. b.).

[4] Alfred Ayer, *Language, Truth and Logic* (London: Penguin Books Ltd., 1936/1990), 65.

According to the interpretation that I put forward, logical principles are simply true in virtue of the meanings of the logical terms. Although their truth is independent of the facts from the world, they are non-arbitrary statements which are regulative for the use of language and deduction in inquiry. More precisely, logical principles specify the use of certain words and statements in inquiry. Since these principles also have a prescriptive function for the use of language and deduction in inquiry, I argue that logic – as a system of logical principles – may, and should, be seen as a way of proceeding (*modus procedendi)* in inquiry.

The idea that logic is an instrument for proceeding in (scientific) inquiry, or a *modus scientiarum*, was famously held by Aristotle and many mediaeval philosophers (e.g. Albertus Magnus, Aquinas, Petrus Hispanus). However, they argued that logical principles are at the same time principles of being, which, implicitly at least, makes them embrace the first interpretation mentioned above. Therefore, although the interpretation of logical principles defended in this paper has some features in common with the Aristotelian view, according to which logic is an *Organon,* i.e., an instrument, it should not be entirely associated with it.

II. Methodological Remarks

I think that it is important to briefly describe here what kind of methods, if any, could, and should, be used in order to evaluate the interpretations of logical principles mentioned above. These remarks will be useful for the particular analysis conducted in the sections below.

First, if logical principles are ontological principles that govern everything that is or could be, how could we test such a hypothesis? Do we have epistemic access, in principle, to everything that is or could be? Does this supposition have empirical consequences which could be tested? As far as I can see, this idea could not be effectively disproved. Nevertheless, I do not consider that it is meaningless, in a wide use of the term 'meaning,' but simply that its presuppositions are not sustainable.[5] On the one hand, it assumes that *reality* has such principles, and, on

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[5] I think that what could be done when we confront ontological interpretations of logical principles – and this is the method that I will follow in this paper – is to criticize their presuppositions, and to show that such interpretations are not necessary for understanding the nature of logical principles and their role in inquiry. This idea was in fact explicitly stated by Ernest Nagel, who emphasized that "if philosophers propose to supply a foundation for logical principles by reading them as formulations of immutable and necessary structures of everything that is or could be, I know of no method for proving them in error. I believe nevertheless, that it is possible to dispense with such interpretations without impairing our understanding of the nature and power of logic." See Ernest Nagel, "In Defence of Logic without Metaphysics," *The Philosophical Review* 58 (1949): 34.

the other hand, it assumes that we are able to know them in an *a priori* manner. Hence, generally speaking, this interpretation maintains that we have *a priori* knowledge about certain relevant facts, although it indicates no ground for this assertion.[6]

Secondly, if logical principles are empirical generalizations, then they should be capable of being tested like all the other empirical hypotheses. However, as we will see in section IV of this paper, this criterion is not met by the logical principles.

Finally, if logical principles are true propositions in virtue of the meanings of the logical terms from a certain linguistic framework, we should be able to show that once we know the meanings of those terms, nothing else is required for establishing their truth. Moreover, once we have abandoned the idea that logical principles are grounded by the real structure of the world, which is supposed to guarantee their non-arbitrariness, we must explain why logical principles are non-arbitrary even in the absence of such a powerful link with reality.

III. Logical Principles as Ontological/Metaphysical Principles

The idea that logical principles are necessary principles of being has a longstanding tradition, and was famously supported by Aristotle. The principle of non-contradiction, one well-known and important logical principle, which is "the most certain of all principles" (*Metaphysics 1005b22*), is asserted by Aristotle, due to his general conception, as being true about facts: the same attribute cannot at the same time belong and not belong to the same subject in the same respect.

In the same spirit, Bertrand Russell also believed that "logic is concerned with the real world just as truly as zoology, though with its more abstract and general features."[7] It is very probable, however, that by this idea Russell was referring to the fact that abstract objects (like propositional functions), which are the subject matter of logic, are also part of the real world, and in this sense logic is also concerned with the real world.[8] The Swiss mathematician Ferdinand Gonseth, however, gave a nice expression of the idea that logic is concerned with the real

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[6] The main problem with a view that asserts the existence of rational insights, as Boghossian puts it, is that "no-one has been able to explain, clearly enough, in what an act of rational insight could intelligibly consist." See Paul Boghossian, "Blind Reasoning," *Aristotelian Society Supplementary* 77 (2003): 230-231.

[7] Bertarnd Russell, *Introduction to Mathematical Philosophy* (London: George Allen & Unwin, Ltd., 1920, 2nd edition), 169.

[8] See Penelope Maddy, "The Philosophy of Logic," *The Bulletin of Symbolic Logic* 18 (2012): 497.

world, by saying that "logic is the physics of the arbitrary object,"[9] expression which also emphasizes the topic-neutral character of logic. Of course, whether we may have knowledge of such objects is a very problematical issue.

Even today, the idea that logical principles are primarily ontological principles is endorsed by some philosophers. For instance, T. Tahko expresses the principle of non-contradiction in a very similar manner as Aristotle did: the same attribute cannot at the same time belong and not belong to the same subject in the same respect and in the same domain.[10] In what follows I will briefly present and critically analyse two recent arguments, proposed by T. Tahko and G. Sher, for the idea that logical principles describe, or have a strong connection with, ontological/metaphysical structures.

a) T. Tahko's Metaphysical Interpretation of Logical Principles

Tahko's general idea is that logic is grounded in metaphysics, logical principles being supposed to express the most general structure of reality. Specifically, "a sentence is logically true if and only if it is true in every genuinely possible configuration of the world."[11] Thus, logical necessities might be explained as those propositions true in virtue of the nature of every situation, or every object and property. In addition, as he emphasizes, since only metaphysical modality could secure the correspondence between a possible world and the structure of reality, genuine possibility should be understood in terms of metaphysical possibility, preserving thus the idea that logic is the most general science. Metaphysics "is about mapping the fundamental structure of reality" and logic "is about representing the results formally."[12] Of course, since it is not necessary to formally represent the results of metaphysics, an immediate consequence of the latter idea is that logic would not be necessary for metaphysics, a view which is very implausible.

The metaphysical account for logical principles proposed by Tahko seems very problematic to me. In what way metaphysics maps "the fundamental structure of reality," and how exactly do we get to know, if it is possible, this fundamental structure of reality? If we suppose that this structure is to be known *a*

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[9] Ferdinand Gonseth, *Qu'est-ce que la logique?* (Paris: Hermann, 1937).

[10] Tuomas E. Tahko, "The Metaphysical Interpretation of Logical Truth," in *The Metaphysics of Logic: Logical Realism, Logical Anti-Realism and All Things in Between*, ed. Penelope Rush (CUP, 2014), 239.

[11] Tahko, "The Metaphysical Interpretation," 239.

[12] Tuomas E. Tahko, "The Metaphysical Status of Logic," in *The Logica Yearbook 2007*, ed. Michal Peliš (Praha, Filosofia, 2008), 8.

posteriori, then we have no ground to say that it is the fundamental structure of reality, because experience offers us just contingent facts.[13] If we suppose that this structure is to be known *a priori*, as the metaphysicians usually believed, we come back to rationalism, but, as we mentioned above, also in this case we have no ground to assert that we have *a priori* knowledge about certain real facts.

In addition, as Nagel[14] similarly pointed out, when we say that logical principles are true in all genuinely possible configurations of the world (GPW), what do we mean by a 'genuinely possible configuration of the world?' If we identify a GPW on the basis of logical principles, namely, a GPW is a configuration of the world which conforms to logical principles, and there is no other way to identify a GPW, then we simply have a nominal, trivial definition. Namely, a GPW is a possible world which conforms to logical principles and thus they hold in each GPW. This definition simply gives the meaning of the expression 'GPW,' and there is no way in which such a definition may by refuted by any possible observations. However, in this case the definition of logical truths becomes circular, because the expression 'logical truth' also occurs in the *definiens*, namely: a sentence is a logical truth if and only if it is true in every world which conforms to logical truths. Of course, if a GPW is identified by metaphysical criteria, then we have the difficulties mentioned above.

Moreover, in the formulation of the principle of non-contradiction mentioned above, a very important role is played by the expressions 'same attribute' and 'same respect.' These specifications seem to be meant to save the principle for all counterexamples and, thus, make us unable to construct a genuine empirical test. The main idea is that the principle is employed as a criterion for specifying 'the same attribute' and 'the same respect.' Thus, the principle has a *self-protective formulation*. For example, if we take a coin and say that it is circular and also not-circular, it will be objected that not in the same respect (once viewed perpendicular to its faces, and then from the middle, parallel to its faces). If we specify the same respect as being the face of the coin viewed perpendicularly, the coin will delimit an angle of thirty degrees and also one of sixty degrees. In this case, the defender of the principle will say: yes, but not in the same respect; it is not viewed at the same distance from the face of the coin. In order to save the principle, what has been previously established as *the same respect* is now modified, i.e., the conditions in which we evaluate the previously

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[13] This is in fact one of the main ideas of Wittgenstein's *Tractatus*, i.e., the view that we may have knowledge, in the precise sense of this term, only about contingent facts, and was also famously stated by David Hume. See also Ayer's reasoning from the *Introduction* section above.
[14] Nagel, "Logic without Ontology," 214-217.

established *same attribute* are now modified, and the principle of non-contradictions functions as a criterion for specifying the new 'the same respect.' We do not have a specification of 'the same respect' antecedent to the application of this principle. Thus, because of the way in which 'the same respect' is used, we cannot properly test the principle. More generally, since the expression 'the same respect' seems to belong to the epistemological lexicon and it is introduced in an ontological definition of the principle, the validity of this interpretation raises serious doubts.

Furthermore, if we consider the diameter of the coin and say that it has 2 centimeters, and then that it has 3 centimeters, it will be argued that it is not possible. But the impossibility does not come from empirical tests. The impossibility for the same diameter to have two dimensions, in the same time, derives from the fact that we use the expressions '2 centimeters' and '3 centimeters' to formulate different outcomes of measurement. No diameter will have two dimensions in the same time because the expressions are used in such a way that one of the attribute of dimension is used to specify the absence of the other. Hence, the underlying idea is that the 'sameness' and 'difference' of attributes are specified in terms of the conformity of attributes to the principle of non-contradiction. We have to apply the principle in specifying 'the same attribute' before deciding whether a certain controversial instance obeys or nor the principle of non-contradiction. This suggests that the principle of non-contradiction works as an instrument of specifying the use of expressions in a language, as a regulative principle for operating distinctions, rather than being an ontological principle.[15]

Finally, it worth mentioning that even the etymology of the word 'contradiction' comes against an ontological explanation of the principle of non-contradiction. The Latin word 'contradictio' derives from 'contradico' which means 'speak against.' Thus, only a *dictum* can come against another *dictum*, but not an object, a fact or an event. In the spirit of this line of thought, David Hilbert emphasized in his lecture "On the Infinite" that to think that facts could contradict one another is simply 'careless thinking':

> As some people see ghosts, another writer seems to see contradictions even where no statements whatsoever have been made, viz., in the concrete world of sensation, the 'consistent functioning' of which he takes as special assumption. I myself have always supposed that only statements, and hypothesis insofar as they lead through deduction to statements, could contradict one another. The view

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[15] For a similar discussion see also Nagel, "Logic without Ontology," 212-214, and Nagel, "In Defence of Logic," 29-30.

> that facts and events could themselves be in contradiction seems to me to be a prime example of careless thinking.[16]

Of course, a fellow of the ontological approach to the logical principles will easily accept that objects and events cannot, as a matter of fact, contradict one another, and this is precisely because the law of non-contradiction does not allow them. What Hilbert says, however, is more than that: he says that the facts or events could not contradict one another because the notion of contradiction cannot be meaningfully applied in the world of facts. That is to say that it makes no sense to assert that facts could or could not contradict one another. To apply the notion of contradiction in the domain of facts is simply a categorical error, an example of 'careless thinking.'

b) Gila Sher's Invariantist Interpretation

According to Gila Sher[17] logic "is grounded both in the mind and in the world, and its two grounds are interconnected." What Sher precisely understands by 'world' is not so clear, but, nevertheless, she clearly specifies that the terms 'world' and 'reality' (taken as synonyms) are not used to denote 'thing in itself,' 'mere appearances,' neither just empirical experience, not conceptual reality. In spite of these negative determinations, however, "logic is both in the mind and in the world in a substantive sense, a sense that yields significant explanations, solves significant problems, and has significant consequences."[18] Although this account is not a purely ontological one, the main features of this interpretation, as we will see below, endorse I believe the idea that Sher's account of logic is strongly related to an ontological interpretation of logical principles.

The main argument for this view regards the intimate relation between logic and reality *via* truth. The relation of logical consequence establishes between a set of sentences Γ and a sentence S if and only if the truth of Γ is transmitted to S, or *guarantees* the truth of S. However, since truth "inherently depends on whether things in the world are as given sentences say they are,"[19] then the notion of logical consequence also depends on the facts of the world. Specifically, in nontrivial cases, S is a logical consequence of Γ if the facts described by Γ *strongly*

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[16] David Hilbert, "On the Infinite," translated by Erna Putnam and Gerald J. Massey from *Mathematische Annalen*, vol. 95, (Berlin, 1926), in *Philosophy of Mathematics: Selected Readings*, 2nd edition, ed. Paul Benacerraf and Hilary Putnam, (Cambridge University Press, 1983), 185.
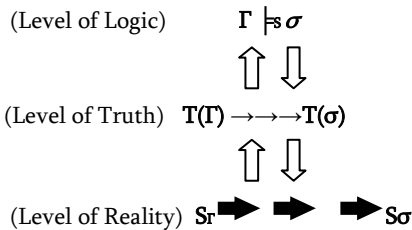
[17] Gila Sher, "Is Logic in the Mind or in the World?" *Synthese* 181 (2011): 354.

[18] Sher, "Is Logic in the Mind," 354.

[19] Sher, "Is Logic in the Mind," 356.

necessitate the facts described by S. More precisely, the main idea is that the relation of logical consequence is grounded by a formal *strong necessitation* relation present in reality, which establishes between states of affaires. This relation is a formal mathematical relation that governs "the formal (structural) features of objects, or their formal behaviour."[20] The notion of formality is defined in mathematical terms, by generalizing Tarski's criterion of logicality, namely, "to be formal is to be invariant under the isomorphisms of structures."[21]

Among the three relations just described (i.e., logical consequence, guarantee, and strong necessitation), there exist downward and upward dependencies, which are meant to ground the relation of logical consequence in reality. The downward dependency indicates that if the relation of strong necessitation does not obtain between the relevant states of affairs then neither the relation of guarantee, nor the relation of logical consequence, obtains. The upward dependency indicates that if certain premises logically imply a certain conclusion then the relation of strong necessitation obtains between the relevant states of affairs, namely, those described by the premises and conclusion. We may represent all these relations – as Sher[22] does – by different kind of arrows in the following diagram:

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\begin{array}{ll}
\text{(Level of Logic)} & \Gamma \models_s \sigma \\[4pt]
& \Uparrow \quad \Downarrow \\[4pt]
\text{(Level of Truth)} & T(\Gamma) \rightarrow\rightarrow\rightarrow T(\sigma) \\[4pt]
& \Uparrow \quad \Downarrow \\[4pt]
\text{(Level of Reality)} & S_\Gamma \blacktriangleright \blacktriangleright \blacktriangleright S_\sigma
\end{array}
$$

Although Sher's interpretation of logical consequence is very interesting, because it goes beyond the limits of possible experience,[23] it is open to criticism.

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[20] Sher, "Is Logic in the Mind," 361-362.

[21] Sher, "Is Logic in the Mind," 363. See also Alfred Tarski, "What are Logical Notions?" *History and Philosophy of Logic* 7, 2 (1986): 143-154.

[22] Sher, "Is Logic in the Mind," 362.

[23] It is beyond the limits of possible experience because there are an infinite number of instances of logical implication, and we cannot verify whether all of them are grounded in something present in reality; we also lack a proof which shows that in principle they could be grounded in reality). In addition, we have no reason to assert that we have access to the real structure of reality, be it mathematical or not.

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First, as Rossberg[24] indicates, there is no requirement to find actual situations in the world in order to show that the premises of an argument are true while the conclusion is false; any counter-model will do this job. Thus, a failure of the relation of strong necessitation seems unnecessary for grounding the failure of logical consequence. In addition, since classical logic is grounded in the worldly strong necessitation relations formulated by classical mathematics, and "in the case of nonclassical logic, the formal laws are given by nonclassical mathematics,"[25] we may wonder, as Rossberg[26] does, how is it possible that classical mathematics allows us to ground classical logic in reality, and intuitionist mathematics allows us to ground intuitionist logic in reality, and, yet, they disagree? For this may suggest that, after all, logic is not grounded in reality, but in the (mathematical) representation of reality. As a matter of fact, it would be a more modest assumption to suppose that mathematics "imposes structure on reality" rather than discovering the structure of reality, in which case "we have considerable freedom in the choice of structures that we want to give the world."[27]

In fact, even if we assume Sher's definition of formality, in order to fulfil its task, we must make explicit a necessary requirement for the mathematical theory which is meant to represent the structure of reality, namely, that it has to be categorical.[28] Thus, logical consequence could be grounded only in worldly formal relations represented by categorical mathematical theories. Moreover, of course, the proposed interpretation of the ground of logic assumes that we could know the real structure of reality. Still, since we are supposed to know this structure *via* mathematics, which is generally believed to be an *a priori* inquiry, then it also assumes an *a priori* knowledge about facts, i.e., about at least part of the real structure of the world. Furthermore, as a final remark, I think that Sher's interpretation only seems plausible because, as her particular examples illustrate,[29] it uses a set-theoretic interpretation of logical operators. Of course, this would not entail that logic is grounded in reality, but merely that we may interpret logical operators in set-theoretic terms.

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[24] Marcus Rossberg, "Comment on Gila Sher's 'Is Logic in the Mind or in the World?'" Pacific APA, Vancouver, April 8-12 (2009): 3. Online version: http://homepages.uconn.edu/~mar08022/papers/Rossberg_on_Sher.pdf

[25] Sher, "Is Logic in the Mind," 364.

[26] Rossberg, "Comment," 9.

[27] Rossberg, "Comment," 9. The existence of different geometries may illustrate better this point with respect to *the* structure of space.

[28] It is well known that not all mathematical theories meet this criterion.

[29] For instance, the existential quantifier is interpreted as non-emptiness, conjunction as intersection, and so on.

To sum up, the idea that logical principles describe the most general structure of reality, or that they are grounded in such a structure, does not seem to be sustainable. First, since logical principles are taken in general to be known *a priori*, i.e., their truth is independent of observations, and also to describe at least some facts, i.e., real structures, the present interpretation assumes an *a priori* knowledge about facts. However, as we repeatedly emphasized, there is no reasonable ground for asserting this idea; we do not have knowledge of undetermined objects, of *objects as such*. Second, it seems to transform the function of logical principles for introducing distinctions and instituting adequate linguistic usage, into ontological constraints. Although it seems very plausible to interpret some logical principles in an ontological manner (at least for the level of the world accessible to our experience), we have no reasonable ground to maintain this. Therefore, this interpretation does not seem feasible; a better candidate that has less problematical assumptions would be preferable.

IV. Logical Principles as Empirical Generalizations

In this section I will critically analyze three main instantiations (Mill, Quine, Maddy) of the idea that logical principles are empirical hypotheses, and, thus not necessary. Maddy's interpretation, as we will see, although is an empirical one, takes them to be necessary only relative to the presence of the corresponding structure of the world – a view which needs some ontological underpinnings.

a) J. St. Mill's View

One of the pioneers who endorsed the idea that logical principles are not necessary propositions was J. St. Mill. For him, they are *a posteriori* and thus unnecessary. Mill believed that logical principles are inductive generalizations[30] confirmed in an extremely large number of cases. This large number of instances makes us to believe that logical principles are necessarily and universally true and

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[30] Mill believed that principles such as the principle of non-contradiction, or of excluded middle, are real propositions, i.e., they convey new information, and not merely verbal, i.e., "which assert of a thing under a particular name only what is asserted of it in the fact of calling it by that name." John St. Mill, *A System of Logic Ratiocinative and Inductive, Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation* (London: Longmans, Green and Co. 1886), 74/ Book I, Chap. VI. Being real, however, these propositions are, as for Quine, *a posteriori*. The ground for Mill's distinction between real and verbal propositions is to be found in his (semantic) theory of denotation and connotation (see John Skorupski, "Mill on Language and Logic," in *The Cambridge Companion to Mill*, ed. John Skorupski (Cambridge University Press, 1998), 36-40.)

that, although is possible, a negative instance will never appear. According to this view, the method for testing the validity of logical principles is the same as for the other empirical hypotheses, specifically, if an argument gives a materially true conclusion from materially true premises then it is valid, if not, it is invalid.[31] Consequently, in order to establish the validity of an argument we need empirical evidence.

We may agree, however, that logical principles could be discovered and learned inductively, but this does not entail that they are known, or could only be known, empirically. As we will argue below, logical principles may be known independently of experience. By this I mean, following Ayer,[32] that their validity is not determined in the same way as for the empirical hypotheses. For instance, let us consider an argument from whose premises 'A' and "if A then B," asserted as true, is drawn – according to the rule modus ponens[33] – the conclusion 'B,' which, as a matter of fact, is false.[34] If we follow the proposed method, then we will have to reject *modus ponens* as a universally valid rule. But it seems that in such a case, as long as the normal meanings of the logical terms are preserved, we are more inclined to say that the premises were asserted mistakenly or that the recognition that 'B' is false was an error. There is no doubt that the proposition "If A and (if A then B), then B" is true as long as the terms 'and' and 'if… then' have the meanings as given by the normal truth tables.[35]

Moreover, we know that the validity of many hypotheses employed in science can only be established by examining the consequences implied by them in accordance with logical principles. Nevertheless, in a non-holistic context,

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[31] This particular method seems to be implicitly present also in Sher's account, because she believes that if a certain relation does not establish between the states of affairs represented by the sentences of an argument, then the argument is invalid, i.e., the relation of logical consequence does not establish either. In Sher's terms, a failure of strong necessitation relation entails the failure of the corresponding relation of logical consequence.

[32] Ayer, *Language, Truth and Logic,* 68.

[33] Mill had in mind the Aristotelian logic, but his considerations may be applied also to modern logic.

[34] Such interpretations, supposed to be counterexamples to modus ponens, were in fact proposed by Vann McGee, "A Counterexample to Modus Ponens," *The Journal of Philosophy* 82 (1985): 462-471 and Niko Kolodny and John MacFarlane, "Ifs and Oughts," *Journal of Philosophy* 107(2010): 115-143, and they have generated ample discussions among logicians and philosophers.

[35] See also Nagel, "Logic without Ontology," 219 and Constantin C. Brîncuş and Iulian D. Toader, "A Carnapian Approach to Counterexamples to Modus Ponens," *Romanian Journal of Analytic Philosophy* VII (2013): 78-85.

when the consequences derived from premises believed to be true are in disagreement with the observations of experience, it is typically not the logical principles used to drawn the consequences which are rejected. If they where, then the relation of logical consequence would be an empirical one, and it would be difficult to speak about the confirmation or confutation of hypothesis by empirical data. It follows that the proposed method for testing the logical principles is not a feasible one. As long as we accept that we can test certain domains of science singularly, i.e., we disprove the holistic view, we should accept the idea that the ground for the revision of logical principles must lie elsewhere than in the subject matter of the natural sciences – in the sense that observations could not directly refute a logical principle. In the next section I will argue that the situation is the same even in a holistic context.

b) Quine's Naturalist[36] Approach

A more sophisticated form of empiricism was elaborated by W.V.O. Quine, who embraces the first option that the empiricist, according to Ayer, has available, namely, logical principles are about the world, and, thus, non-necessary. According to Quine, since "logic, as any science, has as its business the pursuit of truth"[37] and "there is no higher access to truth than empirically testable hypotheses,"[38] it follows that logic, as the entire human knowledge, has the same status, namely, it is *a posteriori*. Logical principles are themselves a constituent part of *the entire system of science*, and, consequently, they also confront, although indirectly, the experience tribunal. Indirectly because, according to Quine, what we actually test are not isolated propositions, or particular sets of propositions, but the entire system of science. In the case of a conflict with experience we may revise, in accordance with the principles of conservatism and simplicity, whatever proposition from the system.[39]

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[36] Quine's conception on the nature of logical principles does not necessarily follow from his holistic view – Carnap himself adopts the epistemological holism, but mainly from his attack of the first 'dogma' of empiricism, which leads finally to the naturalistic representation of knowledge, i.e., to the idea that all our knowledge is a posteriori. Epistemological holism and revisability of any statement are perfectly compatible with the existence of a clear and precise distinction between a priori and empirical knowledge (see Michael Friedman, "Philosophical Naturalism," *Proceedings and Addresses of the American Philosophical Association* 71(1997): 9-10.)

[37] W.V.O. Quine, *Methods of Logic (revised edition)* (New York: Holt, Rinehart and Winston, 1950/1966), xi.

[38] W.V.O. Quine, "Naturalism; Or, Living within One's Means," *Dialectica* 49 (1995): 251.

[39] See W.V.O. Quine, "Two Dogmas of Empiricism," *Philosophical Review* 60 (1951): 20-43.

It is important to emphasize, however, that Quine does not endorse the idea that we establish the validity of logical principles by confronting them with observational data, in order to see if materially true premises entail a materially true conclusion. The revision of a logical principle is made as a pragmatic decision for readjusting the entire system of science to observational data. Logical principles can be revised, "but this is not to deny that such laws are true in virtue of the conceptual scheme, or by virtue of meanings," and "because these laws are so central, any revision of them is felt to be the adoption of a new conceptual scheme, the imposition of new meanings on old words."[40] This amounts, I believe, to saying that logical principles are true in virtue of the meanings of the logical terms, and to the recognition of the fact that the meanings of such terms could be changed.[41]

However, it seems to me that there is an important difference between the revisions of truth-values of empirical statements, whose meanings are preserved, and the revision of the truth-values of statements by changing their meanings it is an important difference. In my understanding, this entails the idea that there is a distinction between propositions true in virtue of meanings, and propositions true in virtue of facts, i.e., between analytic and synthetic propositions, even if such a distinction may admit borderline cases with respect to the entire system of science. In spite of this, the fact that logical principles are revisable does not entail that they are not necessary and, consequently, empirical generalizations. As we will see below, although they could be revised, logical principles are true independent of facts, and thus necessary, in a certain linguistic framework.

In some writings,[42] Quine seems to rule out any kind of distinction between analytic and synthetic propositions, suggesting that all sentences have, in a certain degree, empirical content, i.e., they all are synthetic. For instance, he believes that the validity of mathematics is established by confronting it with the observational data. This happens because when we test an empirical hypothesis we take it often in conjunction with propositions from pure mathematics. In this way pure mathematics becomes applied. If the theory is corroborated by experiments, then mathematical propositions are believed to be true, if not they are refuted.

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[40] Quine, *Methods of Logic*, xiv.

[41] In *Philosophy of Logic*, (Harvard University Press, 1994), 81-82, Quine emphasizes that logical terms change their meanings in different logics. A change of logic amounts, thus, to a change of subject, i.e., a change of the meanings of the logical terms. In this respect, Quine is in agreement with M. Dummett who also considers that when two different logical schools disagree, they understand some logical terms in different ways. See Michael A. E. Dummett, *The Logical Basis of Metaphysics* (London: Duckworth, 1991), 302.

[42] Quine, "Naturalism," 251- 261.

However, as M. Friedman emphasized, the fundamental problem with this representation is that a physical theory, viz. the theory of relativity, is not happily viewed as a large conjunction formed from Einstein field equations, the Kleinian theory of transformation groups, and the Riemannian theory of manifolds, in which case Eddington's experimental results "are potentially spreading empirical confirmation over the entire conjunction."[43] In such cases the mathematical conjunct works rather "as a necessary presupposition of that theory, as a means of representation or a language, as it were, without which the theory could not even be formulated or envisioned as a possibility in the first place."[44] This amounts, in my understanding, to recognize the fact that there is a distinction between propositions from empirical science, i.e., synthetic, and analytic propositions which work as instruments in the system of science, and whose truth is not a problem of matter of facts, but of meanings.[45]

We can, and should, admit that logical principles are revisable, but, following Carnap, who otherwise agrees with many of Quine's ideas,[46] we should recognize a distinction between the revision of the truth-values of certain propositions on empirical grounds, without abrogating their meanings, and the

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[43] Friedman, "Philosophical Naturalism,"12.

[44] Friedman, "Philosophical Naturalism,"12.

[45] Friedman's reply also answers Alonzo Church's objection to Nagel's idea that logical principles are not tested in the same manner as the empirical hypotheses (see Alonzo Church, "Review: Ernest Nagel, 'Logic without Ontology'," *The Journal of Symbolic Logic* 10 (1945): 17. Logical principles, and probably the mathematical ones, are not conjuncts in the entire system of science which confronts the experience tribunal, but rather they are regulative principles which also serve as conditions for formulating certain empirical hypotheses. The relation between logico-mathematical statements and the other statements is not that of conjunction but rather of presupposing, which is a very different relation. As N. Rescher puts it, "p presupposes q means 'q is a necessary condition for the very possibility (or even meaningfulness) of p'". Formally: ($\Diamond p \rightarrow$ q). See Nicholas Rescher, "On the Logic of Presupposition," *Philosophy and Phenomenological Research* 21 (1961): 527.

[46] "Quine shows that a scientist, who discovers a conflict between his observations and his theory and who is therefore compelled to make a readjustment somewhere in the total system of science, has much latitude with respect to the place where a change is to be made. In this procedure, no statement is immune to revision, not even the statements of logic and of mathematics. There are only practical differences, and these are differences in degree, inasmuch as a scientist is usually less willing to abandon a previously accepted general empirical law than a single observation sentence, and still less willing to abandon a law of logic or of mathematics. With all this I am entirely in agreement." Rudolf Carnap, "W. V. Quine on Logical Truth," in *The Library of Living Philosophers, Vol. XI, The Philosophy of Rudolf Carnap*, ed. Paul Arthur Schilpp, (Open Court Publishing Company, 1963/1997), 921.

revision of the truth-values of certain propositions by changing their meanings. I think that Carnap's remarks[47] are helpful for understanding this distinction:

I should make a distinction between two kinds of readjustment in the case of a conflict with experience, namely, between a change in the language, and a mere change in or addition of, a truth-value ascribed to an indeterminate statement, (i.e., a statement whose truth value it not fixed by the rules of language, say by the postulates of logic, mathematics, and physics). A change of the first kind constitutes a radical alteration, sometimes a revolution, and it occurs only at certain historically decisive points in the development of science. On the other hand, changes of the second kind occur every minute. A change of the first kind constitutes, strictly speaking, a transition from a language L_n to a new language L_{n+1}. My concept of analyticity as an explicandum has nothing to do with such a transition. It refers in each case to just one language; 'analytic in L_n' and 'analytic in L_{n+1}' are two different concepts. That a certain sentence S is analytic in L_n means only something about the status of S within the language L_n; as has often been said, it means that the truth of S in L_n is based on the meanings in L_n of the terms occurring in S.

Whenever a change of the first kind occurs, such change is made as a pragmatic decision for readjusting the entire system of beliefs for certain purposes of inquiry. The decision of changing a linguistic framework, i.e., a system of expressions together with rules that govern their use, is not in itself a cognitive matter, although it may, nevertheless, be influenced by theoretical knowledge.[48] Therefore, logical principles, analytic[49] principles in a certain language, are true in virtue of the meanings of the logical terms from that language, and can be revised once we make the pragmatic decision to change it (see section V for the idea that logical principles are 'framework principles').

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[47] Carnap, "W.V. Quine on Logical Truth," 921.

[48] See Rudolf Carnap, "Empiricism, Semantics, and Ontology," *Revue Internationale de Philosophie* 4(1950): 20-40.

[49] There is a distinction between statements true in virtue of the logical terms (logical truths) and statements true in virtue of logical and non-logical terms (analytic statements *per se*). However, if we define the analytic statements as statements true in virtue of meanings, then, in this sense, logical truths are also analytic. In this context of the discussion, the distinction is not so relevant.

c) Maddy's Second Philosophy Account

Another interesting view of logical principles was recently proposed by Penelope Maddy,[50] who develops an empirical interpretation starting from the Kantian combination between transcendental Idealism and empirical Realism. According to Kant, logical structure, viewed transcendentally, is imposed on the world by our discursive modes of thought, and, viewed empirically, the world simply displays those structures as a matter of objective fact. Maddy tries to preserve these two features in a naturalized framework, by arguing, for the empirical side first, that the macro-world simply displays a certain structure, a Kant-Frege (KF) structure (given by the Kantian forms of judgement and updated with the Fregean results, and formed from objects, properties, relations, dependencies), and then arguing, for the naturalized transcendental side, that our cognitive mechanisms have evolved in such way that are able to detect this KF structure. The logic which represents, or is true of, this KF structure, however, is not identical with the entire classical logic, because 'the physical structure of the world' does not validate all principles of classical logic. The law of excluded middle and the material conditional "appear as idealizations introduced into that logic for good reasons."[51]

In sum, Maddy's idealized inquirer, the Second Philosopher, believes that the macro-world really has a KF structure, and that our cognitive mechanisms detect this structure because we live in a KF world and interact with it. These ideas are sustained by a large number of recent psychological studies, i.e., experimental studies, which are meant to support the idea that we are able we detect objects, properties and relations because they are really there, in the world. In the sketched picture, "logical truths are true because the world is made up of objects enjoying various interrelations with dependencies between them, and we tend to believe some of the simpler of these truths because human cognition has been turned by evolution to detect these very features."[52] Nevertheless, since the structure observed in our experience seems not to be present, for example, at the (quantum) micro-world, then we must admit that "logic applies to a situation insofar as it does have those features, and our cognitive machinery has evolved to detect those features." Therefore, the updated definition becomes: "logical laws are

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[50] Penelope Maddy, *Second Philosophy* (Oxford University Press, 2007); Penelope Maddy, "The Philosophy of Logic," *The Bulletin of Symbolic Logic* 18, (2012): 481-504.
[51] Maddy, "The Philosophy of Logic," 500.
[52] Maddy, "The Philosophy of Logic," 501.

true in any situation with the right physical structuring; their truth is contingent on the presence of that structuring."[53] Moreover, Maddy emphasizes that

> we tend to believe the laws of logic independently of any experience because of our hard-wiring, we know them in a sense *a priori*, and we tend to think of them as necessary, that is, we tend to built them into our very idea of a possible world – and all this happens despite the fact that they wouldn't be true if the world were different and in fact don't seem to hold in the actual micro-world.[54]

Although I find this proposal very interesting, I am very sceptic regarding its validity. Even if we may agree that we usually observe a so-called KF structure in the world that we live in, this does not necessarily entail that the (macro-)world really has this structure, i.e., that the KF structure is the real structure of the macro-world. I think that the psychological observations do not offer us a sufficient ground for inferring that the structure we observe is the real structure of the macro-world, i.e., of a certain level of the world. Since psychological studies are based on observations, that are always made in a 'horizon of expectations'[55] which, in turn, reflects the manner human beings approach the world, it follows that observations do not represent pure facts of the world, or its fundamental structure. They are always relative to the human point of view. Thus, although it starts as an empirical interpretation of logical principles, this account is transformed in a *relativized* ontological interpretation. 'Relativized' in the sense that considers the world to have certain different structures at different levels and, due to the fact that we live in a certain domain/at a certain level of the world, we have access to the very structure of (this level of) the world.

To sum up, the interpretation of logical principles as empirical hypotheses, which are true in virtue of empirical facts, is not feasible. Mill's vision seems untenable because it disregards certain logical facts, i.e., the way in which logicians test validity of logical propositions, and the way in which the method of science actually works, namely, it presupposes the validity of logical principles, in deriving consequences from general hypotheses, and is not aiming at validating them. Quine's vision is not essentially problematic because it is holistic, Carnap also accepts the epistemological holism, but because it seems to disregard the distinction between propositions true in virtue of meanings and propositions true in virtue of facts, and, consequently, the kinds of changes that may occur in the entire system of science. The recognition of this distinction means, implicitly, that

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[53] Maddy, "The Philosophy of Logic," 502.
[54] Maddy, "The Philosophy of Logic," 502.
[55] See Karl R. Popper, "The Bucket and the Searchlight: Two Theories of Knowledge," in Karl R. Popper, *Objective Knowledge. An Evolutionary Approach* (OUP, 1979).

logical principles are true in virtue of the meanings of logical terms from a certain linguistic framework. This point will be elaborated in section five. Finally, Maddy's interpretation[56] seems to me to be closely related to an ontological one, by presupposing that we come to know the real structure of the world, and by implicitly assuming that these structures are *reflected* in an invariant way by language.

V. Logical Principles as Regulative Principles of Inquiry[57]

In general, natural language, as it is, is sufficient for the purposes of efficient communication in daily activities. However, in certain domains of inquiry, especially in science, a greater precision is necessary for the use of language than the one found in natural language. For instance, to take a trivial example, a certain term must express the same meaning in the context of an argument, and this is precisely what the principle of identity – in one of its formulations – requires. In the same manner, the principle of non-contradiction requires that a certain term should not be applied and denied to the same object in the context of an argument. People do not always follow the rule modus ponens in their ordinary reasoning, but this desideratum of logic must be followed in science. In this sense, logical principles have a prescriptive function for the use of language. They do not describe the actual way in which agents think and use language.[58] They indicate the direction in which precision may be obtained, and, therefore, they fix an ideal that may, and should, be achieved in order to fulfil certain objectives of inquiry.

Let us consider for instance the various modern systems of logic. Their main aim is not to represent the 'true nature,' if any, of an antecedently identifiable relation of 'implication;' they are built as alternative specifications for a precise use of this term and for the performance of inferences.[59] Without explicit logical

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[56] An interpretation that takes logical principles as a product of evolution, without assuming that they have, or are grounded by, a corresponding structure, would be less problematical. They could be seen is as instruments adopted in the course of evolution for their adaptability function, which also justifies them.

[57] This section develops, and is mainly based on, Rudolf Carnap and Ernest Nagel's interpretations of logical principles and on the interpretation developed by (other) logical positivists (viz. A.J. Ayer, H. Hahn et al.).

[58] The psychologistic conception, which states that logical truths are empirical statements which describe the ways in which people actually think, has been in a continuous obliteration after Gottlob Frege's well-known criticisms, according to which logic is concerned with the ways in which people *must* think, if they are not to miss the truth.

[59] As a matter of fact, Quine himself regards the theory of deduction (for propositional logic) as "a formal systematization of certain aspects of the ordinary use of language and exercise of

principles it is almost impossible to evaluate the validity of the performed inferences. Once the meanings of certain terms – the so-called logical terms – are precisely fixed, inferences can be performed and evaluated in a precise manner. Moreover, the fact that the meanings of logical terms from a system of logic do not correspond to the meanings of their counter-parts from natural language show us why logical principles also serve as "proposals for modifying old usages and instituting new ones"[60] and, thus, their regulative function is again revealed. Their main aim is to direct the use of language in the direction of clarity and precision.

The idea that logical principles are true in virtue of the meanings of the logical terms, we may say, is obvious from the practice of logic. In order to see that a statement is a logical truth, we do not make appeal to any facts, we simply apply the semantic and syntactic methods which are essentially based on the meanings of the logical terms – no matter how we may take these meanings to be defined, via model-theory or via proof-theory (as the inferentialists do). It is important to emphasize the difference between the idea that logical truths are based on linguistic conventions,[61] and the idea that they are true based on meanings. Rudolf Carnap himself disapproved the expression "linguistic conventions" as applying to his explanation of logical truths. The choice of the meanings of the logical terms may be a matter of convention, but once these meanings are fixed, there is not conventional at all which statements are logically true: "once the meanings of the individual words in a sentence… are given (which may be regarded as a matter of convention), then it is no longer a matter of convention or of arbitrary choice whether or not to regard the sentence as true; the truth of such sentence is determined by the logical relations holding between given meanings."[62]

Logical principles are also necessary relative to the meanings we attribute to the logical terms. If we change those meanings, then we must hold a different

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reason." See W.V.O. Quine, "Ontological Remarks on the Propositional Calculus," *Mind, New Series* 43 (1934): 473.

[60] Nagel, "Logic without Ontology," 227.

[61] I do not endorse the idea, as Nagel, in "Logic without Ontology," does, that logical truths are linguistic conventions or consequences of such conventions, given, probably, by implicit definitions. In this way, Quine's famous criticism for the "linguistic theory of logical truth," a label given by Quine, may be putted aside. In fact, as I mentioned, Carnap found this description inappropriate for his explanation of logical truth. Azzouni's recent article on logical conventionalism offers a good analysis of Quine's criticism of logical conventionalism. See Jody Azzouni, "A Defense of Logical Conventionalism," in *The Metaphysics of Logic: Logical Realism, Logical Anti-Realism and All Things in Between*, ed. Penelope Rush (CUP, 2014).

[62] Carnap, "W. V. Quine on Logical Truth," 915-916.

class of logical principles. Of course, there is nothing necessary in maintaining a certain class of meanings for certain words. The fact that a certain choice of meanings was fruitful in the past does not guarantee that it will be fruitful in the future. Nevertheless, the truth of certain logical principles, once certain meanings for logical terms were established, is different from the acceptance of those meanings in future. The acceptance of those meanings is a pragmatic decision which, once accepted, entails a certain class of logical principles.

The idea that logical truths are true in virtue of meanings, i.e., analytic, necessary and prescriptive is fruitfully explained by Carnap in his article "Empiricism, Semantics, and Ontology," with the help of the concept of linguistic framework. As analytic statements, logical principles describe a linguistic framework. They are constitutive for a certain framework by providing the grammar and the rules for operating in that framework. In this sense they are necessary precisely because they are constitutive for the framework. Once you disobey them, you simply refuse to work within that framework. It is analogous with playing a game. If you do not accept the rules of a game, then you do not play *that* game. For that game, for that linguistic framework, the rules are constitutive, and thus necessary – from this internal perspective. The framework, of course, on pragmatic reasons, may be changed; its adoption is a contingent matter. This characterization of logical truths, as 'framework principles,' also reveals their regulative function. Since they indicate how one should work in a given framework, they are regulative for the activities performed in that framework.

Although the regulative function of logical principles is usually recognized, the objection often raised is that in order to formulate a reasonable ideal, and not an arbitrary one, logical principles must have an objective ground, namely, a ground, or a corresponding structure in reality. We may admire, however, this lofty rationalist ideal to ground logical principles in the structure of reality, but we are by no means forced to infer the arbitrariness of logical principles from the fact that they do not have an identifiable correspondent in reality. Human communication and inquiry are directed to the achievement of certain purposes, and it is a matter of fact that the objectives of communication and inquiry are better achieved when the language is used in the manner prescribed by logical principles. An empirical study of the behaviour of men employed in communication and inquiry confirms this idea. Therefore, even though logical principles do not have a ground, or a subject matter, in reality, this does not imply that they are arbitrary. The general idea mentioned above is that the justification of logical principles is better understood in terms of *objectives to be attained.*

More specifically, a set of logical principles is justified, if it is adequate for attaining certain purposes in inquiry. In this sense, the selection of a set of logical principles, instead of another, has an objective basis.

To sum up, logical principles are true statements in virtue of the meanings of the logical terms from a certain linguistic framework, in Carnap's sense discussed in section IV.b. To understand them is sufficient for determining their truth value. These principles, as long as the relevant meanings are preserved, are necessary because to deny them merely means to misunderstand the expressions from their structure (see the answer to the second objection from the next section).

VI. Final Remarks

The main aim of this paper was to present and to briefly analyze the main interpretations of logical principles. I have first presented the central features of the ontological (or metaphysical) interpretation of logical principles (Tahko, Sher), which was found infeasible because, in my understanding, it assumes, without a reasonable ground, an *a priori* knowledge about certain facts, and also seems, at least in Tahko's case, circular. Second, I have analyzed three main instantiations of the idea that logical principles are empirical hypotheses (Mill, Quine, Maddy), and I have tried to show why they seem problematic. Finally, I have sketched the main features of an interpretation which considers logical principles as non-arbitrary statements, regulative for the use of language in inquiry, in the direction of clarity and precision. According to this interpretation logical principles are true statements based on the meanings of the logical terms from a certain linguistic framework. Logical principles are necessary relative to the preservation of those meanings. The pragmatic decision to change the linguistic framework may entail the adoption of another set of logical principles, but, of course, this does not mean that logical principles are refuted by facts (as we argued in section IV). I will end now by considering two objections for the interpretation proposed in this paper.

An objection recently raised by Maddy[63] to the idea that logical truths are true only in virtue of the meanings of the logical terms, and that their truth does not depend (also) on facts from the world/our experience, is that our use of language is not independent of the facts from the world we live in, which shape our use of language. This would entail that logical truths are also dependent of some relevant facts. Therefore, the question from the title of this paper – *what*

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[63] Maddy, "The Philosophy of Logic," 490.

makes logical truths true? – would not get its entire answer by pointing out only to language, or meanings.

I think that this objection could be dismissed. Of course, we may agree that natural language has an historical development and that the meanings of certain words *may be suggested* by our experience from the world that we live in, but this is not relevant for answering the proposed question, i.e., what makes logical truth true?. For instance, we may either follow Einstein[64] in saying that all our concepts and linguistic expressions – viewed logically – are free creations of our mind and could not be abstracted from experience, or we may agree that some concepts might be, somehow, suggested by experience, but this would not change the fact that the relevant factors for determining the truth of logical principles are only the meanings of the logical terms.[65] The issue raised by Maddy is relevant, I think, only for the problem of the origin of meanings, but since is sufficient to fully understand the meanings of the logical terms in order to establish the truth value of a logical sentence, the semantic conception of logical truth remains untouched.

Another objection often raised to the interpretation of logical principles as analytic statements, i.e., true in virtue of meanings, is that this view leaves unexplained the usefulness of logic in epistemic contexts, especially in the growth process of knowledge. I think that this is not the case. For instance, since the truth of logical principles is grounded in the meanings of the logical terms, we may ask ourselves: why these terms are introduced into language? As Hans Hahn[66] emphasized, a very plausible reason seems to be that we are not omniscient. Logical principles and logical deductions have significance for us precisely because we are not omniscient. If we were omniscient, then we probably would make only categorical assertions, without using logical terms as 'not' or 'or.' To use Hahn's example, if I am asked about the colour of the dress worn by Miss Erna yesterday, and I am not able to remember its colour, I could say: it was red or blue, or it was not yellow, but if I were omniscient, I would simply say: it was red (involving in this way no logical term).

Logical inference makes us aware of the propositions implicitly asserted when we assert other propositions – and it is in virtue of this fact that valid

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[64] Albert Einstein, "Remarks on Bertrand Russell's Theory of Knowledge," in *The Philosophy of Bertrand Russell*, ed. Paul Arthur Schilpp (New York: Tudor Pub. Co., 1952).

[65] The knowledge of the syntactic structure is, of course, presupposed in this context.

[66] Hans Hahn, "Logic, Mathematics, and Knowledge of Nature," in *Logical Positivism*, ed. A.J. Ayer (New York: The Free Press, 1959), 157.

inferences have epistemic significance.[67] For instance, if I assert that object A is either red or blue, and I also assert that object A is not red, then I implicitly have asserted that object A is blue. In this case, the conclusion is derived only in virtue of our rules which govern the use of the words 'or' and 'not,' and is not based on real connections among states of affairs, which we apprehend in thought. If someone refuses to recognize this valid logical deduction, he/she would not manifest a different belief about the behaviour of things, but he/she would merely refuse to speak about things according to the same rules as most of us do.[68] As long as we maintain certain rules for the use of expressions, we preserve the meanings of logical terms, and, thus, logical principles cannot be false; any denial of them would be self-contradictory – at least as long as the classical meaning of negation remains invariant. This is precisely why logical principles are necessary in a certain linguistic framework.[69]

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[67] See Constantin C. Brîncuş, "The Epistemic Significance of Valid Inference – A Model-Theoretic Approach," in *Meaning and Truth*, ed. Sorin Costreie and Mircea Dumitru, (Bucharest: Pro Universitaria Publishing House, 2015), 11-36.

[68] See also Hahn, "Logic, Mathematics, and Knowledge of Nature," 156.