Carnap's Semantics, Logical Systems and Linguistic Frameworks

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I. INTRODUCTION

Discussing distinctive philosophical discourses of the 20th century cannot be successful or at least complete without having introduced a relatively short-lived, but extremely prolific group of academics, The Vienna Circle. The particular philosophical standpoints of the respective members of the group can hardly be encompassed in a single theory, however the most general worldviews and affiliations can be understood through their radical empiricist notions and extensive interest in logic and language.

One of the most prominent members of the group, Rudolf Carnap, joined the Circle only a few years after meeting Hans Reichenbach at a philosophical conference in Erlangen. Reichenbach introduced Carnap to Moritz Schlick who remained in touch with Carnap because of their compatible ideas in terms of philosophy and science, resulting in Carnap moving from Jena to Vienna and joining the group two years after.

The Vienna Circle itself had a very short list of direct influences, which primarily consisted of Gottlob Frege, Bertrand Russell and Ludwig Wittgenstein's work. Their focus on the conceptual analysis of natural language, alongside with their intent of developing a consistent and complete account of symbolic mathematical logic is what consequently became understood as the distinguished discourse of the analytic philosophy. Also, as I will discuss later on, Carnap's philosophical positions and interests, especially in the domain of logic and philosophy of logic, were extensively influenced by Hilbert and Fraenkel's axiomatist views which will be pertinent for the construction of his account of the logical syntax. I will not inspect this thoroughly in this paper.

My intention in this paper is to construct a brief overview of the aspect of Carnap's work that was oriented towards the philosophy of language and logic, alongside with examining his thoughts on the normativity that logical systems impose on the scientific theories. Moreover, before elaborating his considerations I will review the terminology that he used in an attempt to reconstruct it for the better understanding of the paper. Since Carnap strived to revisit some traditional philosophical theses, his understanding of a number of the traditional philosophical concepts might be somewhat different.

The terminology I will address is narrowly connected to his work on his book *Der Logishce Aufbau Der Welt* and his article *Empiricism, Semantics, and Ontology*. These two publications are often considered to exemplify the general gist of Carnap's bibliography and offer some basic understanding of his account of logical positivism.

1.1 THE TERMINOLOGY

Firstly, to summarize the idea of logical positivism, it is widely recognized as an umbrella term for the radical empiricist philosophy with a central notion of *the principle of verification*. Verificationism is most often understood as a philosophical doctrine which states that the only propositions that are linguistically and cognitively meaningful are those that are either empirically or analytically verifiable. I will review this definition in the third chapter of this paper, in which it will be explicated in terms of Carnap's understanding of semantics. The doctrine is heavily incorporated in the philosophy of Vienna Circle and will serve as a foundation of their understanding of natural sciences and their respective frameworks. In the

group's opinion, it consequently discerns (1) scientific problems that are adequately formulated and that require attention, from those that are (2) pseudo-problems that only resemble scientific ones, but are utterly meaningless and only cause linguistic confusion.

The lexicon of Aufbau also contains the terms *autopsychological* and *heteropsychological objects*, which I would like to tackle before reviewing them inside the theory. Carnap gives great merit to the agent's senses. He considers them to be the very cornerstone of empirical investigation; they are necessary for the subject to be able to construct atomic linguistic structures which he will address as *autopsychological objects* that form atomic linguistic structures also known as *protocol sentences*, e.g. The table is in front of me., The water is in my hand., and so on. The autopsychological objects' content is accessible solely to the agent perceiving them and is, at this stage, unshareable. This aspect of Carnap's philosophy is often regarded as phenomenalistic in nature.

Diversely, *the heteropsychological objects* belong to other agents and are inaccessible to the subject in the first-person perspective. Once the formal properties of autopsychological and heteropsychological are thoroughly investigated and systematized using the presuppositions of the relevant language, those objects can then be understood in the intersubjective domain and can only then serve as a basis for empirical sciences. The system that encompasses and logically structurizes those propositions is called the *constructional system*.

To understand the concept of the constructional system[1] we must first revisit the notion of reducibility. In *Aufbau*, Carnap defines that objects **a** and **b** are reducible to one another iff all statements about **a** can be expressed by the statements about **b** in their entirety. Using

[1] The term 'constructional system' can also be found as 'constitutional system' in some translations

reducibility of propositions, Carnap will show which sets of entities can be reduced to others and by expressing this in form of a systematic taxonomy, he will have formed classes. Then by using the same procedure, he will have shown how classes can be reducible to other classes, that will consequently form classes of classes and so on. This type of taxonomy is what Carnap calls a constructional system.

Finally, the last concept that will be relevant for the discussion is the concept of a *framework*. This concept is central to Carnap's later work on semantics which is addressed in the third chapter of this paper. A framework, generally speaking, is a sub-system of the relevant language which consists of basic assumptions, upon which the entities and relations between those entities of that sub-system are concisely defined. In case of a formal framework, all the propositions of a framework must be deductively inferable from the axioms. Nota bene, Carnap uses the standard logical definition of an axiom, as an arbitrary proposition of a system which is used as an initial point for further inference. In case of an informal framework, all entities' properties and actual and possible behaviours must be explicable using the basic assumptions, i.e. presuppositions of a system. Since the propositions of an informal system are contingencies, they cannot be analytically inferred from the basic assumptions. I will review and further elaborate this notion later on.

Throughout Carnap's academic career, he notoriously strived towards systematicity and this is reflected in his approach to both natural and formal sciences. His rigorous definitions were challenged by many, most notably by Quine in his paper *Two Dogmas of Empiricism*, years after Carnap's migration to the USA. In the next chapter, I will start by overviewing some interesting aspects of Carnap's view of logic and science.

II. SCIENCE AND LOGIC

Before we start to examine Carnap's semantics, logical systems and linguistic frameworks, it is of crucial importance to grasp what was the general notion that he strived to establish. Since his philosophical background is heavily influenced by a plethora of scientific and linguistic theories, Carnap's work has continuously promoted the intention of constructing a system that will lay down a cornerstone for both science and language by using formal logic as a supporting structure for (a) the empirical and (b) the formal systems.

The former (a) is thoroughly elaborated in the aforementioned seminal work of logical positivism, *Der Logische Aufbau der Welt*. As I've already discussed, Carnap's attempt at formalization and systematization of the autopsychological and the heteropsychological objects will serve as a basis for the establishment of natural sciences. In other words, atomic linguistic structures, a.k.a. protocol sentences are to be systemised through the usage of symbolic logic in order to construct a scientific theory. The latter (b) is more prominent in the later stages of his career in which is more concerned with the conciseness of language. In papers such as *Empiricism, Semantics, and Ontology* Carnap will attempt to redefine ontic commitment and eliminate superfluous metaphysical considerations from philosophy.

Throughout his career, he has somewhat modified his positions, but they have most often pushed forward the idea of an unambiguous language that will ultimately show that the majority of philosophical problems were ill-founded on the basis of linguistic and conceptual ambiguity. This will come to be known as pseudo-problems in philosophy. A similar program was once

attempted by Ludwig Wittgenstein in his first published book, Tractatus Logico-Philosophicus, which served as an inspiration for Carnap's work.

2.1 THE CONSTRUCTIONAL SYSTEM OF 'AUFBAU'

The constructional system of Carnap's *Aufbau* actually stems from his original interest in the field of physics. Carnap has spent the first several years of his academic career working on physics theories which later resulted in the development of a very specific approach to the philosophy of science. Aufbau per se is most certainly not a book about physics or philosophy of physics, but about the psychological insight and logical classification of entities in the domain of things that are empirically graspable. He has taken a radical reductionistic approach to it, constructing a complex hierarchical system, a sort of a logical taxonomy that not only enlists existing objects in a systematised manner but analyses the modus of grasping and understanding them. As we have already seen, the objects that are the subject of scientific taxonomy are the product of processing and systematizing autopsychological and heteropsychological objects rendering them intersubjective in nature.

The logical meta-system that Carnap used for developing the constructional system of *Aufbau* is actually Russell's and Whitehead's symbolic logic that they defined in the *Principia Mathematica*, which Carnap regarded as a complete and coherent formulation of the modern mathematical logic. However, his appeal to the application of this kind of formalism in the philosophy of science was initially established years before when he attended Frege's three lectures „*Begriffsschrift I*", "*Begriffsschrift II*" and "*Logik in der Mathematik*" in 1912 and 1913.

And although he found the lectures engaging, it was only later that he recognised their impact on philosophy and science. I will further elaborate on this in the next chapter on Carnap's logical systems.

Returning to the point of constructing the hierarchy or a taxonomy of propositions in scientific language, Carnap still had to explain the gap between *autopsychological objects* (propositions) and *heteropsychological ones*, and properly define the latter. Basically, he reconstructed the concept of an object by translating the visual field into the mathematical domain, consequently becoming defined in an intersubjective realm. This step allowed him to define the elementary individual object of the system upon which he proposed sets of such objects, i.e. classes. Classes can then be encompassed in bigger sets, i.e. classes of classes and so on. This is further elaborated in Friedman's paper "*The Aufbau and the rejection of metaphysics*".[2]

This very system broadly exemplifies his application of a formal logical system on a scientific theory. Carnap himself claimed that the only propositions that are to be considered within a scientific theory are the ones that can be unequivocally formalized. However, this requirement is only to be understood in principii, as he never advocated for all the scientific propositions to be formalized, only that it is has to be possible to do so.

Furthermore, by applying the criteria for grasping and understating objects in the world, another greater implication of the system has come to light. By attempting to systematize objects and properties that are accessible to a rational subject, metaphysical questions have been caught in the crossfire. *Aufbau* has hence been widely recognized as a first serious program in the

[2] Friedman, M., 2008.

elimination of metaphysics. I will elaborate further on this in the third chapter when we tackle the topic of Carnap's semantics and linguistic frameworks.

2.2 LOGICAL SYSTEMS AND PROMINENT INFLUENCES

Now that we have examined some examples of Carnap's application of logic in *Aufbau,* it would seem appropriate to address his work in logic in a more narrow sense, or to be more precise, his work in axiomatics, pure logic, and for a brief period in time, meta-mathematics. As I've mentioned in the last chapter, after Carnap attended three Frege's lectures on formal logic, he has developed a keen interest in the matter but did not comprehend the extent of its importance up until after the very denouement of the First World War. These Carnap's investigations take place mainly after the Aufbau period, as his interest was slowly but steadily diverted from the philosophy of science toward logic and philosophy of logic.

As Erich H. Reck discusses in his article "*Carnap and Modal Logic*"[3], his work has quite drastically changed its course, although it did not primarily facilitate the expected results;

"Carnap's project also had direct connections to contemporary work by Abraham Fraenkel on axiomatics, Kurt Godel on incompleteness, and Alfred Tarski on ¨ the foundations of meta-logical notions. Carnap was at the cutting edge of research in modern logic during this period, both in terms of his personal contacts and his own endeavours. While these endeavours did not

[3] Reck, E. H., 2008.

bear the systematic fruits he initially envisioned, they did lead to some partial results; they also had a significant influence at the time." (Reck E. H., 2008)

Yet few other mathematicians' works deserves to be introduced in terms of numerous influences on Carnap, and those are of David Hilbert, Richard Dedekind, and as discussed, Abraham Fraenkel. It has soon become evident that Hilbert's, Dedekind's, and Fraenkel's work on axiomatics played a crucial role in Carnap's development as a logician, especially in terms of defining the three central conditions for an axiomatic system to be systematic and non-redundant;

(a) the independence of the axioms – axiom mustn't be derived or reducible to one another

(b) their consistency – there must be no contradiction between two axioms of the system

(c) their completeness, which is later concisely defined.

This discussion brought Carnap closer to the area of axiomatics when he initiated a correspondence with Fraenkel himself. Their discussion has evidently become prolific when the two authors established a need for expanding on the property of completeness and as a result of their discussion, Fraenkel soon published a book containing an elaboration this subdivision.

Reck discusses this notion in a more contemporary manner;

(1) A system of axioms S is deductively complete iff for every proposition P in the relevant language either P or not-P is deductively inferable from S.

(2) A system of axioms S is semantically complete iff there is no proposition P in the relevant language such that both S together with P and S together with not-P are satisfiable, i.e., have a model.

(3) A system of axioms S is categorical iff all models of S are isomorphic.[4]

After Fraenkel failed in terms of providing a solid theoretical background for this subdivision, Carnap's attempt appeared to be more systematic and concise in terms of defining relevant concepts and „establishing explicitly the logical basis [for the system].“[5] His approach was later brought in question as some of the prominent figures on the scene did not share the intuitions on a number of definitions that he introduced in his attempt to resolve this matter, but this is generally thought to be a first solid attempt of reconciliation of the axiomatists' and the classic Fregean and Russellian view on establishment of a coherent and complete system of classical symbolic logic.

In the next chapter I will first review the meta-theoretical background that is pertinent to the discussion on Carnap's linguistic frameworks and then I will address Carnap's take on the semantics of informal and formal languages with his introduction of linguistic frameworks.

[4] Reck, E. H., 2008.
[5] Carnap, R., 2003

After that, it is of importance to at least briefly establish a connection with his work on Aufbau by revisiting his account of the verificationist approach to the theory of natural sciences.

III. SEMANTICS AND LINGUISTIC FRAMEWORKS

Broadly speaking, in terms of any philosophical theory that deals with language, epistemology and logic, a specific distinction is made that deals with questions of propositions, justifications and truths. The established relationship between them serves as a meta-theoretical background of the theory, i.e., a universal framework

PROPOSITIONS	ANALYTIC	SYNTHETIC
JUSTIFICATIONS	A PRIORI	A POSTERIORI
TRUTHS	NECESSARY	CONTINGENT

Logical positivism, as is the case with most empiricist theories, has claimed a necessary connection between analytic propositions, a priori justifications and necessary truths, as it did with synthetic propositions, a posteriori justifications and contingent truths.

This categorical necessity is seminal for understanding Carnap's work in the field of semantics and linguistic frameworks. Firstly, it is important to note that Carnap's renowned article on this matter, *Empiricism, Semantics and Ontology*, didn't see the light of day until after more than 20 years since the first publication of *Aufbau*. Naturally, some of his philosophical views have

changed, but the underlying program of elimination of metaphysical questions has remained ingrained in his work. The discussion in this article doesn't have many connections to his work on *Aufbau*, but in terms of elaborating his view on the semantics of the natural and scientific language, it is essential.

The article itself deals with the question of how to treat abstract entities that we have no immediate experience with, i.e. which are not an object of our perception. It appears to be clear that such entities cannot be objects of protocol sentences, but there are cases in which they seem to be adequately interacting with other discrete elements of the relevant system, i.e. not generating contradictions and inconsistencies. e.g., a mathematician can successfully use concepts of functions or infinities without ever being empirically exposed to such entities. Traditionally, many theoreticians have come up against the issue of ontic commitment and the attempts to resolve it were most often unsuccessful or at least awkwardly postulated. Carnap's intention in this paper was to clarify the matter with the introduction of conceptual or linguistic frameworks which are based on the necessity of categorial distinction at the beginning of the chapter.

He explicitly claims that abstract entities exist and should be defined as any other object in the universe. For Carnap it is not a question about the object, but about the way we talk about it. He introduces linguistic frameworks as rule-governed semantic systems which operate under the normativity of presuppositions or axioms, depending if the system in question is formal or informal, respectively. Introducing a linguistic framework is nothing more than constructing a new way to talk about things. It allows the subject to define the object and to examine its interaction with other objects in the framework.

In the article, Carnap introduces and discusses a number of linguistic frameworks such as the mathematical linguistic framework, the linguistic framework of physical things, the linguistic framework of properties, etc. The formal ones such as the mathematical LF are subjects to the normativity of axioms (e.g. 1 is an element of the set of natural numbers, …) and the informal ones such as the LF of physical things are subjects to the normativity of presuppositions (e.g. spatial occupation, temporality,…). This metalinguistic construction allows us to introduce new LF to speak about new kinds of entities that can render the discourse more sophisticated and systematic. Now we can review what kind of questions can we ask about entities in their respective LFs.

Carnap defines two kinds of questions that we can ask about both informal and formal systems and the entities that are defined by them; the internal questions of existence and the external ones. The former address the states of affairs of entities inside the framework. They will be different depending on whether the LF is formal or informal. So for example, in terms of the informal LF of physical things, we can meaningfully ask the question; 'Is the bottle on the table?' or 'Is the spoon made of silver?', or in the case of the formal LF of logic, we can ask 'Is $(P \rightarrow Q)$ logically equivalent to $(\neg P \vee Q)$?'. Thus we can either analytically or empirically, depending on the nature of the LF, examine whether the question is to be answered affirmatively or negatively.

To review the examples, the question of whether the bottle is on the table is answerable by empirically establishing the spatial relation between the bottle and the table using our senses, while the question of whether $(P \rightarrow Q)$ is logically equivalent to $(\neg P \vee Q)$? is answerable analytically using the deductive inference from axioms or principles of natural deduction. This types of question bear no ontological commitment as we are not asserting anything about the

external world, but only about the entities that are defined via these LFs. To sum up, the internal questions of existence are those that are asked by scientists when they conduct an experiment or when they're proving a theorem. They use the presuppositions and the terminology that is stipulated and accepted by the scientific community and they empirically or analytically determine the outcome of the examination.

This notion is the par excellence evidence of Carnap's positivistic background as it is closely related to the principle of verification. As I have discussed in the introduction, verificationism in its nature demands for a scientific claim to be verifiable either empirically or analytically to have propositional meaning. Carnap's account of empirical verification is essentially defined in terms of forming protocol sentences by means of interpreting the autopsychological objects generated in the senses and rendering them heteropsychological through the systematization of a logically complete system. Carnap's account of analytical verification is much simpler; a proposition P is analytically verifiable iff it can be deductively inferred from the set of axioms of the system. Any claim that appears to be scientific in nature that cannot be subjected to verification isn't only false but meaningless. This is pertinent to Carnap's program of elimination of metaphysical questions that only appear to have semantic content, but since they cannot be subjected to empirical or analytical (logical) verification renders them meaningless.

The external questions of existence are somewhat more complex to answer and they demand closer inspection. As opposed to internal ones, they do not generate claims about the entities of a LF, but about the applicability of a LF itself, i.e. they examine if a LF is useful for discourse, and if so, to which extent. Hence, they are, in itself, not of theoretical, but of practical nature. Above all, Carnap's intention is to make language economical, and the external questions of existence

provide just that. They allow us to refine the linguistic system by introducing new, useful LFs and remove those that do not appear to generate applicable concepts.

Carnap again addresses the problematic metaphysical question such as 'Where is situated number 5?' or 'How does time exist?'. Answers to those questions are what Carnap calls pseudo-statements. Intuitively they appear to have content, but as we have already discussed, they are unverifiable and hence meaningless.

"An alleged statement of the reality of the system of entities is a pseudo-statement without cognitive content. To be sure, we have to face at this point an important question; but it is a practical, not a theoretical question; it is the question of whether or not to accept the new linguistic forms. The acceptance cannot be judged as being either true or false because it is not an assertion. It can only be judged as being more or less expedient, fruitful, conducive to the aim for which the language is intended. Judgments of this kind supply the motivation for the decision of accepting or rejecting the kind of entities." (Carnap, 1950)

The general notion that Carnap introduced in this article hence fails to be categorized in terms of metaphysical nominalism or realism regarding abstract concepts because it appears to be successful in showing that the problems with the discussion were of linguistic, not of metaphysical nature. Carnap himself states in the article that he doesn't believe that he proposed a new solution to the problem but just tried to clarify the existing ones by showing that the opposing views are only trivially different because the question that they are trying to answer is inadequately formulated.

IV. CONCLUSION

In this paper, I have attempted to briefly elaborate some of the highlights of Carnap's prolific academic career in terms of his engagement in the philosophy of language, philosophy of science and logic. As I have already discussed, Carnap's specific philosophical standpoints and interests have shifted from time to time, but a general overview of his work still shows a reasonable amount of consistency that is epitomized in his systematic approach to knowledge. His work on metamathematics and logical syntax that stemmed from his work on axiomatics have become highly influential and developed a wide array of subjects in the domain.

And although the work of the logical positivists has been brought in question extensively during the course of the last century, it would most certainly be irresponsible to dismiss the influence it had on the establishment and progress of the contemporary theories in natural sciences and philosophy.

As I have already mentioned, W.V. Quine was one of the first philosophers to criticize Carnap's work by declaring his rigorous distinction between analytic and synthetic unnecessary and thus claimed his theory too demanding. This Quine's paper again caused controversy in the field when H.P. Grice and P. F. Strawson retorted with their paper *In defence of a Dogma* in which they claimed that the distinction was justifiable to make and that his position attacks not only the distinction between the analytic and synthetic, but the entire enterprise of semantics.

This discussion is still quite active, although to a lesser extent than it was several decades ago and Carnap's *Empiricism, Semantics and Ontology* is still being republished in contemporary journals of metaphysics and philosophy of language.

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