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The Newman-Problem in Carnap’s *Aufbau*“

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Robert Frühstückl, BA

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being so dead keen on reason
Sylvia Plath, The Bell Jar

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Preface

The idea of this thesis first came to my mind after reading the paper *Bertrand Russell's The Analysis of Matter: Its Historical Context and Contemporary Interest* by William Demopoulos and Michael Friedman (1985), which my colleague Georg Schiemer pointed out to me. At that time I was planning to work on the position of structural realism in the philosophy of science. It was mere coincidence that I was studying Rudolf Carnap's *The Logical Structure of the World*¹ (1969) (henceforth referred to as *Aufbau*) at the same time, but in this case it was a lucky coincidence, since the idea of investigating into the details of the Newman-problem, which I came to know after studying that paper, in connection with Carnap's constructional theory seemed a worthy project for a master thesis.

It has to be said however that the arguments presented here are not new. Demopoulos and Friedman (1985) and van Fraassen (2008) are investigating into the issue of Newman and Carnap in some detail. They both try to show, that Carnap's *Aufbau* is facing in effect the very same problem that the mathematician M.H.A. Newman pointed out to Bertrand Russell just about the same time. However I still think that there can be said much more on that. Therefore I have set myself the task of clarifying their arguments in this respect and to give a close reading of the relevant passages in Carnap's *Aufbau* and in Newman's original formulation of the problem (1928) in order to support their claim. Doing this I will also say something about contemporary positions in the philosophy of science, especially about structural realism in some form. However I will not make an original contribution to those modern forms of structuralism. The central aim of my thesis will be best described by saying that I want to explore in full detail whether the Newman-problem is threatening the system of Carnap's *Aufbau*. I will argue, that this is the case, thereby giving support to the discussion of Demopoulos/Friedman (1985) and van Fraassen (2008).

In this respect my work will be to some extent historical. In an earlier phase of planning this thesis however, I intended to treat the story about Newman and Carnap just as a historical case study focussing on the lesson we could learn from that problem for modern accounts of structuralism in the philosophy of science, or even for suitably refined accounts of construction theory as e.g. Leitgeb (2011). In the course of working on the subject matter however, I

¹ See(Carnap 1998) for the German original.

abandoned this extended claim and instead began to focus more and more at the philosophical and systematic aspects behind the story, out of mere historical curiosity. Of course I am still convinced that philosophers of science could learn something from this story but I will have to leave this exposition for future work, not just because I have to stick to the standards of a master thesis but because I think that a precise reconstruction, which aims at historical adequacy is important in its own right.

In this sense I try to give substance to the idea of a history and philosophy of science: my thesis will not present any new philosophical arguments because it also aims, as just said, at historical adequacy; it will not be a straightforward historical study, since it tries to lay ground for future philosophical work to do.

However in trying to substantiate the claims on Newman and Carnap made by Demopoulos and Friedman (1985) one may suspect that I would have to rely on the neo-Kantian reading of the *Aufbau* in some way or other. In fact I will say something about the connection of the neo-Kantian reading and the Newman-problem in the course of my discussion. However I want to emphasise that the aim of my thesis is not to support or defend Friedman's or Richardson's reading of the *Aufbau*, or to say anything in favour of or against it. Instead I try to stick as close to the original as possible.

This brings me to my next remark. I have thought some time about the question, which version I should use in this thesis, the German original or the English translation. For some time I thought to answer this question by quoting every passage of the *Aufbau* twice: the English version in the text and the German version in footnotes. However I think this would go to far in the demand for textual evidence. The reason why I chose the English version in the end is simply that I think it facilitates reading. Above that Carnap's ideal of clarity is indeed handy in this respect. The formulation of his project in the *Aufbau* in the original German text does meet the requirement of precision and clarity to such an extent that makes its translation into another language rather unproblematic. Indeed there is only one case in my work on the *Aufbau*, where I thought that a look at the German original would proof useful in order to get the right understanding of a certain passage. This can be found in section 1.1.1 of my thesis.

When I speak of a constructional system here, I am not referring to any specific instantiation or any particular constructional system, but just to constructional systems as theoretically possible systems of definitions, with many possible sets of basic elements, different possible basic concepts and so on. It is important to bear in mind, that the problem I want to discuss here, is in

no way particularly connected to a specific example of a constructional system, but rather affects construction theory as a whole. Therefore when I refer to the particular example of a constructional system Carnap is outlining in the *Aufbau*, I will speak of “the constructional system of the *Aufbau*”. Otherwise I will always refer to *any* possible constructional system whatsoever.

The plan of my thesis will be as follows:

The first part will be a very general introduction into the programme of the *Aufbau*. Chapter 1.1 will make the reader familiar with some of its central theoretical aspects. I will present Carnap’s idea on the basis of two fundamental theses, which I think explain best his programme. After that I will pay special attention to his concept of definitions before turning to his idea of structural definite descriptions. Chapter 1.2 will then focus solely on the *problem of eliminating the basic relation*, which Carnap raises towards the end of his construction in the *Aufbau*. Since this problem is of utmost importance to the question of the Newman-problem, I will pay some attention to a detailed discussion of this part of the *Aufbau*. Chapter 1.3 finally is a brief discussion of the two most important trends in reading and interpreting the *Aufbau*, the phenomenalist-reductionist reading most prominently put forward by Nelson Goodman and Willard van Orman Quine and the neo-Kantian reading advocated by Michael Friedman, Alan Richardson et al.

Part two will then be devoted to the presentation of the Newman-problem. I will begin in chapter 2.1 with a detailed discussion of Newman’s original paper from 1928. I will condensate Newman’s criticism against Russell into two arguments, which will later be used to clarify the impact of the problem on Carnap’s *Aufbau*. In the second chapter I will have a look at some discussions of the Newman-problem in the literature. Sections 2.2.2 and 2.2.3 will have a look at the arguments by Demopoulos, Friedman and van Fraassen on Newman and Carnap. This discussion will lead us straight into part three in which I finally try to argue that the Newman-problem is threatening the programme of the *Aufbau* making substantial use of the intermediate findings and conclusions of the foregoing sections thereby. I will conclude my thesis with a few remarks on the outlook of a possible reading of the *Aufbau*, as much more akin to structural realism than might at first be supposed, without wanting to come at a definite conclusion on this matter however.

I want to take the opportunity to say a few words of gratitude here.

I am especially grateful to my supervisor Elisabeth Nemeth for helping me with my thesis (and much earlier drafts of it) but also for her support in general and for the helpful and illuminating discussions throughout my years as a student at the philosophy department.

I also want to thank Georg Schiemer, not only for making me familiar with the paper of Demopoulos and Friedman but also for helpful comments during the phase of planning this thesis. I am also very thankful to Christian Damböck in this respect.

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Bernadette Reisinger has commented on the most important part of this thesis and I thank her very much for that.

1. Introduction: The Logical Structure of the World

The first part of this thesis will be devoted to a more or less detailed reconstruction of Carnap's philosophical project in the *Aufbau* and the most important interpretations it has received so far. The overall aim of chapter 1.1 will be to give a brief and general introduction to the *Aufbau* and to clarify the most important concepts used in *construction theory*. I will pay special attention to the method of *definition in use* (section 1.1.2) and the idea of *structural definite descriptions* (section 1.1.3). Chapter 1.2 will be concerned with the problem of the elimination of the basic relation. This part is of outmost importance for the discussion of the Newman-problem in connection with Carnap's *Aufbau*. Chapter 1.3 finally is concerned with a brief presentation of two of the most fundamental lines of interpreting the *Aufbau*, namely the phenomenalist-reductionist reading of Quine and Goodman and the neo-Kantian reading of Friedman and Richardson.

1.1 Carnap's Construction

1.1.1 The fundamental idea of the *Aufbau*

The *Aufbau* was first published in 1928 (cf. Carnap 1998, XI). Although the development of Carnap's philosophy led him away from the specific approach embraced in the *Aufbau*, Carnap never disclaimed the principal aim and the philosophical attitude behind this work. This is also emphasized in Thomas Mormann's *Rudolf Carnap* (2000), which gives a comprehensive introduction to Carnap's philosophical thinking throughout his career. Mormann writes there: "Auch wenn er in seinen späteren Arbeiten die Akzente in mancher Hinsicht anders setzte, hat Carnap die im *Aufbau* geäußerten Gedanken niemals widerrufen." (2000, 83) Above that this is what Carnap himself said in the preface to the 2nd Edition of the *Aufbau* written in 1961: „When I read the old formulations today, I find many a passage which I would now phrase differently or leave out altogether; but I still agree with the philosophical orientation which stands behind this book.“ (Carnap 1969, v)

I think it is important to bear in mind though, that the *Aufbau* is actually a finished project, which was not continued after its publication. Although it would perhaps be exaggerated to see a sudden break in the development of Carnap's philosophical thinking, he nonetheless took another direction in the years following the *Aufbau*. As Thomas Mormann additionally points out, this development in Carnap's thinking is connected with the overall formation of logical empiricism and Carnap's engagement with the Vienna Circle (2000, 107). Thus Mormann writes:

[D]ie Konzeption des *Aufbau* trat nicht nur für die anderen Mitglieder des Wiener Kreises, sondern auch für Carnap selbst in den Hintergrund. Das konstitutionstheoretische Programm des *Aufbau* wurde ersetzt durch das Programm der *physikalistischen Einheitswissenschaft*. Spätestens ab 1932 galt der *Aufbau* auch seinem Autor als ein überholtes Stadium seiner philosophischen Entwicklung. (2000, 107)

Thomas Uebel (1991) is giving a similar assessment of the influence of the Vienna Circle on Carnap's development. He puts specific emphasis on the relevance of the so-called protocol-sentence-debate (1991, 170-171). For Uebel this debate marks Carnap's development after publishing the *Aufbau*:

Carnaps Revisionen seiner Position sind aber nicht nur allein im Zusammenhang der Protokollsatzdebatte zu verstehen, sondern sie markieren auch Stadien der Entwicklung seiner konventionalistischen Wissenschaftstheorie. So gesehen ist die Protokollsatzdebatte – von Nachspielen abgesehen – durch drei seiner Hauptwerke begrenzt: sie begann mit der Reaktion auf seinen *Aufbau* und endete mit seinem Aufsatz „Testability and Meaning“. (Uebel 1991, 171)

For this reason it looks like we are in a position to treat the project of the *Aufbau* as concluded and unified whole. I take this to be an advantage of some kind. At least I think it is safe to say, that we do not have to take into account the ideas and views Carnap later developed on the topics under discussion here, but can focus and concentrate solely on the project of the *Aufbau* and on his views at that time. In this sense, this thesis will be historical in character.

However, the *Aufbau* aims at nothing less than the introduction of a whole new field of investigation and consequently a whole new theory into the realm of philosophical inquiry. The label Carnap gives to his new theory is *construction theory* (1969, 5). Its main concern is, in Carnap's own words, to attempt "a step-by-step derivation or 'construction' of all concepts from certain fundamental concepts, so that a genealogy of concepts results in which each one has its

definite place.” (Carnap 1969, 5) The resulting system is then called *constructional system* (Carnap 1969, 5).

I want to describe the main idea of the *Aufbau* in the following way:

Its aim is the development of a system of definitions, in which every definition has to satisfy two conditions, namely:

- C₁) Every definition of a concept, at any stage in the system can be reduced to one (or more) basic concept(s), which stand as undefined primitives at the bottom of the system. (cf. Carnap 1969, 5-6)
- C₂) Every definition contains just the symbol(s) for the basic concept(s) plus logical vocabulary. As a consequence, the only non-logical sign in any definition, which is part of the system, is the sign for the basic concept. (cf. Carnap 1969, 154)

A definition that satisfies C₁ and C₂ is then called *constructional definition* (Carnap 1969, 6).

A point of qualification has to be added here. Condition C₂ should be read as saying that it must in principle be possible to write out any constructional definition on the basis of logical vocabulary and the undefined primitive concept alone. In the particular constructional system of the *Aufbau*, Carnap does not write out every definition in the strict form required by C₂ but makes use of already defined concepts to facilitate reading. The definition of the concept of *Sense Classes* for example uses the earlier defined concept of *Similarity Between Qualities* (cf. Carnap 1969, 182-183).

These two conditions already give a hint at a central ingredient of Carnap’s philosophy, not only in the *Aufbau*, but also for his later views in general. Namely the importance of the then newly developed methods of mathematical logic for Carnap’s work. Construction theory as developed in the *Aufbau* would be impossible without extensive use of the formal methods of the logic of the *Principia Mathematica* developed by Bertrand Russell and Alfred North Whitehead (cf. Mormann 2000, 41-44). This becomes obvious by looking at how Carnap himself underlines the significance of the logic of *Principia*. He writes in the *Aufbau*: “The present study is an attempt to apply the theory of relations to the task of analyzing reality.” (1969, 7) In the preface to the second edition of the *Aufbau*, Carnap also mentions Gottlob Frege in addition to Russell and Whitehead as inventor of “modern logic” (cf. 1969, vii). Michael Friedman and William

Demopoulos also emphasise the significance of modern mathematical logic for the *Aufbau*:

As Carnap himself emphasizes, this kind of program for individuating concepts by means of purely formal properties only begins to make sense in the context of modern, *polyadic* logic. Monadic concepts correspond to unstructured sets whose only formal property is their cardinality. Polyadic concepts have such diverse formal properties as transitivity, reflexivity, connectedness, dimensionality, and so on. (Demopoulos/Friedman 1985, 626 Footnote)

Carnap makes essential use of these formal methods in the *Aufbau*. Above that he puts especial emphasis on their benefit for any philosophical enquiry:

It is understandable that the new logic has, to begin with, found attention only in the narrow circle of mathematicians and logicians. Its outstanding importance for philosophy as a whole has been realized only by a few; its application to this wider field has hardly begun. As soon as philosophers are willing to follow a scientific course (in the strict sense), they will not be able to avoid using this penetrating and efficient method for the clarification of concepts and the purification of problems. This book is to go a step along this road and to encourage further steps in the same direction. (Carnap 1969, xv-xvi)

In the *Aufbau* this application of formal methods is taken quite literally. Carnap's intention is to impose a type-theoretic hierarchy onto the conceptual system that is to be developed (cf. 1969, 69-70).

Perhaps a few more words of clarification are in order here. So far I have only talked about *definitions*. Although the *Aufbau* is intended as a system of definitions, Carnap is relying on a very specific notion of definition here, which I have already mentioned above, where Carnap spoke of a *construction of concepts*. However we do not know yet, what Carnap exactly means by the word *construction*. The explanation is given in the following passage:

If, in the course of the formation of the constructional system, a new object is "constructed", then this means, according to our definition of construction, that it is shown how statements about it can be transformed into statements about the basic objects of the system or the objects which have been constructed prior to the object in question. Thus a rule must be given which enables us to eliminate the name of the new object in all sentences in which it could occur; in other words, *a definition of the name of the object must be given*. (Carnap 1969, 65)

So for Carnap *constructions* or *constructional definitions* are a kind of translation-rules. They

specify how to replace certain simple terms or names, for certain complex terms, such as terms consisting of the basic concept of a given constructional system plus logical vocabulary. The reason why I want to emphasise this aspect is, that it explains why the definitions of a constructional system must not be mistaken for statements about any supposed *ontological* structure of the objects they define or of the world as a whole or anything like that. This may seem surprising, since Carnap himself speaks of *ontologies* in the very first paragraph of the *Aufbau*. Let us recall this particular passage: „It is the main thesis of construction theory” Carnap said there, “that all concepts can [...] be derived from a few fundamental concepts, and it is in this respect that it differs from most other *ontologies*.” (Carnap 1969, 5, my emphasis, R.F.) Now one might think after reading this passage that the main thesis of the *Aufbau* implies a metaphysical claim after all, triggered by the use of the word „ontologies“. Indeed, since Carnap himself purportedly refers to ontology it is inevitable to think so. There are at least two reasons that speak against such a reading. *First*, Carnap’s criteria for the derivation of concepts are criteria about language. Thus Carnap says: „An object (or concept) is said to be *reducible* to one or more other objects if all statements about it can be transformed into statements about these other objects.” (1969, 6) This passage should make clear, that the character of Carnap’s philosophical investigation must not be confused with that of traditional metaphysics; it is everything else than ontological in this respect. More briefly put, Carnap is not making statements about objects, but about the language in which we talk about objects. This reading accords well with Carnap’s understanding of the relation between *concept* and *object*, which he explains as follows: “It makes no logical difference whether a given signs denotes the concept or the object, or whether a sentence holds for objects or concepts. [...] Actually, we have here not two conceptions, but only two different interpretative modes of speech.” (1969, 10) In the very first section of the *Aufbau* Carnap explains the meaning of the word *object* in his use as: “anything about which a statement can be made.” (1969, 5)² The *second* reason why a metaphysical reading is deceptive, relates to the translation of the *Aufbau* into English. The German original has „Gegenstandstheorie“ (cf. Carnap 1998, 1) instead of “ontology” (cf. Carnap 1969, 5). The sub-discipline of traditional metaphysics, which one might think of by the use of the word “ontology” in the English version, would in German be called “Ontologie” not

² A more extensive discussion on Carnap’s view of the relation between concept and object in the *Aufbau* can be found in Friedman (2000, 77-78)

“Gegenstandstheorie” as in the German version of the *Aufbau*. Hence I think that a metaphysical reading of this passage, which derives its plausibility only from the use of the word “ontologies” is misleading.

So far we have found out that constructional definitions are translation rules for concepts. Now we can go one step further and add some of the details of Carnap’s understanding of this method of definition. He says in the following passage:

By *constructing* a concept from other concepts, we shall mean the indication of its ‘constructional definition’ on the basis of these other concepts. By a *constructional definition* of the concept *a* on the basis of concepts *b* and *c*, we mean a rule of translation which gives a general indication how any propositional function in which *a* occurs may be transformed into a coextensive propositional function in which *a* no longer occurs, but only *b* and *c*. (Carnap 1969, 61)

This brings us to another essential feature of the *Aufbau*. In this passage, the criterion for the adequacy of the translation is spelled out solely in terms of the *extension* of a propositional function. Carnap himself makes explicit, that he is relying on a strictly extensional conception of logic in the *Aufbau* in the following passage:

We have seen earlier that a constructional definition [...] consists in declaring that two propositional functions have the same meaning. [...] Through this procedure, concepts are defined only extensionally. We therefore speak of an *extensional method* of construction. It is based upon the *thesis of extensionality*: in every statement about a concept, this concept may be taken extensionally (i.e., it may be represented by its extension [class or relation extension]). More precisely: in every statement about a propositional function, the latter may be replaced by its extension symbol. (Carnap 1969, 72)

Of course there are profound arguments against such a view. Carnap is well aware of the fact, that the logic of intension may pose a problem for his solely extensional treatment of the concept of “sameness of meaning” (1969, 72). To this end he also discusses one possible objection to his thesis of extensionality in the *Aufbau* (cf. 1969, 73-74). However I will not go into this in greater detail. For our concern it suffices to know what Carnap has in mind, when speaking of two equivalent propositional functions in the *Aufbau*. Above that, Carnap seems to have changed his views on the extensional method after publication of the *Aufbau*. In the preface to the second edition he says: “I am no longer satisfied with my discussion of the *extensional method*” (1969,

ix). I think we can allow this issue to rest here.³

Last but not least, there is one more important feature of construction theory that I want to talk about before going into detail, which is the specific method of imposing a type-theoretic hierarchy onto the conceptual system in the *Aufbau*. There are two aspects about that, which I want to discuss briefly. The first is Carnap's idea of *quasi objects* (1969, 48-50); the second is the idea to treat class and relation extensions as *constructional levels* of a constructional system (1969, 69-70). Both in combination will explain, how the hierarchical structure of the conceptual system, that Carnap wants to implement, actually is going to look like. Let me start *first*, with the concept of a *quasi object*.

The idea is the following: Given any atomic sentence,

$$\varphi(a) \tag{1}$$

it is possible to replace the singular term in (1) by a free variable, such that

$$\varphi(x) \tag{2}$$

results.

For Carnap now the difference between (1) and (2) amounts to the fact, that the atomic formula in (2) does not have any meaning on its own (cf. Carnap 1969, 48). Carnap is in complete accordance with the Fregean view when describing the situation as follows: "The traditional view is that the proper names have a relatively independent meaning and are thereby distinguished from the other signs. These other signs we call, after Frege, *incomplete symbols*." (Carnap 1969, 48)⁴ An example of such an *incomplete symbol* would be the atomic formula in (2). After replacing the singular term of an atomic sentence, Carnap further observes that it is possible to build sentences, in which a predicate *expression* occurs in subject *position* of the sentence. It is worth to quote the relevant passage of the *Aufbau* in full:

In the original usage of signs, the subject position of a sentence must always be occupied by a

³ For a thoroughgoing discussion of Carnap's views of the extensional method in the *Aufbau* see Leitgeb (2011, 267-268).

⁴ The German original has for "incomplete symbols" „ungesättigte Zeichen“ (cf. Carnap 1998, 35).

proper name. However, it proved advantageous to admit into the subject position also signs for general objects and, finally, also other incomplete symbols. This improper use, however, is permissible only when a transformation into proper use is possible, i.e., if the sentence can be translated into one or more sentences which have only proper names in their subject positions. [...] Thus, in improper use, incomplete symbols are used if they designated an object in the same way as an object name. One even speaks of ‘their designata’, consciously or unconsciously introducing the fiction that there are such things. We wish to retain this fiction for reasons of utility. But, in order to remain perfectly aware of this fictional character, we will not say that an incomplete symbol designates an “object”, but that it designates a *quasi object*. (Carnap 1969, 49)

We see that Carnap is willing to use the word “object” if a predicate expression occurs in subject position of a sentence, but he is not willing to classify them as objects in the same sense as the things, designated by proper names. Rather he wants to call them *quasi objects*.

Maybe this will become clearer if we have a look at the example Carnap is giving in the *Aufbau* (cf. Carnap 1969, 49-50).

I will reconstruct this example in the following way:

Just let the symbol a stand for the proper name *Karo*, while the predicate expression $\varphi(x)$ stands for *...is a dog*, which is a propositional function. We can see here that Carnap has created the incomplete symbol “*...is a dog*” by eliminating the singular term *Karo* from the sentence *Karo is a dog*. Now Carnap’s idea is, that it is also possible to create “incomplete symbols of a different sort.” (Carnap 1969, 49) What does that mean? It means to isolate the constituent *a dog* from the propositional function *...is a dog*, thus generating in fact a general term. Now Carnap asks the question how we should express the fact that dogs are mammals. One obvious way that Carnap thinks of would be the following sentence

$$\forall x \varphi(x) \rightarrow \psi(x) \tag{3}$$

where $\psi(x)$ would stand for *...is a mammal*. However this is just one possibility of expressing this proposition. Thus Carnap says:

Instead, we form a new sentence form by allowing ourselves to introduce an incomplete symbol into the subject position as if it were an object name. We say, “A dog is a mammal.” In this sentence, no object name occurs, but we say about the incomplete symbol ‘a dog’ that, while it does

not designate an object, it designates a *quasi object* (Carnap 1969, 49).⁵

So Carnap introduces the notion of *quasi objects*, to be sensible to the fact, that the objects, designated by universals or certain general terms, are not objects in the same sense as those, referred to by proper names. In the passage I quoted before, Carnap said that *quasi objects* would be something like helpful fictions and that their use would not be permissible under every circumstances whatsoever (cf. Carnap 1969, 49). In the example case of “Dogs are mammals” it is permissible to use these fictions however, since this sentence can easily be translated into (3) in which the quantifier ranges over individuals in the object domain.

Carnap’s view of quasi objects relates to the *second* aspect I want to talk about. I have already raised the question, how it is possible for Carnap to impose a type-theoretic hierarchy onto the constructional system. The answer lies in his concept of *constructional levels* and is within reach now. Carnap explains this concept as follows:

If, in a constructional system of any kind, we carry out a step-by-step construction of more and more object domains by proceeding from any set of basic objects by applying in any order the class and relation construction, then these domains, [...] of which each forms a domain of quasi objects relative to the preceding domain, are called *constructional levels*. [...] Here, the relativity of the concept ‘quasi object’, which holds for any object on any constructional level relative to the object on the preceding level, is especially obvious. (1969, 69-70)

Thus we can summarize the structure of a constructional system as follows:

We start with certain individuals, the so-called *basic elements* (Carnap 1969, 98). By defining, i.e. constructing a class of basic elements or a relation of any arity between basic elements, we reach a higher constructional level. In defining classes of classes or relations of relations of any arity between the basic elements of the system, the next higher constructional level is constructed and so on (cf. Carnap 1969, 68-69). Thus the resulting constructional system will have a hierarchical structure, similar to the hierarchy of types in type theoretic logic (cf. Carnap 1969, 51-54).

⁵ See (Carnap 1969, 49-50) for the original formulation of this example.

1.1.2 Explicit definitions and definitions in use

Now after clarifying the outlines of a constructional system I want to say a bit more about Carnap's understanding of definitions. Carnap distinguishes two types of definitions in the *Aufbau*. The first, and to some extent, the standard case would be the method of *explicit definition* (cf. Carnap 1969, 65); the second form is called *definition in use* (cf. Carnap 1969, 65-67). The same distinction between these two methods of definition is also mentioned in Carnap's logic textbook *Abriss der Logistik*⁶ (henceforth referred to as *Abriss*) which was his contribution to the *Schriften zur wissenschaftlichen Weltauffassung* which were edited by Moritz Schlick and Philipp Frank, as is well known both distinguished figures in the history of the Vienna Circle (cf. Stöltzner/Uebel 2006, XXVIII). In §§3d and 7b of the *Abriss* a discussion of the methods of explicit definition and definition in use can be found (cf. 1929, 7-8 and 15).

However, let us have a look at the *first* class of definitions, the explicit definitions. What is Carnap's understanding of the method of explicit definition? Carnap explains it as follows: „In the simpler case, a symbol can be introduced which is composed out of already known symbols (i.e., out of the basic symbols and other already defined ones) such that this symbol can always be put in the place of a new object symbol if this is to be eliminated.“ (1969, 65) An additional aspect of the method of explicit definition that I want to mention here is added in the *Abriss* where Carnap says: „Definitionen dienen nur zur Abkürzung, sind prinzipiell nicht notwendig“ (1929, 7).

So the method of explicit definition serves two different purposes. *First*, according to the general understanding an explicit definition is the introduction of a symbol into a language which is equivalent to some of the already introduced symbols in that language. As Alfred Ayer puts it in his *Language, Truth and Logic* (1936): „We define a symbol *explicitly* when we put forward another symbol, or symbolic expression which is synonymous with it.“ (1936, 66) Hence the function of an explicit definition is to provide the possibility of saying things differently but with the same meaning. As we have already seen Carnap understands sameness of meaning as preservation of truth-values. This is also the reason why Carnap thinks of explicit definitions as abbreviations. Since an explicitly defined term always preserves truth-values when substituted with its *definiendum*, the expressive power of the language does not increase by introducing new,

⁶ See (Carnap 1929)

explicitly defined terms. Therefore Carnap sees explicit definitions as helpful abbreviations, because they provide equivalent and perhaps simpler ways of saying things.

The *second* function of an explicit definition is more specifically linked to the project of the *Aufbau*. Carnap wants the constructional definitions to work in both directions. This means that it should be possible to *construct* a concept from the basic concept plus logical vocabulary as well as to *reduce* a concept (of a given complexity) to the basic concept plus logical vocabulary (cf. Carnap 1969, 6). Above that for Carnap the constructional definitions are meant to be interchangeable *salva veritate*. From this I conclude that the constructional definitions have to be explicit definitions since they have to satisfy the condition of interchangeability *salva veritate* and thereby enable the reduction of already defined concepts to the basic concept(s) plus logical vocabulary as well as the construction of concepts from the basic concept(s) plus logical vocabulary.

At the same time however, Carnap recognizes that for an important reason, the constructional definitions cannot be explicit definitions in the sense described above. The reason for this lies in the distinction between objects and quasi objects. The argument takes three steps: *First* we have to recall, that every constructional definition reaches a new constructional level (cf. Carnap 1969, 69-70). We have also learned, that a constructional level either has the form of a class extension, or of a relation extension (cf. Carnap 1969, 67-68). Both objects, class as well as relation extensions are quasi objects (cf. Carnap 1969, 57-60). As a consequence, a constructional definition always represents a quasi object. In Carnap's own words:

Hence, constructional levels are object spheres which are brought into a stratified order within the constructional system by constructing some of these objects on the basis of others. Here, the relativity of the concept 'quasi object', which holds for any object on any constructional level relative to the object on the preceding level, is especially obvious. (Carnap 1969, 70)

For my purpose the important aspect is not the relativity of the concept of a quasi object. It should be clear from the beginning, that every constructed concept must represent a quasi object, except the basic concept itself, since it is – at least for the time being – left undefined. Thus Carnap writes: „We shall proceed [...], by placing, not classes, but relation extensions, the *basic relations*, at the beginning of the constructional system. These, and not the basic elements, form the undefined basic objects (basic concepts) of the system, and all other objects of the system are constructed from them.“ (Carnap 1969, 98) Because of this there is a second condition that

constructional definitions would have to satisfy in addition to being interchangeable *salva veritate*. The definitions, or better the defined concepts have to represent quasi objects in order to count as constructional definitions. Only then does the construction reach a new constructional level. Now Carnap argues that no explicit definition in the sense described above can satisfy this requirement. This is because in an explicit definition:

[T]he new symbol is declared to have the same meaning as the compound one. In this case, the new object is not a quasi object relative to certain of the older objects, since what it is can be explicitly indicated. Thus, it remains within one of the already formed object spheres (Carnap 1969, 65).

Therefore it seems as if two conflicting requirements, which could not possibly be satisfied at the same time, would come together here. Although ordinary explicit definitions satisfy the first condition of being interchangeable *salva veritate*, they cannot satisfy the second condition of representing quasi objects. That means, that it is impossible to reach a new constructional level by means of an explicit definition. Hence there must be an alternative method of definition, one that guarantees interchangeability as well as ascension to a new constructional level.

Fortunately Carnap finds a method of definition, suitable to satisfy these two requirements. So I now come to the *second* class of definitions used in the *Aufbau*, the so-called *definitions in use*. Let us sum up the problem Carnap was facing. He writes:

If no explicit definition is possible for an object, then its object name, given in isolation, does not designate anything in the manner of already constructed objects; in this case, we are confronted with a quasi object relative to the already constructed objects. However, if an object is to be called ‘constructed on the basis of the previous objects,’ then it must nevertheless be possible to transform the propositions about it into propositions in which only the previous objects occur, even though there is no symbol for this object which is composed of the symbols of the already constructed objects. (Carnap 1969, 65-66)

This passage most clearly describes the dilemma above. A constructional definition does represent a quasi object. In this sense it cannot be an explicit definition. At the same time, it must be possible to eliminate the symbol for a particular quasi object in any sentence in which it could occur, leaving its truth-value constant. Carnap’s way out of this difficulty is provided by the method of definition in use. Briefly put, Carnap understands definitions in use as the introduction of a “translation rule”, rather than of a new, synonymous symbol (cf. 1969, 66). In his own

words:

Thus we must have a translation rule which generally determines the transformation operation for the statement form in which the new object name is to occur. In contrast to an explicit definition, such an introduction of a new symbol is called a *definition in use* (*definitio in usu*), since it does not explain the new symbol itself – which, after all, does not have any meaning by itself – but only its use in complete sentences. (Carnap 1969, 66)

The new symbol does not have any meaning by itself, because it represents of course a quasi object, which will become clear in the following.

Perhaps the best way to understand these two kinds of definitions is to look at examples. Carnap is giving one for both methods of definition in the *Aufbau*. The example for an explicit definition reads as follows: “If the number 1 and the operation + are known, then the other numbers can be defined explicitly: ‘ $2 =_{df} 1+1$ ’, ‘ $3 =_{df} 2+1$ ’ etc.” (Carnap 1969, 66) Here we have a kind of standard case for an explicit definition. The newly introduced symbols are synonymous with the old, i.e. already defined symbols. The definitions satisfy the condition of being interchangeable *salva veritate* in any sentence in which they can occur. Therefore the sentence “ $2+3 = 5$ ” has the same truth-value as the sentence “ $(1+1)+((1+1)+1) = 5$ ”. We also see, why the method cannot suffice for providing constructional definitions. This is because the new defined terms, or concepts do not stand on any other constructional level than do the old concepts, out of which they are composed. But if this is not the case, then construction cannot take place.

I will quote Carnap’s example for a definition in use in full, because it already gives us a precise understanding of the need and the purpose of this method of definition in the *Aufbau*.

Let us assume that the concepts of a natural number and of multiplication are known. The concept of *prime number* is to be introduced. The expression “prime number” cannot be defined explicitly in the way in which we have previously defined the symbols “2” and “3”. Thus it might seem as if a definition of the following form would be permissible: “prime numbers $=_{df}$ those numbers which ...” or “A prime number $=_{df}$ a number which ...” But a definition of this form only appears explicit; this depiction is brought about by the linguistic forms which make it appear as if such expressions as “the prime numbers” or “a prime number” designate objects, since they use such expressions as subjects in sentences. Expressions such as “those which ...” or “a ...” are already (very useful) abbreviations for *definitions in use*; they correspond to the class symbols of logic. The prime number concept is not a proper object relative to the numbers 1, 2, 3, ... Thus it can be defined only in use by indicating which meaning a sentence of the form “*a* is a prime number” is to have, where

a is a number. This meaning must be indicated by giving a propositional function which means the same as the propositional function “ x is a prime number,” and contains nothing but already known symbols, and which could thus serve as a translation rule for sentences of the form “ n is a prime number”. Thus we could define: “ x is a prime number” $=_{df}$ “ x is a natural number and has only 1 and x as divisors.” (Carnap 1969, 66-67)

I think this passage explains most clearly why the method of definition in use is needed in a constructional system. In the example above Carnap is claiming, that a definition of the form “prime numbers $=_{df}$ those numbers which...” is not permissible. The reason for this is connected to the idea of *quasi objects* and brings us right to the point, of the foregoing section. The difficulty with a definition of the concept of prime number by means of an apparently explicit definition is, that the definiendum is not an object but a quasi object. This is the reason why Carnap speaks of the concept of prime numbers as “not a proper object relative to the numbers 1, 2, 3, ...” (1969, 67). Therefore there cannot be an explicit definition of this concept in the sense described above, but just a, as Carnap says “translation rule” (1969, 67). But how are these to look like? As Carnap explains:

In order for a translation rule to be applicable to all sentences of a certain sentence form, it must refer to propositional functions. It must equate with on another the expressions for two propositional functions, one of which contains the new object name, while the other contains only old ones, and both of which must contain the same variables. (1969, 66)

This is exactly what Carnap does in the example above where the propositional function “ x is a prime number” is identified with the propositional function “ x is a natural number and has only 1 and x as divisors” (cf. Carnap 1969, 67). Hence the concept of prime number is defined by a definition in use. From this, Carnap draws a general conclusion: “*Thus, the ascension to a new constructional level takes place always through a definition in use.*” (1969, 67)

Of course one may ask the question, why Carnap is not relying on the method of implicit definition instead. The answer lies in Carnap’s logicism, as Alan Richardson made clear in a detailed and very illuminating discussion (cf. 1998, 40-47). Richardson concludes on the matter:

So what Carnap needs in his constitutional system for empirical concepts is a method of definition which is formally sufficient for a step-by-step constitution of the entire system of scientific concepts, but one which is superior to implicit definition in that it maintains connection between the defined concepts and empirical reality – or, more precisely, that allows for synthetic, empirical

knowledge. (Richardson 1998, 46)

I will not go into further detail here but just leave the issue at that. In the following section I will be concerned with the specific form, these definitions in use ought to have.

Maybe A.J. Ayers view on this method of definition is the perfect connecting passage to that section:

We define a symbol *in use*, not by saying that it is synonymous with some other symbol, but by showing how the sentences in which it significantly occurs can be translated into equivalent sentences, which contain neither the *definiendum* itself, nor any of its synonyms. A good illustration of this process is provided by Bertrand Russell's so-called theory of definite descriptions (Ayer 1936, 68).

1.1.3 Structural definite descriptions

I will now come to the most important concept in Carnap's *Aufbau*, with regard to my thesis. So far we have seen how Carnap intends a constructional system to look like and how the particular constructional definitions are to be understood, namely as definitions in use. The next important concept I want to discuss is the concept of structure and Carnap's understanding of it in the *Aufbau*. This will lead us to his conception of science as a system of so-called "structural definite descriptions", which will be an important aspect for the examination of the Newman-problem in connection with the *Aufbau* (cf. Carnap 1969, 27).

Carnap introduces the structure concept at a very early stage in the *Aufbau* in §§10-16 which is also an indication for its central theoretical importance in construction theory altogether (cf. Carnap 1969, 19-30). So what purpose does this concept serve?

Carnap uses the concept of structure, to develop a specific method of picking out certain individual objects, which are part of a larger structure or collection of objects. Thus Carnap writes: "In order to develop the concept of a structure, which is fundamental for construction theory, we make a distinction between two types of description of the objects of any domain; these we call property description and relation description." (1969, 19) It is no difficulty to follow Carnap's line of thought here. For the distinction between a *property description* and a *relation description* rests on the simple idea, that there are two possible ways of describing a specific

object. Imagine the following example⁷: Two persons are involved. They are confronted with a collection of arbitrarily chosen objects. The task is to identify individual objects in this collection without the use of ostension or of simply naming the object. One person identifies objects; the other person has to check, whether she can pick the same object, by simply looking at the description the first person has given. Now the use of a property description in this example would just mean to describe and characterise the object(s) in that collection by their single properties they instantiate. In this case the first person would end up with a list of properties, each assigned to a certain object in the collection. The second person, if equipped with this list, should be able to pick out the same object(s) as the first person, just by looking for the (simultaneous) instantiation of the relevant properties.⁸ Now although I have used the plural here, since it is possible that two distinct objects share the same properties, it is clear, that the property description is primarily a description of a single object. In Carnap's words: "*A property description indicates the properties which the individual objects of a given domain have*" (1969, 19). However, Carnap also maintains, that property descriptions display a certain weakness. Thus he says: "We place such strong emphasis upon the difference between these two types of description because we shall maintain that they are not of equal value." (1969, 20) In order to understand this argument, we have to get clear about the nature of relation descriptions, as Carnap understands it. To explain this, I will come back to the example I already used before. The person, who compiles the list with the descriptions of some of the objects, is now only allowed to use relation descriptions. In this case, this person would not describe individual objects but the relations an individual object has to other objects. Again by compiling these relation descriptions in a list, the second person should be able to choose the right objects on the basis of such a description. This is how Carnap puts it: "[A] *relation description* indicates the relations which hold between these objects, but does not make any assertion about the objects as individuals." (1969, 19) It therefore seems, that these two methods of description are complementary. While the first one only says something about individual objects, but not about their relation to other objects, the second one only talks about relations between objects, leaving

⁷ This example, on which I will rely throughout this section, has some similarity to the example Carnap gives as an illustration for the method of *proper analysis* in contradistinction to the method of *quasi analysis* in §70 of the *Aufbau* (cf. Carnap 1969, 112-113). However this similarity is only accidental. I do not want to draw an analogy between these two cases.

⁸ Carnap's own example for a property description can be found in (1969, 20).

out any information about the properties of individual objects. But despite this alleged complementarity, Carnap does not think of these two methods of description as of equal value, as we have already heard before. Why is this the case? Carnap tells us:

Relation descriptions form the starting-point of the whole constructional system and hence constitute the basis of unified science. Furthermore it is the goal of each scientific theory to become, as far as its content is concerned, a pure relation description. [...] In science, any property description either plays the role of a relation description except that it is in more convenient form, or else, if transformation is not yet possible, it indicates the provisional character of the theory in question. (1969, 20)

I think the first thing to mention here is, that it becomes not entirely clear whether Carnap thinks that relation descriptions actually do form the basis of scientific practice or if they just *should* do so. In other words, the question is, whether Carnap's statement about the role of relation descriptions in science should be understood as a descriptive or as a normative assertion. Maybe one could reasonably argue that it is both. Relation descriptions are actually and successfully used in science therefore they should be used. Carnap gives an example for the two methods of description in context of physics that perhaps can clarify this question:

In physics, we apparently have a property description when the color names ("blue", "red", etc.) are used. In present-day physics, descriptions of this kind are nothing but abbreviations, since they presuppose wave theory and since the color names can be translated into expressions of this theory (i.e., rates of oscillation). However, formerly, these property descriptions revealed the incomplete character of the theory of light, since they were not transformable into relation descriptions. (Carnap 1969, 21)

This passage explains very clearly how Carnap thinks that relation descriptions work. His view seems to be, that progress in science leads to the ever more advancing replacement of property descriptions for relation descriptions in our scientific theories such that it would be possible to describe an entire field of empirical reality by means of relation descriptions alone. The use of proper names in this view, would just serve as convenient abbreviation, but would actually be omitted if possible.

But this is just the first step to Carnap's conception of structural definite description in the *Aufbau* however. For now, after distinguishing property and relation descriptions, Carnap makes

a further division within the class of relation descriptions: “There is a certain type of relation description which we shall call *structure description*.” (1969, 21)

In order to get a clear grasp of this type of description, we first have to get clear about the term “structure” in this context. For Carnap the introduction of a relation description was a step towards a more abstract treatment of the objects in question, compared to a property description. Now, with the help of the concept of structure, Carnap intends to go even one step further in this direction. Thus he writes:

Unlike relation descriptions, these [the structure descriptions, R.F.] not only leave the properties of the individual elements of the range unmentioned, they do not even specify the relations themselves which hold between these elements. In a structure description, only the *structure* of the relation is indicated, i.e., the totality of its formal properties. (Carnap 1969, 21)

This passage in turn raises the question, of what is meant by the term, *formal properties*? We already know that Carnap is making substantial use of the logic of the theory of types in the *Aufbau*; therefore it is plausible to assume that he is considering such properties that are representable in a formal-logical system (cf. Carnap 1969, 21). In Carnap’s own words:

The formal properties of relations can be defined exclusively with the aid of logistic symbols, i.e., ultimately with the aid of the few fundamental symbols which form the basis of logistics (symbolic logic). (Thus these symbols do not specifically belong to the theory of relations, but form the basis for the entire system of logic [...].) (1969, 21)

In other words, Carnap understands formal properties as those properties, which can be described by logical vocabulary alone.

The next step in Carnap’s explanation of structural definite descriptions is the concept of *sameness of structure*. Carnap is giving a criterion for sameness of structure in terms of topology, i.e. with the aid of an arrow diagram such that: “If two relations have the same arrow diagram, then they are called *structurally equivalent*, or *isomorphic*.” (Carnap 1969, 22) Consequently Carnap adds: “If two relations have the same structure, then they are equivalent in all formal properties.” (1969, 22) Now equipped with this concept of structure as the formal properties of relations, Carnap’s idea is, to develop a system of descriptions, which relies solely on structural, i.e. formal features of the relations between the objects in a given domain, such that it should be possible to pick out any object in the domain solely by a structural definite description of that

object, without any use of ostension whatsoever. Carnap calls this type of description *structural definite description* (cf. Carnap 1969, 27-30). Transferred to the example discussed above that would mean that the first person in our game is writing down structural definite descriptions of some of the objects in a given collection. The second person, equipped with a list of these descriptions should then be able to pick out the same objects by just looking at the descriptions at the list. But what would such a description actually look like? Carnap is thinking of two possible ways to depict the structure of a relation in the *Aufbau*, namely the “arrow diagram” (1969, 22) and the “listing of all pairs for which the given relation holds” (1969, 22). The *first* one would be a graph of the relation(s) in question. It is clear as Carnap says, that the drawing of a graph is: “possible only if the number of members is finite.” (1969, 23) An example of such a structure description would be the following diagram:

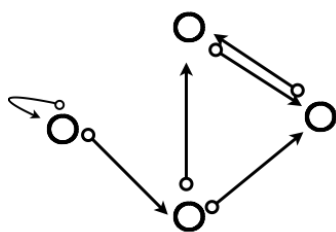


Figure 1.1.3.1

Here we have a collection of objects, designated by the symbol “●” and a description of the relations between these in terms of purely structural features. In this case we have a symmetric relation, indicated by the double arrow, an asymmetric relation, indicated by the common arrow and a reflexive relation, indicated by the arrow which points to its origin.

The second method of setting up a structural definite description would simply be to make a list of the related objects, i.e. to make a list of the extension of the relations in question (cf. Carnap 1969, 22). This would simply mean to write down the set of n-tuples of a given structure, which consists of certain relations (cf. Richardson 1998, 47). As Carnap explains:

For example, one can number the members arbitrarily and only for the purpose of producing the list. Such a list can be inferred from the diagram, i.e., it contains no more than the diagram; conversely, the list of pairs allows us to construct the diagram. Thus, the list of pairs, as well as the arrow diagram, gives the *complete* structure description. (Carnap 1969, 22)

Now let us apply this method to our example. I arbitrarily name the objects in figure 1.1.3.1 A, B,

C and D. I say that the set, consisting of these elements is exemplifying structure S . Now I can use the relations represented by the arrows in the graph, to write down the set of n-tuples this structure consists of. Thus we get:

$$S = \{(A, C); (C, A); (B, B); (B, D); (D, A); (D, C)\} \quad (4)$$

As Carnap said in the passage cited above, I can now use this list of n-tuples to draw a graph of structure S , which would look like this:

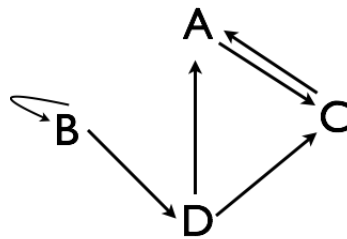


Figure 1.1.3.2

Carnap himself is giving the famous example of a map of the Eurasian railroad network in the *Aufbau* (cf. 1969, 25-27).⁹ I will not go into further detail here however, since the example I have given, should already suffice in explaining Carnap's conception of a structural description. Of course Carnap is envisaging a use of this method of description for science. In fact, he presents an argument according to which science has to rely on this method of description in the end. "[A] definite description through pure structure statements is generally possible to the extent in which scientific discrimination is possible at all; such a description is unsuccessful for two objects only if these objects are not distinguishable at all by scientific methods." (Carnap 1969, 27) The reason lies in a rigorous demand for objectivity: "For science wants to speak about what is objective, and whatever does not belong to the structure but to the material (i.e., anything that can be pointed out in a concrete ostensive definition) is, in the final analysis, subjective." (Carnap 1969, 29)

So for Carnap the aim of any objective, rational science must be, to get rid of any of its ostensive and subjective content and to become a system of structural definite descriptions in the end. The following passage is indicative for this reading of Carnap: "One can easily see that physics is

⁹ Alan Richardson is giving a modified version of this example in (1998, 47-49).

almost altogether desubjectivized, since almost all physical concepts have been transformed into purely structural concepts.” (Carnap 1929, 29) However there may be alternative readings of this passage of the *Aufbau*, e.g. van Fraassen (2008) is interpreting Carnap here as giving a transcendental argument, i.e. an argument concerning the conditions of the possibility of science (cf. 2008, 227). I will come back to that later however.¹⁰

For now I want to dwell on a further aspect of Carnap’s method of structural definite descriptions. So far we have seen how this method of description works in a very simple case, involving only four different objects and three distinct relations between these. We do not yet know, how the uniqueness of the structural definite descriptions is achieved in a much more complex collection of objects. As Alan Richardson puts it:

Carnap is faced with the problem of specifying all the concepts of science purely structurally. But it is clear, that relations considered in isolation can share structure. Thus, a simple structuralist account would not be able to distinguish, for example, any two equivalence relations defined over domains of the same cardinality when these relations are considered in isolation. (1998, 49)

The solution to this problem is deeply connected with the idea of a unified science. (cf. Richardson 1998, 50; cf. Friedman 1999, 97-98).¹¹ If *all* concepts of science are part of the type-theoretic structure of a constructional system, then it is possible to uniquely define them on the basis of a structural definite description “through their differing formal ‘places’ within this all encompassing global structure” (Friedman 1999, 97). Richardson gives the following explanation: “Thus, Carnap exploits the idea that relations over objects at some type level are themselves individuals in the domain of other relations of higher type to achieve the rich structure of relations needed to achieve a constitutional system for total science.” (1998, 50) It should be clear by now, how the system of structural definite descriptions is supposed to work according to Carnap.

However there is still a problem left as Richardson is pointing out, referring to Carnap’s example of the Eurasian railroad network:

[T]he example does not yet show how elimination of essential reference to particular relations is possible – doing that would require that the entire constitutional system already be in place – it does

¹⁰ See section 2.2.3 for a more detailed discussion of van Fraassen’s view on Carnap’s *Aufbau*.

¹¹ For more on Carnap’s views on the unity of science in the *Aufbau* see Pincock (2003).

show how the constitutional system can proceed given that it has gotten started. (Richardson 1998, 50)

This remark guides us straight into the following chapter, which will be concerned with the problem of eliminating the basic concept in a constructional system.

1.2 The elimination of the basic relation

1.2.1 Substitution of the basic concept

Before we can have a look at the Newman-problem we have to become familiar with §§ 153-155 of the *Aufbau*, in which Carnap discusses the problem of the elimination of the basic relation (Carnap 1969, 234-238). It is in these sections, that Carnap encounters the Newman-problem (cf. Demopoulos/Friedman 1985, 635-638; van Fraassen 2008, 227-228).¹² Before going into detail, I want to bring to mind, at which particular stage of the process of establishing a constructional system we would stand now if we would have worked all our way through the *Aufbau*. In order to understand the problem, we have to assume for the moment that we have just completed a system of structural definite descriptions, i.e. of constructional definitions exactly as instructed by Carnap. We would have started from a primitive, i.e. undefined basic concept of *recollection of similarity* R_s , which is a binary relation (1969, 178-179). From this basis we would have made our way through the realm of the autopsychological objects to the physical objects and finally from then on to the heteropsychological and cultural objects (Carnap 1969, 175-234). As a consequence we would have carried out a reduction of all concepts of science to one binary relation, the basic relation R_s . It might seem then that we would have achieved the central aim of the *Aufbau* and that our task would be finished und successfully concluded. Unfortunately however, now another issue arises for Carnap, which will be central in what follows. Carnap cannot be satisfied with the outcome of the constructional system at this stage. This is for the following reason:

¹² See also Pincock (2007).

All statements which occur in the constructional system are statements about nothing but the basic relations. [...] However, this characteristic of the statements of a constructional system is not in harmony with the earlier thesis that statements of science are purely structural statements or that, in principle, it is possible to transform them into such statements [...]. A purely structural statement must contain only logical symbols; in it must occur no undefined basic concepts from any empirical domain. Thus, after the constructional system has carried the formalization of scientific statements to the point where they are merely statements about a few (perhaps only one) basic relations, the problem arises whether it is possible to complete this formalization by *eliminating from the statements of science these basic relations* as the last, nonlogical objects. (Carnap 1969, 234-235)

This is the problem of the elimination of the basic relation. At first sight it might seem that this problem is superfluous. After all one may ask, why a primitive concept at the bottom of the system should present a problem at all. We just have to take a look at Carnap's conception of the axiomatic method, described in the *Abriss*, to see this. In the section about concepts he writes: "Gewisse Begriffe, die ‚Grundbegriffe‘, werden undefiniert an den Anfang gestellt. Alle weiteren Begriffe werden als ‚abgeleitete Begriffe‘ in schrittweisem Fortgang (‚Kettendefinitionen‘) aus diesen Grundbegriffen definiert." (Carnap 1929, 70) There seems to be no difference to the conception of the *Aufbau*. But why then worry about the elimination of the primitive basic concept? After all what Carnap has achieved is nothing less than the reduction of *all* concepts of *any science* to one basic relation. Above that Carnap is making a similar remark in the *Aufbau*:

A theory is *axiomatized* when all statements of the theory are arranged in the form of a deductive system whose basis is formed by the axioms, and when all concepts of the theory are arranged in the form of a constructional system whose basis is formed by the fundamental concepts. (1969, 7)

So for Carnap the constructional system is an essential part of an axiomatic system.

However the problem is that the original thesis of construction theory simply commits Carnap to a complete formalisation (cf. Carnap 1969, 235). In §16 of the *Aufbau* Carnap makes the following, crucial remark:

The series of experiences is different for each subject. If we want to achieve, in spite of this, agreement in the names for the entities which are constructed on the basis of these experiences, then this cannot be done by reference to the completely divergent content, but only through the formal description of the structure of these entities. [...] Let it suffice for the moment to say that, *for science, it is possible and at the same time necessary to restrict itself to structure statements*. (1969,

What do we get from this passage? I think the consequence is that the constructional definitions, which have been set up in the system, can only serve their purpose if it can be shown, that all properties which they have, also belong to the basic concept(s) from which they are initially constructed. According to Carnap, constructional definitions are objective (cf. 1969, 29) and they are completely independent of any ostensive content (cf. 1969, 27). Therefore, these properties must be instantiated by the basic concept too. Hence, Carnap is forced to give a constructional definition of the basic relation in the *Aufbau* (cf. 1969, 235). This problem is also made clear in Friedman (1999):

Yet the basic relation R_s is so far itself undefined: it is simply introduced as a nonlogical primitive [...]. But the ultimate goal of construction theory still eludes us, for the scientific objectivity of the basic relation R_s has itself not yet been shown. Moreover, since all other concepts have been reduced to R_s , all we have really shown so far is that they are objective if it is. In other words, Carnap's programme requires a *complete* formalization of all concepts of science, and we have achieved so far merely a partial (albeit still very impressive) formalization. (Friedman 1999, 101)

We see that Friedman draws the same conclusion from the relevant passages in the *Aufbau*, although phrased in different terms. But what becomes obvious is, that Carnap has set the aim in the *Aufbau* such, that it is not just a matter of convenience that the basic relation itself should also be defined, i.e. eliminated, but that this definition is necessary in the strictest sense, since the coherence of the whole construction system hinges on it. Alan Richardson holds a similar position:

Despite having finished his outline of the constitutional system on this high note, Carnap raises one final worry. The constitution of the intersubjective world does not fulfil the project of giving purely structural definite descriptions (PSDDs). Thus, [...] Carnap [...] asks whether it is not possible to finish the dematerialization of science by structurally defining the recollection of similarity relation (R_s) itself. (1998, 87)

However there are also alternative readings of this passage in the *Aufbau*. Against the view of the necessity of the elimination of the basic relation argues the so-called “reserved reading” by Christopher Pincock presented in Pincock (2005). Pincock is developing something like a naturalistic reading of the *Aufbau*, which wants to treat construction theory as an “empirical

scientific discipline.” (Pincock 2005, 518, 539) As Pincock says: “On this reading, it is a mistake for Carnap to try to wholly eliminate primitive relations from his construction systems” (2005, 539). The failure lies in the extension of the constraint of giving structural definite description from single constructional definitions – for which this constraint is of course mandatory – to the whole constructional system. Thus Pincock writes:

However, in §§153-155 we see Carnap transforming this constraint on constructions within a single construction system into a test on the adequacy of the construction system itself. What is the motivation for this test if it is not some prior, philosophical conception of objectivity? I cannot find any motivation consistent with Carnap’s avowed neutrality. This forces me to reject the proposed elimination of *Rs* in §§153-155 as misguided. (2005, 539)

I will follow the reading of Friedman and Richardson on this thesis however, since I believe that their interpretation accords much better with the textual evidence in the *Aufbau* in this particular instance than does Pincock’s reserved reading. However one may grant his point that the argument for the necessity of the elimination of the basic relation hinges on a “prior, philosophical conception of objectivity” (2005, 539). But as we have seen, this accords very well with what Carnap says himself. Hence I do not see how this can be turned into an argument against Carnap’s position. This is also indicated when Pincock himself says that he takes “some consolation in the fact that Carnap tells us that these sections ‘may be omitted’”, which I think does not count as serious argument (2005, 539).

Anyway, the situation we are confronted with is the following: We have a system of definitions, in which every definitional formula satisfies the conditions C_1 and C_2 .¹³ Now as a result of the previous discussion, we have to add a third condition to make the constructional system coherent. Hence I introduce condition:

C₃) The basic concept of a constructional system can be defined such that its definitional formula contains only logical vocabulary (cf. Carnap 1969, 235).

This is what Carnap means by an “elimination of the basic relation” (cf. Carnap 1969, 235). So far we have gathered a clear understanding of why this elimination is necessary. The next question consequently must be, how this definition or elimination of the basic concept is possible

¹³ See section 1.1.1 for a definition of these conditions.

and how it is actually to be carried out. Carnap's line of thought on this matter runs as follows:

Given a constructional system which proceeds from certain basic relations, there is a possibility that this system can also be formulated with a different set of basic relations. (Carnap 1969, 235)

I think that this is intuitively plausible. Roughly, the constructional definitions are of the form¹⁴

$$X =_{df} (...bc...) \quad (5)$$

where bc is the sign for the basic concept, which is the only non-logical sign in (5). Now Carnap's thought is, that there must be an alternative way of defining the object X , which does not rely on bc but on another basic concept, say bc' . Our initial definition (5) then becomes:

$$X =_{df} (...bc'...) \quad (6)$$

But now the question arises, whether (5) and (6) actually are equivalent. To be really functioning as alternative ways of defining the same object, (5) and (6) actually must have the same meaning, i.e. the same extension. But if (5) and (6) have the same meaning, it follows that bc and bc' must have the same meaning or the same extension as well, which would mean that bc and bc' actually are identical. Carnap is aware of this problem. After stating that it is in principle possible, to formulate the constructional definitions with a different set of basic concepts, Carnap goes on:

But then the construction of each object would have to be formulated in a different way. Assume that we were to try to transform the previous constructional definitions by simply substituting the new basic relations for the old ones; (Carnap 1969, 235)

Which is exactly what I have done in the example of the definitions (5) and (6) above, where bc was replaced by bc' . Now what is going to happen? Carnap tells us:

[I]t would then indeed be possible for the lower levels that the thus transformed definitions are not meaningless or empty. But for a reasonably high level, the probability of such an accident is extremely small. It is still less likely that the empirical statements of the constructional system about constructed objects would accidentally continue to hold even after the transformation. (Carnap

¹⁴ As an example for a constructional definition where this is obvious see the definition of the set of basic elements (cf. Carnap 1969, 179). Of course the actual definitions, especially of the higher levels are much more complex than that (cf. 1969, 187).

1969, 235)

So what do we learn from the last two passages? I think that Carnap shows as two options here, for the substitution of the basic concept of a particular construction system:

- α) Substitution has to be followed by a reformulation of the constructional definitions of the entire constructional system (cf. Carnap 1969, 235).
- β) The symbol for the old basic concept is just replaced with the symbol for the new basic concept (cf. Carnap 1969, 235).

I think the first option simply boils down to the well-known point that according to Carnap there is in principle a plurality of different possible construction systems, differing in their choice of the basis, which again is divided in the choice of a set of basic elements and of one (or some) basic concept(s) (cf. Carnap 1969, 98). Hence (α) is not of any interest to us since the question we try to answer is, whether it is possible to substitute the symbol for the basic relation without an entire reformulation of the whole constructional system (cf. Carnap 1969, 235). So what is the consequence if we choose (β)? According to Carnap, the consequences would not at all be good, as we have already seen. It is not just, that we cannot be sure whether our two definitions (5) and (6) actually are equivalent, it is not even sure that (6) is not altogether “meaningless” or “empty” at all (cf. 1969, 235). This becomes even more likely, the more the complexity of the constructional definition increases, where the complexity is here identical with the construction level at which the particular definition takes place (cf. 1969, 235). Finally Carnap also mentions, that it is very unlikely, that the thus transformed constructional definition would satisfy the “empirical statements” of the constructional system (cf. 1969, 235).

Now this last point is of particular importance, because we will see that it also provides Carnap with a solution to the problem of eliminating the basic relation. But before going further in this direction, I want to briefly sketch Carnap’s understanding of the “empirical statements” of a constructional system, which will be necessary to understand the argument in section 1.2.3.

1.2.2 On empirical theorems of a constructional system

A constructional system is not just a system of definitions. According to Carnap, it also contains statements or theorems, which can be understood as propositions about the objects, which are constructed in the system (cf. Carnap 1969, 176). Carnap explains the nature of the statements of a constructional system as follows:

The statements or theorems of a constructional system are divided into two different types [...]. The first type of theorem can be deduced from the definitions alone (presupposing the axioms of logic, without which no deduction is possible at all). These we will call *analytic* theorems. The second type of theorem, on the other hand, indicates the relations between constructed objects which can be ascertained only through experience. We call them *empirical* theorems. If an analytic theorem is transformed into a statement about the basic relation(s), a tautology results; if an empirical theorem is thus transformed, it indicates empirical, formal properties of the basic relation(s). [...] [T]he empirical theorems express an empirically ascertained state of affairs. (1969, 176)

I said before, that Carnap finds a solution to the problem of eliminating the basic relation here. How is this solution going to look like? What we have learned about a constructional definition from the above quoted passage is the fact, that it contains not only analytical but also empirical statements. Whereas the fact that some conclusions about the formal properties of the constructional definitions are entailed by a constructional system is unproblematic, or so I think, one might be sceptical when it comes to the empirical statements of the system. Especially Carnap's formulation, that an empirical statement indicates "*empirical, formal* properties of the basic relation(s)" (1969, 176, my emphasis) might at first glance seem like a contradicting concept. Maybe looking at an example might be helpful here.

The first and simplest form of an empirical statement of the constructional system of the *Aufbau* is a statement about the basic relation:

Theorem: Th. 1 $R_s \in as$ (empirical)

Paraphrase: R_s is asymmetrical (Carnap 1969, 179).

Now what does that mean? Why is the asymmetry of R_s an empirical consequence of the constructional system rather than, say, a mere instance of stipulation? After all, we know from the beginning that this relation is asymmetric. It is not at all clear, how this should be an instance

of an empirical discovery. The basic relation of the constructional system of the Aufbau is introduced as “Recollection of similarity” (Carnap 1969, 178). Carnap explains this relation as follows: “ x and y are elementary experiences, where a recollected representation of x is compared with y and found to be part similar to it” (Carnap 1969 178). But why should the statement, that R_s is asymmetric be empirical? As I understand it, nothing in the explanation of the meaning of R_s explains, why the formal property of this relation should be an empirical fact of the matter. Perhaps this question can be resolved if one thinks of the process of formulating constructional definitions, as actually applying the relation R_s on a set of basic elements. Something similar to this thought is already indicated when Carnap translates the constructional definitions into the *language of fictitious constructive operations* (cf. Carnap 1969, 153, 159-162). In the language of fictitious constructive operations, “the construction is envisaged as a rule for a constructive operation. Its main purpose is to facilitate the intuitive recognition of the *formal* correctness of the construction” (1969, 153). The idea is “to make the assumption that a certain subject A is to be given operational rules as to how objects are to be formed from the given.” (1969, 159) In this line of reasoning, it would simply be a matter of empirical findings that:

$$\forall x \forall y R_s xy \rightarrow \neg R_s yx \quad (7)$$

where the quantifiers range over the set of basic elements. What sentence (7) tells us is that the relation R_s is asymmetric. The situation described in the language of fictitious constructive operations:

The only material which A has for synthesis is the *basic relation list*, the inventory list of R_s . This list contains pairs of terms of the relation extension, each argument designated by an arbitrary but determinate token (number) [...]. Without knowing this sense [of the basic relation, R.F.], A can ascertain, from his basic relation list (i.e., empirically), the theorem Th. 1 (Carnap 1969 179).

It follows that the existence of empirical theorems in a constructional system could be indeed connected to the language of fictitious constructive operations. After all, the empirical finding of the asymmetry of R_s seems to presuppose the fiction of a basic relation list or so one could argue. According to this interpretation it is not at all clear how to arrive at a statement about the formal nature of R_s without such a list, since, even if it is an empirical theorem, it has to be derived from *something*. Above that, in the passage cited above, Carnap explicitly claims, that the conclusion,

leading to Theorem 1, is an empirical consequence of the investigation of the list all *Rs*-pairs given to A.

On the other hand it seems unlikely to be true, that the existence of empirical theorems in a constructional system is just a consequence of the language of fictitious constructive operations, because Carnap says that its “purpose is purely didactic, namely, to provide illustrations” (Carnap 1969, 157). Another reason why the statement about the asymmetry of *Rs* is empirical could simply be, that it can’t be an analytic consequence, since *Rs* is, as basic concept undefined. Hence, there cannot be any analytic consequences from its definition. Carnap seems to suggest, that statements that follow from the constructional system have to be either analytic or empirical (1969, 176). If they cannot be analytic, then they must be empirical instead. This may be a justified line of reasoning when it comes to an explanation of the empirical theorems. Since they cannot be analytic, they have to be empirical, *tertium non datur*. I will leave it at that for the moment.

The particular constructional system developed in the *Aufbau* contains only three empirical statements. Besides the asymmetry of *Rs* these are the two-dimensionality of the visual field, which is theorem 5 (cf. Carnap 1969, 186) and the three-dimensionality of the colour solid, which is theorem 6 (cf. 1969, 186). The last one will be of particular importance for what follows. In the *Aufbau* it reads as follows:

Theorem: Th. 6. 3 Dnhomvic Proxcol (empirical)

Paraphrase: The order of the colors on the basis of Proxcol has the homogeneous dimension number 3; that is to say, *the color solid is three dimensional*. (Carnap 1969, 186)

This theorem follows from the constructional definitions of the color-concept and of the concept of “proximate colors” (cf. 1969, 186). Since it is an empirical theorem, it is not possible to derive it logically from these definitions; as we have seen, this follows from Carnap’s definition of empirical theorems in contradistinction to analytic statements of a constructional system (1969, 176). Above that a subject equipped with the inventory list of Proxcol would find out empirically that the *color solid* is three-dimensional¹⁵, just by looking at the particular relations on this list. Carnap does not explicitly discuss this possibility for theorem 6 in the *Aufbau* but for theorem 5, which states that “*the visual field is two dimensional*.” (Carnap 196, 185) The corresponding

¹⁵ For an explanation of the concept of dimension see (Carnap 1929, 77-78).

construction from which theorem 5 is derived, is the definition of the concept of “proximate places” which is designated by “Proxpl” (cf. 1969, 185). Here Carnap adds the following illuminating explanation:

On the basis of the inventory list of Proxpl which A has produced, he can determine the dimension number of the Proxpl-order (this possibility shows very clearly that the dimension number is not a spatial property, but a property which belongs solely to the theory of relations, and that it is defined in a purely extensional way). In this way, A finds empirically that this dimension number equals 2. (1969, 185)

This passage explains that there is an intimate connection between these two statements. Carnap says: “In general, there is a certain analogy between the division of visual quality classes into places and their division into colors” (1969, 186). Therefore, we can assume, that the constructive operation, performed by subject A will be the same in both cases and hence, that the theorem of the three-dimensionality of the *color solid* is thus empirically established as well as the theorem about the two-dimensionality of the visual field. As we can see, Carnap draws the following conclusion: “The three dimensionality of the color solid can be expressed analogously to the two dimensionality of the visual field as a *formal* property of Proxcol” (Carnap 1969, 144, my emphasis, R.F.). Hence our assumption above was justified, for now we see that the theorems 5 and 6 are empirical in that they cannot be derived logically from the constructional definitions but can be “read of” the respective inventory lists; nonetheless they express formal properties since they say something *about* a particular constructional definition (cf. Carnap 1969, 185).

I want to hold on to this discussion still a bit longer just to add a further aspect, which will also guide us into the following section. Alan Richardson says something about the character of the structural definite descriptions, which could be of importance for our discussion here. When discussing how the uniqueness of the structural definite descriptions is to be achieved, Richardson makes the following remark:

[T]he uniqueness of the described relation is logically presupposed in the definition but is only empirically ascertainable. The empirical nature of the guarantee of the uniqueness of reference of the structural definite description is meant to give content to the idea that the constitutional system is a constitutional system for empirical concepts, as opposed to the formal concepts of mathematics. This finds its expression in Carnap’s distinction between logical and empirical theorems within the definitions of the system. (Richardson 1998, 50-51)

The interesting point about this passage is, that Richardson here links the problem of the uniqueness of the structural definite descriptions, to the empirical theorems of a constructional system. Richardson wants to point out, that the constructional definitions are intended to capture some facts of our experience, in other words, that the constructional definitions have *empirical* content. This is very important to keep in mind, since it provides Carnap with a solution to the problem of elimination of the basic relation while at the same time leads his conception of a system of structural definite descriptions into Newman's trivialisation-problem, as will be shown in the following.

1.2.3 The elimination of *Rs* in the *Aufbau*

I will now pick up where I left off in section 1.2.1. There I have discussed Carnap's remarks about the possibility of substituting the basic concept within an already constructed constructional system. Before I turned to the short digression about empirical theorems in the *Aufbau*, I was looking at the passage where Carnap said that it is at least unlikely, that the empirical theorems of the system will be true, i.e. not change in truth-value, after substituting the basic concept. I have also said, that this provides Carnap with a solution to the problem of eliminating the basic concept (cf. Carnap 1969, 235). I will now discuss this argument in full detail.

In section 1.2.1 I quoted Carnap saying that "[i]t is still less likely that the empirical statements of the constructional system about constructed objects would accidentally continue to hold even after the transformation." (Carnap 1969, 235)

This marks the point where we left off before. Carnap now continues:

From this it follows that the original basic relations can be characterized by saying that the objects which are constructed from them in a certain way show a certain empirical behavior; (1969, 235)

How this is possible becomes clear after the following consideration. The empirical statements of a constructional system are of course open to empirical testing (cf. Carnap 1969, 176). In section 1.1.1 of my thesis I have described Carnap's project in the *Aufbau*, as setting up a system of definitions such that every definition can be reduced to an expression, containing only the sign for the basic concept plus logical vocabulary. Now for Carnap, this is just one of a pair of theses

of construction theory (cf. 1969, 186). Thus Carnap writes:

A second thesis [besides the one I have just circumscribed, R.F.] of construction theory asserts that *each scientific statement is, in the final analysis, a statement about the basic relation(s)*; more precisely, each statement can be transformed into another statement which (besides logical constants) contains only the basic relation(s) (Carnap 1969, 187).

In the *Aufbau* Carnap exemplifies this procedure of complete formalisation of a statement of a constructional system, using the well-known theorem 6 about the three-dimensionality of the *color solid*. Thus he writes down theorem 6 as an expression, which contains only the sign for the basic relation *Rs* and logical vocabulary (cf. 1969, 187-188). The possibility of translating the empirical statements of a constructional system into statements containing only the basic concept plus logical vocabulary is of outmost importance.¹⁶ For Carnap now draws the following, generalising conclusion: “In the same way, *all empirical statements of science can be expressed as statements about purely formal properties of the basic relation(s)*. This holds generally, no matter which basic relations and no matter what constructional system may be chosen.” (Carnap 1969, 188) It is this possibility, which solves the problem of eliminating the basic relation *Rs* in the *Aufbau*. For if statements which contain only the basic concept plus logical vocabulary have empirical content, i.e. they state empirical facts, then by the converse argument, the basic concept could be described with reference to these empirical facts (cf. Carnap 1969, 235). This is exactly what Carnap says: “From this it follows that the original basic relations can be characterized by saying that the objects which are constructed from them in a certain way show a certain empirical behavior” (1969, 235). So Carnap draws the conclusion that it is possible to identify a certain basic concept (of a certain constructional system), by reference to the empirical facts, which are asserted by the (empirical) statements containing that particular basic concept. Thus Carnap writes:

[D]efinite descriptions of the basic relations could be formulated with reference to the behavior of

¹⁶ At this point one might think, that the doctrine of verificationism, as commonly associated to logical empiricism and the Vienna Circle, is now creeping in construction theory. Indeed, there are passages in the *Aufbau*, which support such a view. See e.g. (Carnap 1969, 291-292). Creath (1982) gives an argument against a straightforward verificationist reading of this passage. Michael Friedman is indeed granting the fact that Carnap here “articulates a version of what will later become the verifiability principle” (1999, 108), however he also emphasises “that these empiricist doctrines do not play an essential role in Carnap’s criticism of traditional metaphysics.” (1999, 109)

objects on a sufficiently high level. Thus it follows that it is possible to define, through purely logical concepts, the basic relations which were originally introduced as undefined basic concepts. (1969, 235)

This is the idea of eliminating the basic relation. A structural definite description of the basic relation itself is given. Accordingly the basic relation is defined and thus eliminated. We can now clearly see why this possibility hinges on the existence of empirical statements of a constructional system. Briefly stated, Carnap's idea is, to identify the basic concept as the one and only concept, that satisfies a well-chosen propositional function, which results from an empirical statement of the system, in which the basic concept is omitted, i.e. turned into a variable (cf. Carnap 1969, 238). As Michael Friedman says: "What we have done, in effect, is eliminate the constant relation R_s in favor of a variable ranging over relations: R_s is the unique relation satisfying certain empirical conditions." (Friedman 1999, 102) Friedman also points out the importance of the empirical for the constructional system as a whole in his discussion. Thus he says:

In constructing other objects from our nonlogical primitive(s), we will make essential use of certain empirical facts. In Carnap's system, for example, we make essential use of the (putative) fact that there is one and only one sense modality based on R_s that is exactly five-dimensional¹⁷. (Friedman 1999, 102)

Bearing this in mind, van Fraassen's account of Carnap's project in the *Aufbau* seems to be a bit mistaken when he says that: "Carnap attempts simultaneously to refer to experience and to claim that the notions he needs are experience-independent." (van Fraassen 2008, 225) Of course Carnap tries to establish a system of definitions, which is capable of identifying any object of scientific discourse by means of structural definite descriptions, i.e. without the use of ostension whatsoever. But this does not mean that Carnap claims or is committed to claim that the notions he needs are independent of experience altogether as Michael Friedman made clear in the passage cited above.

¹⁷ The dimensionality of the visual field is a product of the dimensionality of the visual sense and the color solid. As Carnap writes in the *Aufbau*: "The visual field is a two-dimensional order of places such that a color of the three-dimensional color solid can be correlated to each of these places." (1969, 183) A further explanation is given by W.v.O. Quine: "Finally each of the five senses can be singled out by its dimensionality; for Carnap points out, each has a different number of dimensions. Sight for instance, has five: the two spatial dimensions of the visual field and the three dimensions of color (hue, brilliance, saturation)." (Quine 1995, 11-12)

Anyway I will not come back to a discussion of van Fraassen's views of the *Aufbau* until part two of my thesis. Before that I want to complete the first part with a brief discussion of some of the predominant readings of the *Aufbau* available today.

1.3 Interpreting the *Aufbau* between reductionism and neo-Kantianism

1.3.1 The classic empiricist reading of Goodman and Quine

The readings of Nelson Goodman and W.v.O. Quine of the *Aufbau* have dominated the view of Carnap's early work as thorough defence of phenomenalist reductionism for as long as Michael Friedman and Alan Richardson most notably started to rethink this classic understanding of the *Aufbau* (cf. Savage 2003, 81; cf. Mormann 2000, 84-86; cf. Mormann 2001, 329), see also Friedman (1999, 89-90) and Richardson (1998, 10-13).

Perhaps the most famous expression of the phenomenalist-reductionist reading is contained in Quine's classic paper *Two Dogmas of Empiricism* (Quine 1980c). In this paper Quine explains the fundamental thesis of the *Aufbau* in the following way: "Radical reductionism, conceived now with statements as units, set itself the task of specifying a sense-datum language and showing how to translate the rest of significant discourse, statement by statement, into it. Carnap embarked on this project in the *Aufbau*." (Quine 1980c, 39)

A second feature of Quine's reading is that Carnap's project in the *Aufbau* is seen as closely related if not identical altogether, to Russell's external world programme. Thus Quine says: "To account for the external world as a logical construct of sense-data—such, in Russell's terms, was the program. It was Carnap, in his *Der logische Aufbau der Welt* of 1928, who came nearest to executing it." (Quine 1969b, 74) This last quotation shows very well how Quine thinks of the *Aufbau* as cornerstone of a long-lasting line of philosophical effort. This becomes even clearer in the following passage: "Carnap's *Aufbau* was the culmination of the phenomenism that evolved through Hobbes, Locke, Berkeley, and Hume and had had its roots in Descartes's doubts and in the ancient perplexity over knowledge and error." (Quine 1995, 13)

Nelson Goodman puts forward a similar assessment of the *Aufbau*. Along with Quine he emphasizes the purported phenomenism of Carnap. Thus he writes in his contribution to the

volume *The Philosophy of Rudolf Carnap*, edited by Paul Schilpp (1963): “The system is plainly phenomenalistic” (Goodman 1963, 545). Goodman also emphasises the adherence to the tradition of British empiricism: “It belongs very much in the main tradition of modern philosophy, and carries forward a little the effort of the British Empiricists of the 18th Century.” (1963, 558) If we had to sum up Quine’s and Goodman’s reading of the *Aufbau* in simple terms, we would probably perform this task best by saying that Quine and Goodman take the *Aufbau* to be a cornerstone in the history of phenomenalistic reductionism and that its original contribution to this line of philosophical thought is the consequent integration of the newly developed methods of mathematical logic. Goodman highlights this last point: “The *Aufbau*, for all its fragmentary character, and for all its defects, is still one of the fullest examples we have of the logical treatment of problems in non-mathematical philosophy.” (1963, 558)

There are of course several passages in the *Aufbau*, which support a phenomenalist reading. In a way the specification of the basic elements alone makes a case for the phenomenalist reading, e.g. the passage, where Carnap says that “we have to proceed from that which is epistemically primary, that is to say, from the ‘given’, i.e., from experiences themselves in their totality and undivided unity” (1969, 108) purportedly supports the views of Quine and Goodman very well. Additional support comes from Carnap’s own reconsideration of the *Aufbau* contained in his reply on Goodman’s contribution to Schilpp (1963): “In my first book, *Der logische Aufbau der Welt*,” he writes, “I tried to show how the whole system of concepts in science could be constructed on a very simple phenomenalistic basis referring to elementary experiences (*‘Elementarerlebnisse’*).” (1963, 944) We see from this, that the phenomenalist-reductionist interpretation undeniably has initial plausibility. Nevertheless there are also good reasons for the neo-Kantian line of interpretation to which I will come in the following section. Right now, I want to go a bit further into the details of the phenomenalist-reductionist reconstruction of the project of the *Aufbau*.

A coherent discussion of the views of Goodman and Quine on the *Aufbau* can also be found in Leitgeb (2011). Leitgeb describes their basic assumptions as follows:

Every scientific sentence can be translated via explicit definitions into another sentence that consists solely of logical signs and terms that refer to ‘the given’, such that in each of the underlying definitions the defined expression and the defining expression necessarily have the same extension. (2011, 266)

In this formulation we immediately recognize the importance of the phenomenal basis, the “given” for this approach. But we also see that this reading does not pay particular attention to Carnap’s claim, that a full formalization of scientific discourse would require even the elimination of the basic concept of a constructional system. I will come back to this point when discussing the neo-Kantian reading of the *Aufbau* in the following section.

However even if one may doubt Goodman’s and Quine’s views of the philosophical programme of the *Aufbau*, they both share the credits for discovering the most important problems that the constructional system that Carnap developed in outline in the *Aufbau* has to face.

Goodman is of course very famous for his criticism of the method of quasi analysis¹⁸ while Quine’s objection focuses on the “assignment of colors to the world points” (Carnap 1969, 195) which marks the beginning of the construction of the physical objects (cf. Carnap 1969, 191-213). Now Quine’s famous objection to this technique is, that Carnap, in the course of the envisaged assignment, has to rely on a concept, for which he has not given a constructional definition first. Thus Quine writes:

[I]t provides no indication, not even the sketchiest, of how a statement of the form ‘Quality *q* is at *x;y;z;t*’ could ever be translated into Carnap’s initial language of sense data and logic. The connective ‘is at’ remains an added undefined connective; the canons counsel us in its use but not in its elimination. (Quine 1980c, 40)

Interestingly enough, Leitgeb (2011) provides a classification of the many problems put forward against the *Aufbau* according to their severeness. Leitgeb is distinguishing *pseudo-problems*, *feasible problems* and *serious problems* (2011, 270). Now Goodman’s problems concerning the method of quasi analysis count as feasible for Leitgeb, while he takes Quine’s problem to be serious (cf. Leitgeb 2011, 270). I will not go into further detail here however. Goodman or Quine did not take the problem I am going to discuss in my thesis into consideration at all; at least I do not know any discussion of the Newman-problem in relation to Carnap’s *Aufbau* by neither of

¹⁸ See (Goodman 1951, 114-146). The method of quasi analysis – developed in §§ 71-73 of the *Aufbau* (Carnap 1969, 114-120) – is still heavily discussed today. After Goodman’s criticism, it is a somewhat received view, that the method as presented in the *Aufbau* is defective (cf. Mormann 2000, 100-101). Although there are positions, which argue that a suitably refined method of quasi analysis may serve some purpose after all. Examples for such a view would be Mormann (2009) and Leitgeb (2007). For more on the method of quasi analysis see e.g. Lewis (1969), Mormann (1994) and Toader (2004).

them. It seems that this problem came under consideration only after the reinterpreting of the *Aufbau* had begun and that Demopoulos/Friedman (1985) provides the first discussion of it with respect to construction theory.

1.3.2 The Neo-Kantian reconsideration of the *Aufbau*

The interpretative and reconstructive work of Michael Friedman and Alan Richardson challenged the conventional line of thinking about the *Aufbau* described in the foregoing section (cf. Tsou 2003, 671-672; Moulines 1991, 264). Above that, the work of Michael Friedman on Carnap's *Aufbau* has to be seen in the context of a more extensive re-evaluation of the philosophy of logical empiricism, in particular of Moritz Schlick, Hans Reichenbach and above all, of Rudolf Carnap (cf. Mormann 2001, 329). Friedman's position on the philosophical programme of logical empiricism is summarized in the following statement:

Perhaps the best way to put the point is that the logical positivists have staked out an entirely novel position that is, as it were, intermediate between traditional Kantianism and traditional empiricism: it gives explicit recognition to the constitutive role of a priori principles, yet, at the same time, it also rejects the Kantian characterization of these principles as *synthetic* a priori. (Friedman 1999, 9)

His reading of the *Aufbau* is in accordance with this position. Therefore Friedman rejects the received view of a phenomenalist-reductionist programme in the *Aufbau* as “fundamentally misguided” (Friedman 1999, 90). His criticism rests on two objections against the reductionist reading of the *Aufbau*. The first one concerns the appeal to the German tradition of Gestalt psychology in the *Aufbau*, which does not accord with the phenomenalist reading, or so Friedman argues (1999, 91-92). The second, and in my opinion even stronger, argument that Friedman puts forward against the phenomenalist reading, is the plurality of possible bases for a constructional system (cf. 1999, 92-94). In the *Aufbau* Carnap sets up in outline a constructional system with an autopsychological basis (cf. Carnap 1969, 101). However he also considers the possibility of a constructional system with a physical basis (cf. 1969, 99). But, as Friedman argues, this clearly indicates that the defence of phenomenism cannot be Carnap's most important concern in the *Aufbau* then (1999, 94). In fact, according to Friedman Carnap goes even further: “Yet Carnap stresses repeatedly that the specific system he presents is only one possible ‘constructional system’ [...] among many others” (Friedman 1999, 92). So we see that the possibility of varying

bases for many different possible constructional systems is indeed an important aspect and a general feature of construction theory, as envisaged by Carnap (cf. Carnap 1969, 99-100). Thus Friedman concludes: “It is therefore clear beyond the shadow of a doubt, I think, that the *Aufbau* has a much more general aim than the particular construction of a phenomenalist system.” (Friedman 1999, 94)

Having thus established his criticism against the received view, Friedman goes on in explaining his positive views about the programme of the *Aufbau*.

The fundamental aim of construction theory is, according to him: “[T]he articulation and defense of a radically new conception of objectivity.” (Friedman 1999, 95) A conception that makes substantive use of the technical machinery of mathematical logic in explaining the objectivity of scientific knowledge (cf. Friedman 1999, 95). The most important and interesting aspect of Friedman’s reconsideration of the *Aufbau* is his explanation of the familiar roots of some of the problems Carnap is discussing in the *Aufbau*, with the ones of the neo-Kantian tradition in German philosophy (cf. Friedman 2000, 63, 69-71). I cannot go into further detail here but must leave it at the following remark, which is almost programmatic for Friedman’s interpretation of the *Aufbau*:

Thus, Carnap does not begin his construction with sensations or sense data precisely because even these entities must ultimately be defined on the basis of purely formal or structural properties—by their logical ‘places’ within a single interconnected system of concepts. Viewed from this perspective, Carnap’s project has less affinity with traditional empiricism and more with Kantian and neo-Kantian conceptions of knowledge. The primary problem is to account for the objectivity of scientific knowledge, and the method of solution is based on a form/content distinction. (1999, 98)

The second influential work for this line of interpretation of the programme of the *Aufbau* is Richardson (1998) who also emphasises the affinities to neo-Kantianism. Richardson e.g. lists some aspects which the *Aufbau* shares with the neo-Kantian tradition: “[T]he central role of logic, the attempt at ontological neutrality, the connection with exact science, and, especially, the epistemological distinction between the objective and the subjective.” (Richardson 1998, 138) It is perhaps illuminating to look at Leitgeb’s formulation of the central thesis of this reading, as I have done before with the phenomenalist-reductionist interpretation. According to Leitgeb, the neo-Kantian reading states that:

Every scientific sentence can be translated via explicit definitions into another sentence that is purely structural, i.e. which consists solely of logical signs, such that in each of the underlying definitions the defined expression and the defining expression necessarily have the same extension. (Leitgeb 2011, 266)

We can most clearly see the difference between these two traditions of interpreting the *Aufbau* by comparing their respective fundamental theses, as displayed by Hannes Leitgeb.

Whereas the fundamental thesis of Quine's and Goodman's reading, according to Leitgeb relies on terms that refer to immediate experience, as we have already seen; the thesis of Friedman and Richardson however gives credit to Carnap's claim of a complete formalization of all concepts of science whatsoever (cf. Leitgeb 2011, 266). It is an interesting aspect, that the problem of the elimination of the basic relation, seems to be obsolete in the phenomenalist reductionist reading, since the existence of primitives, referring to sense data, would not at all conflict with the central aim of a constructional system according to this reading. The elimination would then seem to be just a logical exercise, which "may be omitted" as Carnap himself labels the corresponding sections in the *Aufbau* (cf. 1969, 234). Another difference between these two readings is the emphasis on the concept of structure in the neo-Kantian reading, which is not mentioned in the thesis of the phenomenalist reading, according to Leitgeb (cf. 2011, 266).

Now one might raise the question whether the Newman-problem is affecting the *Aufbau* only if a specific reading, in this case the neo-Kantian one, is applied. I think that this would not be a plausible account. *First* of all, Carnap is discussing the problem of the elimination of the basic relation in some detail in the *Aufbau* (cf. 1969, 234-238). This indicates, that the problem is not insignificant in Carnap's view. *Second*, although Carnap is labelling the sections of the *Aufbau*, which are concerned with the elimination of the basic relation "may be omitted" (1969, 234) this does not mean, that the problem is not a serious one and, above all, it does not mean that the problem does not exist.

However what may differ is the estimation as to the degree of significance of the problem for the programme of the *Aufbau*. I will say a bit more on that in the following parts of my thesis.

2. Structuralism and the Newman-Problem

I will now leave the conception of the *Aufbau* at that for a while and instead concentrate on exploring and clarifying the Newman-problem. I will begin in chapter 2.1 with a discussion of Newman's original paper, which was first published in 1928 (cf. Demopoulos/Friedman 1985, 627). The aim is not only to get a historical and to some extent exegetical perspective on the Newman-problem, but also to develop a precise definition which will be used in throughout the following sections. In chapter 2.2 I want to have a look at some discussions of the Newman-problem in the literature. The aim of this section is to further clarify some formal logical and philosophical issues surrounding the problem. Above that I will also discuss the positions of Demopoulos and Friedman (1985) and of van Fraassen (2008) in more detail since they explicitly connect the problem of the elimination of the basic relation in the *Aufbau*, with the Newman-problem.

2.1 M.H.A. Newman's objections against Bertrand Russell

2.1.1 The trivialisation argument

I have to confess that this section suffers from a serious deficiency, right at the beginning. The paper, in which Newman formulates the problem that was named after him, originally was intended as a reply to Bertrand Russell's *The Analysis of Matter* (2001). Now it seems to suggest itself that it would be necessary to discuss Russell's views presented in this book in some detail, in order to be able to understand Newman's objections against them. However, doing so would certainly exceed the scope of my thesis. I therefore have to rely on Newman's own reconstruction of Russell's position. Since my only aim here is to get a clear grasp of the problem he discovered while leaving aside the question of its consequences for the philosophy of Bertrand Russell, it may be permitted to skip Russell's views from my discussion.¹⁹ I will additionally be

¹⁹ There is another reason why someone might object against this approach to the topic. It is not only the case, that Newman originally intended his arguments as criticism against Russell; there is also an ongoing discussion about

relying on the reconstruction of Russell's position in Demopoulos/Friedman (1985) instead. Above that it would mean to cut short the importance of Newman's discovery if one would limit its scope to the Russellian programme. Rather, the Newman-problem is an original formulation of a much more principal problem for any structuralist account of the nature of scientific knowledge or of our scientific theories. In this respect, its theoretical importance and its interest for any philosophy of science can barely be overestimated. To give just one example for the relevance of Newman's thought for present day philosophy of science, one only has to look at John Worrall's recent defence of his version of structural realism, in which arguments against the Newman-problem form an eminent part (cf. Worrall 2007b, 147-153). This position of Newman's criticism seems to be perfectly justified, since his general conclusion is nothing less than that it "seems necessary to give up the 'structure – quality' division of knowledge in its strict form." (Newman 1928, 147) I will now try to give a reconstruction of the argument leading to that conclusion. Newman begins his investigation with the question, "what is meant by the *statement* that 'two systems of relations have the same structure'" (1928, 139), leaving aside the issue of defining the term *structure*. He gives the following answer:

Let a set, A, of objects be given, and a relation R which holds between certain subsets of A. Let B be a second set of objects, also provided with a relation S which holds between certain subsets of its members. The two systems are said to have the *same structure* if a (1, 1) correlation can be set up between the members of A and those of B such that if two members of A have the relation R their correlates have the relation S, and *vice versa*. (Newman 1928, 139)

This is Newman's definition of the concept of "sameness of structure". He also gives an example-case for such a definition in terms of people and the relation of being acquainted (cf. 1928, 139). The idea is this: Given two sets A and B and two relations R and S. Let A be a collection of individual persons and let R be the relation of "being acquainted with". Then it is

Russell's influence on Carnap, especially in the period of the emergence of the *Aufbau*. Again it would exceed the scope of my thesis to go into detail here. For more on the relation between Russell and Carnap see e.g. (Richardson 1990), (Sauer 1993), (Ribeiro 2000) and (Pincock 2002). While (Sauer 1993) and (Richardson 1990) are highlighting the differences between the epistemological approaches of Russell and Carnap, (Pincock 2002) and especially (Ribeiro 2000) argue for the view of an important influence of Russell's epistemology for the project of the *Aufbau*. It has to be noted though, that they focus on Russell's *External World*-programme, rather than the *Analysis of Matter*. See (Russell 2009).

possible to create a graph, what Newman calls a “map” of the structure of A by making a node for each person and an edge between any two nodes in case the relation of “being acquainted with” holds between these (cf. 1928, 139). The next step in Newman’s thought then is, to draw a graph of the structure B, consisting of nodes now connected by the relation “joined by a line”, such that A and B have the same structure (cf. 1928, 139). We can therefore expand the definition of “sameness of structure” by the condition, that two sets with equal structure have the same graph. I want to recall my discussion of Carnap’s idea of structural definite descriptions in section 1.1.3 above for a moment. For we can now see that Newman’s concept of a map of a structure is analogous to Carnap’s idea of an arrow diagram of a structure (cf. Newman 1928, 139; Carnap 1969, 22).

Newman draws the following conclusion from the example he has just given:

The important feature of the definition, brought out by the example, is that it is not at all necessary for the objects composing A and B, nor the relations R and S, to be qualitatively similar. In fact to discuss the structure of the system A it is only necessary to know the *incidence* of R; its intrinsic qualities are irrelevant. (Newman 1928, 139)

In this respect Newman’s discussion of the concept of structure also accords very well with the concept as envisaged by Carnap (cf. 1969, 21). But there is a further consequence that Newman takes into consideration:

Further, no important information about the aggregate A, except its cardinal number, is contained in the statement that *there exists* a system of relations, with A as field, whose structure is an assigned one. For given any aggregate A, a system of relations between its members can be found having any assigned structure compatible with the cardinal number of A. (Newman 1928, 140)

I will call this the *triviality of structure descriptions*. In my own reformulation it becomes the following principle:

TSD The statement, that a set *M* exemplifies a structure *S* does not contain any non-trivial information about *M* except its cardinal number.

We can see, that this is exactly what happened in the example case that Newman brought up. The structure of the set A, instantiated by the relation R, can be imposed on any set; therefore also on

the set B in particular, provided B has the same cardinal number as A. That the relation “being acquainted with” and “joined by a line” are qualitatively different from one another does not matter at all, as Newman told us above (cf. 1928, 139). But if this is the case, it follows that the only non-trivial information about set A is just its cardinal number (cf. Newman 1928, 139). This important observation of Newman is the first step in the criticism of Russell’s position but also the first step in formulating a serious problem for any account of structuralism in the philosophy of science. Before I go into further detail however, I want to have a quick look at some structuralist positions in the philosophy of science.

2.1.2 Structuralism(s) in the philosophy of science

In this section I am going to introduce a distinction between two versions of structuralism in the philosophy of science. I will discuss a version labelled *epistemological structuralism* (henceforth referred to as ES) and a second version, which is called *ontological structuralism* (henceforth referred to as OS). I adopt both of these from the extended discussion in Ladyman (1998).²⁰ I will begin with a discussion of epistemological structuralism. Ladyman’s formulation of this version runs as follows:

Maxwell wanted to defend a robust scientific realism, [...] and he also wanted to explain how we can have epistemic access to unobservable entities. [...] The answer that Maxwell gave, [...] was that we can know about them by *description*, that is we can know them *via* their *structural* properties. (Ladyman 1998, 411)

I want to condensate this into the following formulation:

ES Everything that can be known about unobservable, hence theoretical entities is captured by a description of their structural properties.

²⁰ It has to be added however, that I do not intend to say, that these two versions that I am going to discuss right now, are jointly exhaustive when it comes to possible versions of structuralism in epistemology or the philosophy of science. For example one might make a further distinction to capture the views of Joseph Sneed. According to Sneed: “Structuralism is essentially a view about the logical form of the claims of empirical theories and the nature of the predicates that are used to make these claims.” (1983, 350) However I will leave aside this specific conception of structuralism here.

Ladyman himself explicitly links this version to Russell's programme in the *Analysis of Matter* and the method of ramsification (cf. 1998, 411). In this respect he is in full accordance with Friedman and Demopoulos who also explain Russell's structuralism with reference to the method of ramsification (cf. Demopoulos/Friedman 1985, 622).

The second version of structuralism in the philosophy of science that I want to discuss now is a result of Ladyman's discussion of the problem of theory change and underdetermination. Thus he writes: "So we should seek to elaborate structural realism in such a way that it can diffuse the problems of traditional realism, with respect to both theory change and underdetermination. This means taking structure to be primitive and ontologically subsistent." (Ladyman 1998, 420)

Ladyman himself discusses this under the heading "Towards a Metaphysical Structural Realism" (cf. 1998, 415). But because I am only interested in this version because of the additional ontological commitment²¹ compared to ES I think it is justified to condensate a version of ontological structuralism OS as follows:

OS The description of the structural properties of unobservable entities entails a commitment to (ontological) realism about structure.

Of course one may ask the question what the difference between ES and OS amounts to, whether it is one of degree or whether it is categorical. The most important difference between these two versions is of course the ontological commitment that is entailed in just one of these. But again the question arises, whether it is possible at all to discriminate neatly between these two formulations of a structuralist programme. This question is of special importance with regard to the claimed metaphysical neutrality of the *Aufbau* (cf. Carnap 1969, 281-287; Friedman 1999, 110). I will say a bit more on this in chapter 3.2 however. Ladyman (1998) sets himself the task of answering the question, whether structural realism is a theory about epistemology or ontology (cf. Ladyman 1998, 410). I will not go into further detail however. At least what we have got is a hint that some structuralist views may have problems when it comes to explaining the nature of the structural content they are talking about.

Perhaps it is safe to count the structuralism of Russell on the side of ES whereas the conception

²¹ I have taken the notion of an ontological commitment of the famous paper by Quine (1980b).

in Ladyman 1998 would clearly be an instance of OS (cf. Ladyman 1998, 411-413, 420). The position of John Worrall (2007a) would on this account have an intermediate position between ES and OS (cf. Ladyman 1998, 410).

Above that one may ask the question whether there is a relation of implication between these two views, such that ES collapses into OS after all. I will leave this question for future work. Instead I want to raise the question, what Newman's view of Russell's structuralism would be according to the scheme of OS and ES.

I think that in Newman's reconstruction, Russell's structuralism oscillates between ES and OS. To see this, we only have to look at the following passage where Newman assigns the following position to Russell:

[O]ur knowledge of the external world takes this form: The world consists of objects, forming an aggregate whose structure with regard to a certain relation R is known, say W; but of the relation R nothing is known (or nothing need be assumed to be known) but its existence; that is, all we can say is, '*There is a relation R such that the structure of the external world with reference to R is W*'.
(Newman 1928, 144)

First of all, this account of Russell's epistemological position is analogous to the example case we have discussed above. On this view, the world, which means something like "everything that can be experienced and thus be a potential object of knowledge", is just a collection of things. In the example given above, the things or objects the world consists of would correspond to the nodes in a graph. There are certain relations between the objects of the world, which would of course be represented by the edges in a graph. When Newman says that there need not be any knowledge about these relations, he just means that there need not be any knowledge as to the quality of the relation R.²² Thus on Newman's account of Russell's view, knowledge about the world boils down to the statement, that there is a certain structure, exemplified in the world. Now it immediately jumps to mind, that this formulation has two distinct aspects. In one sense it is a statement of epistemology and says something about our capacities of acquiring knowledge of the external world; in the other sense, however, it can also be read as a statement of ontology, saying that the world, or the objects the world consists of, instantiate a certain structure. This is the reason why I think, that Newman was not perfectly clear as to whether Russell's structuralism is

²² Recall the statement I quoted above, where Newman said, that the intrinsic quality of a relation R are „quite irrelevant“ (cf. Newman 1928, 139).

to count as instance of OS or ES. Thus Russell's position would oscillate between ES and OS on this reading.

Demopoulos and Friedman argue explicitly against an ontological reading of Russell's structuralism. In their view "the structure/quality distinction does not mark a difference in ontological status: external events have both structure and qualities [...]. Neither is it the case that one is 'more fundamental' than the other". (1985, 624-625) Although I am not sure whether Newman would subscribe to such a view, I think it is nevertheless in accordance with his line of thought, to describe his criticism as epistemological objection against Russell's structuralism. I will call his argument the *epistemological problem* in what follows (henceforth referred to as EP).

2.1.3 The epistemological problem

Newman's original formulation of the epistemological problem runs as follows: "Hence the doctrine that *only* structure is known involves the doctrine that *nothing* can be known that is not logically deducible from the mere fact of existence, except ('theoretically') the number of constituting objects." (1928, 144)

Of course this would be a devastating consequence for any account of structuralism in the philosophy of science since, as Demopoulos and Friedman put it: "[O]n this view, only questions as to the cardinal number are open to discovery!" (1985, 627) It is easy to show, why this is a direct consequence of TSD. Consider as a first step Newman's statement that on Russell's account, structure is everything there is to be known. From TSD we know that any collection of objects can be arranged so as to exemplify a certain structure. Hence, that a certain set exemplifies a certain structure is a matter of logical consequence, not one of empirical discovery, which it should be in the first place (cf. Demopoulos/Friedman 1985, 627). This is, in a nutshell Newman's epistemological problem.

On this basis I come to my own reformulation as follows:

EP The only non-trivial and thus non-deducible knowledge captured by structuralism is about the cardinal number of the set exemplifying a certain structure.

Newman clearly sees the consequence for any account of the nature of our scientific theories,

which purports to describe their empirical content by means of a description of the structural properties. He discusses the question of the existence of atoms as an example (cf. Newman 1928, 143). Of course this is well chosen with regard to our discussion here, since it involves the question of an unobservable, thus theoretical entity and what can be known of it. With an impressive sense of clarity Newman gets right to the point when saying: “I believe this is a real question, to be answered by consideration of the evidence, not a matter of definition”. (1928, 143) Or as Jeffrey Ketland puts it: “We might call it *physics without physics*.” (2004, 295) This constitutes the heart and core of Newman’s objection to Russell’s structuralism.

Newman is also discussing a possible response to this problem, one that will not suffice in solving the problem however, as we will see in the following.

The suggestion is to divide the class of possible relations into *trivial* and *important* relations, which is suggested by Russell himself in *The Analysis of Matter* (cf. Newman 1928, 146; Demopoulos/Friedman 1985, 628). Demopoulos and Friedman describe this distinction as one between *important* and *unimportant* relations (cf. 1985, 628). The idea is, as may be guessed, to block TSD by excluding unimportant relations, which would be any relations that are not connected in any way to empirical discovery, but simply hold because of their formal properties (cf. Newman 1928, 146; Demopoulos/Friedman 1985, 628). It would be possible to avoid TSD by restricting the range of possible relations, to important relations that is. I want to explain this line of reasoning on the basis of Newman’s example from section 2.1.1 above. In this case, the repair would rest on the possibility to distinguish the relation R “being acquainted with” as *important* from the relation S “being joined by a line” as *unimportant*. That the structure of set B is isomorphic to the structure of A would then be no problem at all, since we already know, that the relation S is just an unimportant, trivial relation, whereas relation R is an important one. Thus it is a matter of empirical discovery, whether the people in set A are acquainted with each other and hence, that A exemplifies a certain structure with reference to relation R is not only a consequence of its cardinal number and logic alone.

Demopoulos and Friedman show however that this will not suffice as general solution to EP. Their argument reads as follows:

Russell cannot avoid trivialization by claiming that the relation with the structure *W* which exists as a matter of logic is not necessarily the *important* relation with structure *W* [...]. That is to say, one cannot avoid trivialization in this way without some means of distinguishing important from unimportant relations on a given domain. But the notion of importance which must be appealed to is

one for which Russell can give no explanation (Demopoulos/Friedman 1985, 629).

Van Fraassen comes to a similar conclusion: “But this is just a logical maneuver. Without any information about that supposedly (postulatedly?) factual distinction between the *important* and *unimportant*, we have no grip at all on what the assertion says about the world.” (van Fraassen 2008, 221-222)

I will leave the issue of Newman and Russell for now. What we have achieved is a precise understanding of the problem, which will be discussed with regard to Carnap’s *Aufbau* in part three of this thesis.

In the following section I will have a look at some philosophical and historical discussions of the Newman-problem, in addition to the exegetical approach of Newman’s original paper presented just now.

2.2 More on the Newman-problem

2.2.1 The mathematics of the Newman-problem

Ketland (2004) provides a very illuminating discussion of the mathematical nature of the Newman-problem. He is envisaging the Newman problem in relation to modern positions of structural realism that rely on the method of ramsification²³ in their treatment of theoretical terms (cf. Ketland 2004, 287-288). The Newman problem seems to pose a serious threat against such positions as will become clear after considering the reconstruction of Russell’s position by Demopoulos and Friedman, which I have already touched in section 1.2.1.

In *The Analysis of Matter*, Russell wishes to exploit the notion of logical form or structure to introduce scientific objects and relations by means of so-called *axiomatic* or *implicit definitions*. Thus, if we represent a scientific theory by

$$\theta(O_1, \dots, O_n; T_1, \dots, T_m),$$

²³ For the original formulation of the (later) so-called Ramsey-sentences see Frank P. Ramsey’s *Theories* in (Ramsey 1960, 212-236)

say, where $O_1, \dots, O_n$ are observational or perceptual terms and $T_1, \dots, T_m$ are theoretical terms, then Russell in 1927 is prepared to accept the Ramsey-sentence

$$\exists \tau_1, \dots, \exists \tau_m \theta(O_1, \dots, O_n; \tau_1, \dots, \tau_m)$$

as the proper statement of our scientific knowledge. (Demopoulos/Friedman 1985, 622)

So it seems as if the Newman problem will affect any account of the content of scientific theories that builds upon the method of ramsification in its treatment of the theoretical terms of a theory.

Thus, as Ketland says:

The epistemological significance of this technical construction it [sic!] that it perhaps offers the possibility of defending a plausible intermediary or ‘third way’ position between realism and anti-realism [...]. This position has come to be termed ‘structural realism’. (Ketland 2004, 287-288)

The method of ramsification is not used in Carnap’s *Aufbau* however, which is the reason why I will not go into further detail here.

The reason why I want to discuss Ketland’s paper is, to get some clue about the mathematics of the problem. I will quote Ketland’s reconstruction in full:

This argument [the trivialization argument, R.F.] rests on a mathematical point, which can be stated as an easy theorem of set theory:

Let X be a set/collection and let $\mathbf{M}$ be a structure such that $|\text{dom}(\mathbf{M})| \leq |X|$. Then there exists a structure $\mathbf{M}_X$ whose domain is X with a substructure isomorphic to $\mathbf{M}$. (Ketland 2004, 294)

The structure $\mathbf{M}$ consists of a domain and a set of relations (cf. Ketland 2004, 294). One assumption of the theorem is that $|\text{dom}(\mathbf{M})| \leq |X|$, which means that the absolute value of the domain of the structure $\mathbf{M}$ is less or equal than the absolute value of the set X (cf. Ketland 2004, 294). Given these conditions, the existence of a structure isomorphic to $\mathbf{M}$ follows as mathematical result (Ketland 2004, 295). “Intuitively put”, says Ketland: “Given any set/class X , we can impose any structure $\mathbf{M}_X$ we like onto subject only to *cardinality* constraints.” (Ketland 2004, 295)

2.2.2 Friedman and Demopoulos on the Newman-problem

I have already made substantial use of the discussion of Demopoulos and Friedman (1985) in the foregoing sections on Newman. In this section I want to continue this discussion but also make a first step towards Newman and Carnap's *Aufbau*. Demopoulos and Friedman not only deserve credit for bringing the Newman-problem to the attention of a wider philosophical audience. They have also shown, that the problem Newman discovered has an analogue in Carnap's *Aufbau*. It is this particular aspect that I want to look at right now.

First of all, Demopoulos and Friedman highlight the important differences between Russell's structuralism in *The Analysis of Matter* and Carnap's conception in the *Aufbau*. In section 2.1.2 I have already pointed out, that Russell's conception could be described in terms of ES. However the case of the *Aufbau* is not that clear at all as Friedman and Demopoulos argue (cf. 1985, 625-627). The most important difference between these two approaches being the following:

“Carnap's *Aufbau* does not embrace structural realism. *All* concepts of science are to be explicitly defined within a single ‘constructional system’” (Demopoulos/Friedman 1985, 625), whereas Russell is prepared to accept the Ramsey-sentence of a theory as we have already seen. Thus a constructional system cannot be treated as instance of ES since, as I have defined this position, a distinction between observable and unobservable or theoretical entities is an explicit assumption of such a view. The *Aufbau* is in this respect a far more radicalised version of Russell's structuralism or of any other instance of ES in general. Its aim is not to rest on a distinction between observational and theoretical terms and the method of ramsification, but simply to formalize *all* parts of meaningful discourse whatsoever (cf. Friedman 1999, 101). Thus Demopoulos and Friedman say: “Carnap in the *Aufbau* goes much further: all terms whatsoever are to be replaced by variables.” (1985, 627)

This of course is nothing else than a reformulation of Carnap's claim that it is possible to pick out any object in a given domain by means of a structural definite description. However in chapter 1.2 we have seen, that this whole procedure hinges on the fact, that there is a primitive basic concept at the bottom of the system, which enables the constructional definitions in the first place. We have also seen there, how this leads into the problem of eliminating the basic concept. This elimination in turn explains Friedman's and Demopoulos' claim, that the procedure is turning all terms into variables, since after the elimination, the structural definite description will only contain logical vocabulary. “The point is that such purely structural descriptions contain no

non-logical vocabulary; ultimately, we will need only variables and the logical machinery of *Principia Mathematica* (or set theory).” (Demopoulos/Friedman 1985, 626) This is the point, where the discussion of the Newman-problem in Carnap’s *Aufbau* begins. Their reconstruction reads as follows:

Well, R_s also has a logical form or structure: it has a *graph* $\Gamma(R_s)$. [...] To be sure, we can know these formal properties of R_s only empirically; but once we know them, we can express them in a purely formal schema $\Gamma(R)$, where R is now a *relation-variable*. The idea, then is to define R_s as the unique relation with this graph [...]. Since $\Gamma(R)$ is now a purely formal schema containing no non-logical primitives, the *uniqueness* claim implicit [...] will never be satisfied. As long as the condition Γ is consistent, there will always be infinitely many distinct relations with this graph [...]. The analogy with the Newman-problem is evident. (Demopoulos/Friedman 1985, 636)²⁴

I have quoted this longer passage in full, since it gives us the most comprehensive formulation of the Newman-problem in connection with Carnap’s *Aufbau*. The argument as presented by Demopoulos and Friedman is very clear: By turning the basic relation R_s of the constructional system into a variable, there will be infinitely many other relations, with the same formal properties, that will satisfy any particular constructional definition. There is a further aspect of the Newman-problem that becomes visible now. Newman’s epistemological objection to Russell focused on the triviality of the information, that a certain structure is instantiated by a certain collection of objects. Now in Carnap’s case in the *Aufbau* we are looking at the same problem from a different angle. We know there to be infinitely many relations that would satisfy the constructional definitions of our system, but we do not know, which one is the *right* relation, so to speak. In other words, we cannot know, whether the constructional definitions rely on the basic relation of “recollected similarity” and not on arbitrarily chosen, binary relations which just happen to be asymmetric, in which case the constructed definitions would lose all empirical content (cf. Carnap 1969, 236). Thus Friedman concludes on this problem:

If we succeed in disengaging objective meaning and knowledge from ostension and lodge them instead in logical form or structure, then we run the risk of divorcing objective meaning and knowledge from any relation to experience or the empirical world at all. We run the risk, that is, of erasing completely the distinction between empirical knowledge and logico-mathematical

²⁴ A similar discussion can be found in (Friedman 1999, 102-103).

knowledge. (1999, 103)

We can clearly see, that this is nothing less than an alternative formulation of the EP, which Newman pointed out against Russell's structuralism that is now threatening the constructional system of the *Aufbau*. Thus what Demopoulos and Friedman argue for is, that the TSD as well as the EP are a consequence of Carnap's construction theory.

2.2.3 van Fraassen on Newman and Carnap

In addition to Friedman and Demopoulos a discussion of the Newman-problem and related puzzles throughout the younger history of science can be found in van Fraassen (2008).

Beginning with the controversy over realism and anti-realism, involving such dominant figures as Max Planck and Ernst Mach, van Fraassen tries to show that the Newman-problem is just a particular instantiation of a much more fundamental problem, which all anti-realist or structuralist positions in the philosophy of science would face. Therefore, van Fraassen draws a continuous line from the opposition between Planck and Mach to Hilary Putnam's model-theoretic argument, in which Bertrand Russell, Henry Newman and, most interestingly, Carnap's *Aufbau* also have their places (cf. van Fraassen 2008, 191-235). Van Fraassen seems to think, that all structuralist philosophies of sciences do have a common root in a view, which he calls the „*Bildtheorie* of Science" (van Fraassen 2008, 191), which he defines as follows: „As I shall present it, the advocacy of the *Bildtheorie*, the view that what science gives us is *representations*, [...] is also integral to the origins of what is now known as structuralism in the philosophy of science.“ (van Fraassen 2008, 191) Unfortunately I cannot undertake a historical investigation into the question, whether van Fraassen is right with this thesis and the controversy between Planck and Mach is a clear foreshadowing of the debates around structural realism in contemporary philosophy of science. For my purpose here, this question can be left unanswered however. What is of more interest with regard to my thesis is the following passage, which I want to quote in full length:

Structuralism about science – the thesis that a science represents only structure in its domain – became increasingly and recurrently a salient theme in twentieth-century philosophy of science. This development had two motivating philosophical controversies in its past. One was in the philosophy of mathematics, and specifically of geometry, where the conception of a theory of space was gradually replaced by the conception of geometry as a branch of abstract mathematics. The

other [...] occurred in the debates among physicists about the status and use of models, where we see a clear foreshadowing of later debates over scientific and structural realism. (van Fraassen 2008, 191)

Van Fraassen here refers to some aspects of the emergence of philosophy of science in general, which also bear importance with regard to Carnap's project in the *Aufbau*. It is well known that the developments in 19th century geometry had a great influence on the formation of logical empiricism. A concise and programmatic sketch of this fact can be found in (Majer 2002):

In recent years the works of Friedman, Howard and many others have made obvious what perhaps was always self-evident. Namely, that the philosophy of the logical empiricists was shaped primarily by Einstein and his invention of the theory of relativity, whereas Hilbert and his *axiomatic approach* to the exact sciences had comparatively little impact on the logical empiricists and their understanding of science – if they had any effect at all. (2001, 213)

It would be interesting to investigate further into the question, what specific role the transformation in the understanding of geometry in 19th century philosophy of mathematics played for the conception of the *Aufbau* in particular. That there is something to say on this matter becomes evident also in Mormann (2003):

Geometry, as synthetic geometry, was an important source of inspiration of Carnap's philosophical thought. The constitutional theory of *Der Logische Aufbau der Welt* is inspired, to a large extent, by the relational systems of synthetic geometry treated in *Der Raum*.²⁵ (Mormann 2003, 46)

A similar point can be found in Richardson (2003):

I want to suggest" Richardson says there, "that it was Carnap's engagement with a new technical situation in pure and applied geometry that led to his own distinctive accounts of the epistemological problem and the conviction that logic was the appropriate tool for the solution of that problem. (Richardson 2003, 174)

We can see from this that the innovations that took place in 19th century geometry are also present in Carnap's philosophy and in particular in the *Aufbau* itself. The next step would be, to investigate into the question, how the debate about the "status and use of models" as van Fraassen

²⁵ *Der Raum* was the title of Carnap's doctoral thesis (cf. Mormann 2000, 51-55; Friedman 2000, 64-70).

puts it (cf. 2008, 191) is also present in the programme of the *Aufbau*. Unfortunately, I have to leave the execution of this research programme for future work. The reason why I put especial emphasis on this point was to show, that the *Aufbau* might as well have been read as a cornerstone in the history of the emergence of structuralist positions in the philosophy of science, rather than as continuation of the tradition of phenomenalist empiricism.

Be that as it may, what is of importance for us now is the question, what account van Fraassen gives of the relation between Newman and Carnap. So the question we have to ask is, what van Fraassen's position on the Newman-problem amounts to? Van Fraassen gives an example of the problem, which I will discuss in full detail now.

The setting is the following:

Suppose I have seven neighbors, and I insist that they instantiate a model **M** I have of a rigidly hierarchical social structure. (van Fraassen 2008, 219)

From this we can formulate the following assumptions: The seven neighbours constitute a set *S* of objects, whose cardinal number is seven. The elements in *S* do not by themselves instantiate a particular ordering. But in principle it is possible, to impose some kind of ordering relation on *S*, so that the elements in *S* stand in a particular relation to each other. In van Fraassen's example this relation is interpreted as a social hierarchy. So van Fraassen tries to show, that a particular form of a social hierarchy, which he calls „Model **M**“ can be imposed on the set *S*.

This model **M**“, he continues, „we can envisage as follows: it has seven elements and a ‘directly under’ relation. To visualize it, its elements are the general, directly under him two colonels, and directly under each colonel there are two majors. (van Fraassen 2008, 219-220)

So the social hierarchy in this case, consists of three classes. The condition of membership to each class is defined *in relation* to the other classes. If someone is a general, then he/she does not stand in the „directly under-relation“ to any other member of society. If someone is a colonel then he/she stands in the „directly under-relation“ to the general or the generals if there are more of them and the majors stand in the „directly under-relation“ to him/her. This is the structure of Model **M** spelled out. Now let us go a step further:

How can I say that my neighbors instantiate this hierarchical structure?“ To justify that I have to define a relation $\ll$ which has the same properties as the relation *directly under* has in my model.

(van Fraassen 2008, 220)

Although it is not made explicit at this point, I think we are justified to assume, that van Fraassen here means *formal* properties, when speaking of the „properties of the relations“. Since the symbol “ $\ll$ ” by itself is not interpreted in any qualitative way, nor is its empirical content specified. With regard to the relation “directly under”, the situation is different. This relation is introduced as a description of a social hierarchy and thus has empirical content. That the rank of a general is immediately above the rank of a colonel is an empirical fact of the matter. Therefore we need to become sure about the formal properties of the relation „directly under“. From the description of the Model **M** that van Fraassen is giving us, we know that „directly under“ is a binary relation. It always involves two elements a, b where a is directly under b or b is directly under a but not both hence we also know that the relation is asymmetric (if a is “directly under“ b, then b is not “directly under“ a), irreflexive (a is not “directly under“ a) and intransitive (if a is “directly under“ b and b is “directly under“ c then a is not “directly under“ c). Any relation which has this formal properties can be interpreted as the “directly under“-relation as van Fraassen uses it in his example for Model **M**.²⁶ Now let us apply this to the Set S:

So I arbitrarily label my seven neighbors as follows: 1, 10, 11, 100, 101, 110, 111. Then I define the relation $\ll$ as follows: neighbor 1 does not bear $\ll$ to anything; any neighbor with a label of form Y_1 or Y_0 bears $\ll$ to the neighbor labeled Y; and that is all. (van Fraassen 2008, 220)

After that we are done. We now have imposed the structure of Model **M** on our set S. How does van Fraassen’s example work? Spelled out in detail, it would look like this: There is no element x in S, which satisfies $1 \ll x$.

If $Y=1$ then $Y_0=10 \Rightarrow Y_0 \ll Y$ which means $10 \ll 1$;

and $Y_1=11 \Rightarrow Y_1 \ll Y$ which means $11 \ll 1$.

If $Y=10$ or 11 , then either $Y_0=110 \Rightarrow Y_0 \ll Y$ which means $110 \ll 10$; or

²⁶ Of course one might say, that at this point the formal definition of the „directly under“-relation is counter-intuitive, since also the rank of a major is below the rank of a general. Van Fraassen however speaks of a relation of being *directly* under. Therefore it is clear, that this relation is meant to be intransitive. In this sense the rank of a major is below the rank of a general and directly under the rank of a colonel.

$$Y_1 = 111 \Rightarrow Y_1 \ll Y \text{ which means } 111 \ll 111.$$

I want to recapitulate the central aspects. Van Fraassen has started with a model **M** that was obviously intended to model the social structure of the armed forces of any english-speaking country. The description of this model was given, by a description of structure in the sense of a description of the mutual relations of the members of this society to each other. This relation was called *directly under*. Van Fraassen wanted to illustrate the trivialisation argument, by showing that this description actually can be used on any set of objects, in his example not only on the members of the military but also on the certainly unarmed neighborhood, *provided* there are the right number of them (cf. van Fraassen 2008, 219-220).

The important point of course is, that this trivialising result is not a consequence of any difficulty, specific to the particular example discussed above. It is essential to highlight that point, since one could argue, that a way out of the difficulty would be, to give a more precise description of the structure instantiated by the model **M**. That will not do. As van Fraassen puts it: “In general, equality of size between two sets means just that there is a one-to-one correspondence between them, and that correspondence can be used to single out a *copy* in the one set of any relational structure there may be displayed in the other.” (2008, 220) From this it should be clear, that the trivialisation result will follow for any two sets, which have the same size no matter how complex or simple the structure in question turns out to be.

Even more important for my present purpose is van Fraassen’s discussion of the trivialisation problem in connection with Carnap’s *Aufbau*. After a brief summary of Russel’s response to the objections put forward against the *Analysis of Matter* (cf. van Fraassen 221-223), van Fraassen continues with this discussion. He mainly draws on analogies between Russell’s programme in the *Analysis of Matter* and the *Aufbau* with regard to the trivialisation problem. Therefore he concludes the section about Newman and Russell with the following remark: “This story has its sequel in writings by Rudolf Carnap, Hilary Putnam, and David Lewis, where we will recognize the themes from Helmholtz, Russell, and Newman in a new setting.” (2008, 224) Besides Friedman (1999) and Demopoulos/Friedman (1985) it is the only example I know so far, of explicitly linking Newman’s objections to Russell’s programme to the *Aufbau*. Van Fraassen starts by discussing Carnap’s thesis, according to which it should be possible, to refer to empirical objects, by the means of a structural definite description (cf. 2008, 226). The passage in Carnap’s *Aufbau*, which van Fraassen is pointing out at this stage, is the following: “It is of

especial importance to consider the possibility of such a system [of definite descriptions, R.F.] for the totality of all objects of knowledge. Even in this case it is not possible to make an a priori decision. But we shall see later that any intersubjective, rational science presupposes this possibility.” (Carnap 1969, 25) Van Fraassen takes the very same passage as his starting point (cf. 2008, 226). According to him:

What we see here is a vacillation between several possibilities. (A) Is nature so structured that everything can be uniquely identified by means of a description that captures only that structure? [...] (B), ‘any intersubjective, rational science presupposes this possibility’. If that is so we have a transcendental justification for the assertion that knowledge of structure includes all the knowledge there is to be had. Disturbingly, Carnap throws out yet a third option in this Part of the *Aufbau*: that (C) we should adopt an ontology in which isomorphism implies identity. (van Fraassen 2008, 226-227)

Van Fraassen is referring to Carnap’s example of the map of the Eurasian railroad network here, which Carnap himself is giving as an illustration of his conception of a system of structural definite descriptions in the *Aufbau* (cf. 1969, 25-27). In section 1.1.3 where I discussed Carnap’s view of this system, I also had a look at the conclusion Carnap draws from this, which I will repeat again here:

Thus, the result is that *a definite description through pure structure statements is generally possible to the extent in which scientific discrimination is possible at all*; such a description is unsuccessful for two objects only if these objects are not distinguishable at all by scientific methods. (Carnap 1969, 27)

This is the passage, which van Fraassen must have had in mind when identifying these three possibilities of understanding Carnap’s position that I have just cited. I want to comment on these three possibilities one by one in the following.

1.) Nature is so structured

If I understand van Fraassen correctly, it is possible according to this reading, to identify every object in a given domain through a system of structural definite descriptions, because the objects are in fact related to each other in a way that corresponds to these descriptions (cf. van Fraassen 2008, 226). At this point van Fraassen identifies a problem in the conception of the *Aufbau*, which I think is spurious. Van Fraassen refers to the example of the system of the Eurasian

railroad network when stating:

But if this system had some global symmetries, then the identifications would not be unique. What if we bring in more structural features, besides the railroad connection relation? Can we be sure that if we bring in enough – when we are at the level of ‘a system for the totality of all objects of knowledge’ we will not be plagued with such non-uniqueness? (van Fraassen 2008, 227)

In other words what guarantee is there, that two obviously different objects would not come out to have the same structural properties and thus being indistinguishable in a system of structural definite descriptions? Or, more generally, van Fraassen asks, how we can be sure, that the formal logical structure captures the empirical relations between the empirical objects science talks about. Now why do I think, that this question is misleading? First of all, I think it is necessary to clearly separate this question from the trivialisation problem. As already said bringing in “more structural features” as van Fraassen has it cannot solve the Newman problem, which is also seen by van Fraassen himself, since the Newman problem would arise even if we brought in all structural features there are available to us. (cf. van Fraassen 220). The reason why I think that van Fraassen’s account of the *Aufbau* is misleading here is best explained in Friedman (1999). Friedman raises a somewhat similar question there:

[T]he notion of logical form or structure is such that two different relations, such as the temporal order and the spatial order on a line, may have precisely the same formal structure. How, then, can two such relations be discriminated from one another solely on the basis of structure? (Friedman 1999, 97)

I think that this is exactly the same question that van Fraassen raised above. But unlike van Fraassen, Friedman has a definite answer to it:

Here is where the ‘fundamental thesis of construction theory’ comes into play: if we imbed all relations within a single global structure of relations, then we may hope to be able to discriminate (according to Carnap we *must* be able to discriminate) formally identical relations through their differing formal ‘places’ within this all-encompassing global structure [...]. This is why the unity of science – the unity of the object domain [...] – is so important to Carnap. (1999, 97-98)

Thus what makes van Fraassen’s worries seem spurious is the fact that two objects in the system of structural definite descriptions are discernible not just because of the formal properties of their structural definite descriptions (as van Fraassen seems to think), but also because of the *place*

within the global formal structure they own as Friedman argues. Friedman thereby also provides us with a deeper understanding of the theoretic role of the argument for the unity of science in the *Aufbau*, since he clearly describes why the unity of the object domain and thus the unity of science are theoretically necessary for Carnap to make his conception of a system of structural definite descriptions work at all. Anyway I think that this provides us with enough reasons to reject van Fraassen's account here. It is not the case, that the difficulty of non-uniqueness is threatening the whole constructional system at this point, as we have seen in Friedman's discussion of the problem. Therefore I will now move on to van Fraassen's second suggestion of reading the *Aufbau*.

2.) A transcendental justification

The passage, where Carnap is saying that the possibility of a system of structural definite descriptions is a presupposition of any science can of course inevitably be read in a transcendental way. But I think it is questionable if it should be read as a straightforward "justification for the assertion that knowledge of structure includes all the knowledge there is to be had." (van Fraassen 2008, 227) Of course one may want to emphasize a certain affinity to transcendental arguments here. One could even cite the neo-Kantian reading of Friedman and Richardson in favour of such an interpretation, since they are reading the *Aufbau* as a project to answer the question, how objective, rational knowledge of the world is possible at all. Anyway I think that van Fraassen's claim, that at this stage in the *Aufbau* we get a "transcendental justification" is misleading, even with the background of the neo-Kantian reading of Friedman and Richardson. Maybe one could put forward a weaker reading of this passage, according to which Carnap just wanted to say that he does not need to prove the possibility of such a system, since the actual existence of science accounts for it. In other words, there would not be successful scientific theories if it were not possible to identify objects by means of structural definite descriptions. The following passage seems to support this understanding: "Let it suffice for the moment to say that, *for science, it is possible and at the same time necessary to restrict itself to structure statements*. This is what we asserted in our thesis." (Carnap 1969, 29-30) I can see no clue for the strong transcendental reading that van Fraassen seems to suggest here. Taking this as transcendental justification would mean to apply the term "transcendental" to any argument, which states necessary conditions for anything, which is of course absurd.

3.) Isomorphism implies identity.

This is the last possibility of understanding Carnap here that van Fraassen is identifying. I think that this supposedly consequence of Carnap's position is straightforwardly mistaken. I have already quoted the relevant passage of the *Aufbau* to which I think van Fraassen is referring in making this point. There, Carnap concluded the example of the map of the Eurasian railroad network with the statement, that if two objects are not distinguishable through structural definite descriptions, they are not distinguishable at all for any *science* (cf. Carnap 1969, 27). The emphasis of the word "science" is crucial. I think that Carnap does not want to say that two objects are identical if they cannot be discriminated by means of structural definite descriptions, in a strong, ontological sense. All he says is, that "they are indistinguishable [...] for science in general." (Carnap 1969, 27) But that two objects are indistinguishable for science does not necessarily imply that they are identical in an ontological sense at least not without further argument. To conclude from that, that Carnap is adopting an ontological position, according to which, "isomorphism implies identity" (cf. van Fraassen 2008, 227) would mean, to ascribe a position to Carnap, according to which, science is to investigate into the nature or essence of things in a somewhat Kripkean style (cf. Kripke 1980, 110, 128-134). For only then would the fact that two objects are indistinguishable for science imply a statement about the metaphysics of these objects. This is most definitely not Carnap's intention and above that I also think that it is not a hidden consequence of Carnap's line of thought. Evidence for this can be gathered just by looking at §161 of the *Aufbau* as an example (cf. 1969, 256-257). There Carnap clearly distinguishes the concept of "constructional essence" from that of "metaphysical essence". The relevant passage reads as follows:

If we ask for the *constructional essence* of an object, we wish to know the constructional context of this object within the system, especially how this object can be derived from the basic objects. On the other hand, if someone asks for the *metaphysical essence* of an object, he wishes to know what the object in question is in itself. Such a question presupposes that the object does not only exist as a certain constructional form, but also as an 'object-in-itself', and this characterizes the question as belonging to metaphysics. This is frequently overlooked, and thus this same question is sometimes posed in science, which is nonmetaphysical, and where such questions have neither justification nor meaning. (Carnap 1969, 256)

From this passage we can see, that Carnap clearly is aware of the difficulty of avoiding metaphysical and in particular ontological claims. The claimed neutrality of construction theory with respect to the different epistemological schools (§178) is another indicator, that van Fraassen's view here is not an adequate reconstruction of the *Aufbau* (cf. Carnap 1969, 286-287). Of course one may ask the question, whether the claimed ontological neutrality can be achieved at all. I have raised a similar question in section 2.1.2 above, where I asked whether the position of epistemological structuralism (ES) does not collapse into ontological structuralism (OS) after all. But this would have to be shown in more detail however. The arguments van Fraassen is giving here do not suffice. I think that the conclusion that Carnap is forced to take up an ontological position according to which, structurally indiscernible objects are not only indistinguishable for science but also – much stronger – ontologically identical is not a plausible account of Carnap's thinking. The reason being that it is possible, or so I have tried to show, to phrase this problem of isomorphic structures in the *Aufbau* in purely epistemological terms, avoiding any ontological issues altogether.

To sum up my discussion of van Fraassen then, I do not think, that his account of the system of structural definite descriptions in the *Aufbau* is correct. As I have tried to show, I think there are good reasons for rejecting all three of the possibilities van Fraassen is considering of reading Carnap here.

On the other hand I do think that van Fraassen is right, with his assessment of the inability of the constructional system to distinguish between isomorphic relations (cf. 2008, 227). This point is also emphasised in a discussion of the programme of the *Aufbau* by Wybo Houkes (2002). He says: “[S]ince constitution theory may contain only purely structural definite descriptions, it cannot distinguish between isomorphic relations” (Houkes 2002, 294). But, unlike van Fraassen, Houkes does not point in the direction of the Newman problem here.

I think that van Fraassen is certainly right when it comes to the question, whether the Newman-problem is also threatening the programme of the *Aufbau*. He draws somewhat the same conclusions, as do Demopoulos and Friedman, although his evaluation is slightly different from theirs. For van Fraassen the difficulty boils down to the following fact:

“The elimination must replace relation descriptions by structure descriptions, as we saw above, that is to say, by assertions that there are relations having certain properties, and instantiated in certain ways. (2008, 227)

The properties these relations must have are of course their formal properties. In the case of the basic relation of the constructional system outlined in the *Aufbau*, the relation was binary and asymmetric. That the relations are instantiated in certain ways can be empirically checked on the basis of the empirical statements of a constructional system. Now van Fraassen draws the expected conclusion:

But now (section 154) he notices a difficulty—in effect the very same difficulty that M.H.A. Newman pointed out to Russell just a little later. If a statement to the effect that there are relations having certain properties and are instantiated in certain ways is framed entirely in logico-mathematical terms then it can be satisfied in any set of sufficient size. (van Fraassen 2008, 227)

So also to van Fraassen there can be no doubt, that Carnap is actually meeting the same problem as Russell in *The Analysis of Matter*. But he still goes a step further and tries to draw a much more general conclusion for which the problem of trivialisation in the *Aufbau* is just a special case:

[W]e see two problems for the concept of science as a representation by means of mathematical models. First of all [...], there are distinct but isomorphic structures discernible in nature, but mathematical models will capture only the structure that is common to them. [...] Secondly, [...] given any significant limitation on what is observable or detectable by us, there will be many non-isomorphic structures that fit what we do observe or detect. (van Fraassen 2008, 228-229)

We see from this, that for van Fraassen the problem has two directions as it were. I think the first direction he is considering is just a reformulation of the TSD. To any relation discernible in nature, there will (trivially) be isomorphic relations. The second direction brings in a new aspect. If my reading is correct, then van Fraassen here is saying, that there will be distinct structural descriptions that “fit” the same observable phenomena, but are not isomorphic. With this assessment van Fraassen certainly goes beyond the scope of Newman’s criticism. I am also not sure, whether this poses a problem for Carnap’s *Aufbau*. On the contrary it rather would seem to me, that Carnap could go along well with this conclusion. The reason being that the possibility of many distinct constructional systems seems to capture that outcome of van Fraassen’s discussion (cf. Carnap 1969, 99). In this line of reasoning there would be e.g. a constructional system with autopsychological basis, as outlined in the *Aufbau*, say CS_1 and a system with physical basis say CS_2 . Now two respective definitions of CS_1 and CS_2 are not isomorphic, since they rely on

different basic concepts and on different sets of basic elements. Therefore one and the same object may be constructed at a rather early stage in CS_1 while in CS_2 it would be an instance of a definition of a higher level. Nevertheless, we would have two non-isomorphic structural definite descriptions of the same object without any further epistemological problem. Therefore I think, that the second direction of van Fraassen's conclusion will not be a serious problem for Carnap's construction theory. However, the first direction, which I take to be a reformulation of the TSD will be a problem for Carnap's *Aufbau* as we will see in part three.

For van Fraassen the discussion of Newman, Russell and Carnap has a much more general aim. What is at stake for him in the end is the question of how it is possible to generate knowledge of the empirical world by means of any mathematical representation at all (cf. van Fraassen 2008, 228). However the scope of my thesis has a much narrower range. In the final part, which is now following I will only investigate into the Newman problem in Carnap's *Aufbau*.

3. The Newman-problem in the *Aufbau*

In this final part, I will come to the very heart and core of my thesis. The question, which is going to be raised now is whether the Newman-problem, in the sense that I have ascribed to it in chapter two above, really is affecting Carnap's project of giving structural definite descriptions in the *Aufbau* as (Demopoulos/Friedman 1985), (Friedman 1999) and (van Fraassen 2008) have claimed. That means, that I will investigate whether the TSD and the EP are a consequence of the conception of construction theory. In other words, the question is whether the system of structural definite descriptions is threatened by the trivialisation problem like Russell's account of structuralism was. In section 3.1 I will investigate in full detail whether this is the case. Section 3.2 is then adding some clarifications as to the relation between Carnap's project and modern structural realism before drawing a general conclusion.

3.1 The trivialising result in Carnap's construction

3.1.1 After eliminating the basic relation

We have seen so far how Carnap thinks of a solution to the problem of defining the basic concept of a constructional system. In this section we are going to see why this solution is defective and why the *Aufbau* suffers from the same difficulty as purportedly any other structural account of knowledge.

I want to follow Carnap's line of thought step by step.

We had assumed that, after a replacement of one set of basic relations by another, the constructional formulas of the system would not remain applicable, and the empirical statements would cease to hold. (Carnap 1969 235)

This marks the point where we left off in section 1.2. Now Carnap continues:

However, our assumption is justified only if the new relation extensions are not arbitrary, unconnected pair lists, but if we require of them that they correspond to some experienceable,

‘natural’ relations (to give a preliminary, vague expression). (1969, 235-236)

This might be hard to follow since Carnap is here talking about a precondition of falsehood, i.e. about conditions under which the constructional definitions would not be adequate. So it seems that for Carnap it is important, that substitution of the basic concept in a given constructional definition can result in an expression, which does not function as a proper definition of a certain object or which does not have any meaning at all. This is for the following reason:

If no such requirement is made, then there are certainly other relation extensions for which all constructional formulas can be produced. However, in such a case, the construction leads to other entities than with the original relation extensions, but, for these other entities, the same empirical statements still hold as for the original ones (that is to say, the symbols for these statements are still the same, but they now mean something different). (1969, 236)

I think this passage shows that Carnap in fact was recognising the same problem, as was Newman. I will put this under closer scrutiny in the following section.

3.1.2 The TSD and the EP in the *Aufbau*

From the discussion in section 1.1.3 we know already, that in a structural definite description, only the formal properties of relations are considered, i.e. only such properties, which are representable by the logical apparatus of type-theoretic logic as it were. Bearing that in mind it does not present any difficulty to make clear Carnap’s point from above. Consider any constructional definition of the particular construction system of the *Aufbau*, i.e. one, which relies on the basic relation *Rs*:

$$X =_{df} (\dots Rs \dots) \tag{8}$$

We already know, that the basic-relation *Rs* has the formal property of being asymmetric. Therefore it follows, according to what Carnap said in the passage cited above, that the constructional definition, represented by sentence (8), can be trivially produced by any other relation, say *Rs’*, as long as it has the formal property of being asymmetric. Thus we would get a second definition on this basis:

$$X' =_{df} (\dots Rs' \dots) \tag{9}$$

It is important to distinguish the operation, which generated (9) out of (8) from the operation, which generated (6) out of (5) in section 1.2.1 above. In the first case, Carnap was thinking about the possibility of substituting one basic concept for another. The question, which gave rise to this thought, was simply whether it is possible to define any object in an alternative way, i.e. with an alternative basic concept.

In the case presented here, the assumption was, that any other relation with the same formal properties could substitute the basic relation R_s in a given definition. The definition of the object X would then not at all differ in all its formal aspects and since the formal properties are the only ones a constructional system is intended to represent, this operation might just seem legitimate and unproblematic. But now the problem begins to manifest. The important and devastating consequence is, that construction theory, as envisaged by Carnap, has no resources altogether to distinguish definition (8) from (9), since R_s and R_s' have the same formal properties, they are isomorphic and hence indistinguishable. Of course one would want to say, that it were possible to distinguish sentence (8) from (9) by saying that R_s is the relation of *recollection of similarity*, while R_s' is nothing but an arbitrarily chosen binary relation with the formal property of being asymmetric. But within the scope of construction theory, this difference just cannot be spelled out.

Let us recall now Newman's example for the concept of sameness of structure.²⁷ The two relations involved in his thought were "being acquainted" and "joined by a line", instead of R_s and R_s' as in our case here. But apart from that, the situation is the very same. We are confronted with two relations that we know to be qualitatively different from one another, but which are nonetheless indiscernible in their formal properties. Furthermore it is a matter of a simple paper and pencil exercise to create a copy of a particular constructional system, relying on basic relations which indeed have all the same formal properties, but nevertheless are different when it comes to their empirical or – as Carnap has it – *experienceable* content (cf. 1969 236). Thus Carnap says:

All we have to do is to carry out a one-to-one transformation of the set of basic elements into itself

²⁷ See (Newman 1928, 139) and section 2.1 above.

and determine as the new basic relations those relation extensions whose inventory is the transformed inventory of the original basic relations. In this case, the new relation extensions have the same structure as the original ones (they are ‘isomorphic’ [...]). (Carnap 1969, 236)

Now I think this passage makes it obvious that what Carnap here described is exactly the same problem that Newman pointed out to Russell. In this passage Carnap shows, that the trivialising result can be easily created, given any set and a structural description of the relations between the members of this set, just as Newman showed that the relation “being acquainted with” on set A and the relation “joined by a line” on set B have the same structure, just because of their formal properties (cf. 1928, 139).

We can now spell out this analogy in full detail:

Where Newman has the set A as random collection of people, Carnap’s basis is the set of basic elements of the constructional system. The relation of “being acquainted with” in Newman’s example is just the basic relation of *recollection of similarity*, *Rs* in the *Aufbau*. Finally the set B in Newman’s example would correspond to the copy of basic elements into itself that Carnap speaks of in the above just cited passage. Now just as Newman comes up with the relation “joined by line” which has an isomorphic structure as “being acquainted with”, Carnap, comes up with a “transformed inventory of the original basic relations” (1969, 236) which I have labelled *Rs’* above and which is isomorphic to *Rs*.

I think that I have made sufficiently clear now, that the argument in (Newman 1928, 139) is analogous to the one in (Carnap 1969, 235-236). Therefore I think that the claim of Demopoulos and Friedman is correct and we are allowed to conclude, that the TSD poses a problem for the particular constructional system Carnap outlined in the *Aufbau* (cf. Demopoulos/Friedman 1985, 636; Friedman 1999, 102-103; van Fraassen 2008, 227). Above that I want to argue that the TSD will pose a problem for any constructional system, i.e. for construction theory as a whole. The reason being that a copy of the set of basic elements into itself can be made, whatever particular basis may be chosen.

The next question we will have to raise is, whether the *Aufbau* also suffers from the epistemological problem, the EP, as does Russell’s structuralism.

Let us see what Carnap’s own conclusion from the TSD in the *Aufbau* amounts to:

From this it follows that, to each originally constructed object, there corresponds precisely one new

one with the same formal properties.²⁸ Thus all statements of the constructional system continue to hold, since they concern only formal properties. However, we can then not find any sense for the new basic relations; they are lists of pairs of basic elements without any (experienceable) connection. It is even more difficult to find for the constructed objects any entities which are not in some way disjointed. (Carnap 1969, 236)

Now the crucial point is Carnap's formulation, that there would not be any *sense* for the constructed objects on the basis of *Rs*'. This can only mean, that the construction would then fail to deliver the intended result, which means, they would not express any empirical content. But if so, then the only content they do express is formal-logical. Thus, as Friedman concludes: "[A]ssuming that our chosen empirical conditions are themselves logically consistent, the existence claim implicit in our definition of the basic relation(s) will be a logico-mathematical truth" (Friedman 1999, 102-103). Hence the statement, that there exists a relation that satisfies a certain empirical statement of a certain constructional system is not subject to any empirical discovery, since such a relation exists trivially. Therefore we can conclude that also the EP poses a threat to the constructional system of the *Aufbau*.

In showing that the TSD as well as the EP have exact analogues in the *Aufbau* I have tried to give substance to Demopoulos' and Friedman's observation, that Carnap is facing and in effect recognizing the very same difficulty that Newman pointed out to Russell's structuralism. I will conclude this discussion with a look at Carnap's proposed solution to the problem.

3.1.3 Founded relations and important relations – a way out?

Most interestingly Carnap himself is discussing a possible solution to the problem he has to face in the *Aufbau*; a solution which is also a perfect analogue for the distinction between important and unimportant relations that Newman discussed (cf. Demopoulos/Friedman 1985, 636-637). We will see how this solution is going to look like.

In the antecedent section, we have seen how the TSD is affecting the *Aufbau*. Any relation can satisfy the structural definite description of the basic relation trivially, provided it has the same

²⁸ It is important to bear in mind, that Carnap here is referring to his own example, which involves an exact copy of the set of basic elements. It is because of this, that he can say that there exists *exactly one* new object with the same formal properties.

formal properties as the original basic relation. Carnap is responding to this problem, by restricting the number of possible relations (cf. Friedman 1999, 103). Since the problem was that there would be relations, which do not express any empirical content, satisfying nonetheless the constructional definitions, Carnap is introducing a further class of relations:

“In contrast to relations of this sort, we wish to call relation extensions which correspond to experienceable, ‘natural’ relations *founded relation extensions*.” (1969, 236) This means that Carnap intends to introduce a class of relations, which express some empirical content. Now for Demopoulos and Friedman this purported solution amounts to the simple fact, that Carnap “proposes to do precisely what we saw Newman recoil from, above: he wants to reckon ‘importance’ (foundedness) as ‘among the prime unanalysable qualities of the constituents of the world’!” (1985, 637) As Michael Friedman points out:

Carnap responds, then, precisely by restricting the range of our variable: we are not to consider all relations – which, as mere mathematical sets of pairs, may be “arbitrary, unconnected pair lists” – but we are to restrict ourselves to “experienceable [*erlebbaren*], ‘natural’ relations” or what Carnap calls “*founded*” relations [...] (Friedman 1999, 103).

I want to examine Carnap’s attempted solution more closely in the following.

What does the concept of *foundedness* exactly mean? First of all, Carnap says: “The concept of foundedness is *undefinable*.” (Carnap 1969, 236-237) This goes without saying, since if it would be definable – that is in terms of construction theory: if there would exist a structural definite description defining the concept of foundedness – the problem would repeat itself. For this constructional definition would have to rely on a certain basic concept and we would then have to ask, how this in turn can be eliminated and we would have to start all over again. “It also can not be derived from the (customary) basic concepts of formal logic” (Carnap 1969, 237). Whereas the concept of equivalence can be defined in terms of the concepts of transitivity, reflexivity and symmetry, being all basic concepts of logic, such a derivation is not possible for the concept of foundedness. “On the other hand, it does not belong to any definite extralogical object domain, as all other nonlogical objects do.” (Carnap 1969, 237) If it would belong to such an extralogical object domain, then it would be possible to give a structural definite description of it. But then, as in the case before, the problem won’t be solved.

In this desperate situation, Carnap develops a somewhat surprising solution to this problem:

Our considerations concerning the characterization of the basic relations of a constructional system

as founded relation extensions of a certain kind hold for every constructional system of any domain whatever. It is perhaps permissible, because of this generality, to envisage the concept of foundedness as a concept of logic and to introduce it, since it is undefinable, as a *basic concept of logic*. (1969, 237)

This might seem surprising at best. Carnap is arguing, that the concept of foundedness is comparable to the concept of generality and might therefore be considered as basic concept of logic:

That this concept is concerned with the *application* to object domains is not a valid objection to introducing it as a basic concept of logic. The same is true for another basic concept of logic, namely, generality [...]. Logic is not really a domain at all, but contains those statements which (as tautologies) hold for the objects of any domain whatever. From this it follows that it must concern itself precisely with those concepts which are applicable to any domain whatever. And foundedness, after all, belongs to these concepts. (Carnap 1969, 237)

However the argument, that foundedness would be applicable to any object domain and therefore count as concept of logic seems not convincing at all. Thus Alan Richardson comes to the following conclusion on this supposedly solution:

This argument seems extraordinarily bad. The analogy with the universal quantifier is obscure and misleading. Foundedness is, after all, nothing more than an undefined property of relations and plays nothing like the role of the quantifier. (Richardson 1998, 88)

And in the following he adds: “Moreover, foundedness seems to smuggle directly into logic precisely the difficulty to be overcome.” (1998, 89).

The evaluation of Demopoulos and Friedman is even more devastating, since they call such a solution straightforwardly “absurd” (cf. 1985, 637). Friedman accords with Richardson on the estimation that Carnap thereby undermines the whole project of the elimination of the basic relation of the *Aufbau*. Thus he asks:

But what can the “experienceable, ‘natural’ relations” be except precisely those relations somehow available for ostension? Our original motivations, in other words, have been totally undermined by Carnap’s final move. (Friedman 1999, 103)

Similarly Houkes (2002): “This proposal appears to solve the problem of univocalness at the

price of objectivity. For is ‘foundedness’ not every bit as subjective as the original recollection of similarity?” (Houkes 2002, 294) Van Fraassen arrives at the same conclusion:

As Newman pointed out, any distinction of this logical form blocks the trivializing argument. In that sense, Carnap has solved his problem, formally speaking. But does this not give up entirely on the structuralist programme he had announced? That a relation is ‘experienceable’, ‘natural’ is not something that can be formulated using only logical vocabulary. (2008, 228)

Of course this question brings us right to the point of the problem. I think in an important sense the situation for the *Aufbau* after the elimination of the basic relation is even worse than it was before. To be sure Carnap has argued convincingly for the necessity of C_3 , i.e. for the definition of the basic concept in order to achieve the aim of a complete formalization, which in turn is necessary to give substance to the idea, that every scientific statement can be translated into a statement about structure alone. However in light of the situation we are confronted with now, and with regard to Friedman’s and van Fraassen’s evaluation of this situation, it might seem that a single primitive concept at the bottom of the system is not as much a damage for the programme of the *Aufbau*, as is an altogether unconvincing concept of *foundedness*.

On the other hand, there are positions according to which, the problem is not that bad. Against such a straightforward rejection of Carnap’s solution speaks e.g. Mormann (2001) who claims that one could make sense of the concept of foundedness with a specific understanding of the word “experienceable”. Thus Mormann writes:

Against Friedman, one may argue that “experienceable” for Carnap here meant something like “scientifically experienceable”. Thereby, the objectivity of the constitutional system and the naturalness of its founding relation depends on its capacity of reconstructing the system of scientific knowledge.” (2001, 331)

However I do not think that one can rightfully attribute such an understanding of the term “experienceable” to Carnap in the *Aufbau*. Carnap’s own estimation of his purported solution is also an argument against this view, since it is, most notably, also Carnap himself who admits that this solution is at best short-term and consequently that there lies an “unresolved problem” (Carnap 1969, 238).

It is the same problem, which prompted Newman to argue against the division between structure and quality altogether, as we have already seen (cf. Newman, 1928, 147). Newman explains the

reasons for this negative conclusion as follows:

In the present case we should have to compare the importance of relations of which nothing is known save their incidence (the same for all of them) in a certain aggregate. For this comparison there is no possible criterion, so that ‘importance’ would have to be reckoned among the prime unanalysable qualities of the constituents of the world, which is, I think, absurd. (Newman 1928, 147)

It seems now that Carnap is here in perfect accordance with Newman, but nonetheless ready to rather accept this attempted short-term solution than to have none at all. So we see in the last consequence, that Newman’s objections to Russell’s structuralism can be applied almost in its entirety to the project of the *Aufbau*. Although Carnap is aware of the fact, that there is an open problem left in construction theory, he does not pick up this line of enquiry again after its publication in 1928.

3.2 Outlook and conclusion – structural realism in the *Aufbau*?

The central aim of my thesis was to give substance to the claim of Demopoulos and Friedman (1985) that the *Aufbau* suffers from the very same difficulty that Newman pointed out to Bertrand Russell’s *Analysis of Matter*. We have seen that van Fraassen (2008) also argues for this view. However we have also seen, that his discussion rests on a reading of Carnap’s *Aufbau* which I have criticised for several reasons. Nevertheless I think that they all are correct when it comes to their position on the question, whether the Newman problem will be a consequence of construction theory. In part three of my thesis I have tried to give a detailed reconstruction of this. I have argued that the TSD as well as the EP arise as a consequence of the elimination of the basic concept of a constructional system. Above that I have also argued, that Carnap’s suggestion of the introduction of the concept of foundedness is analogous to Newman’s discussion of distinguishing important from unimportant relations, the only difference being, that Carnap accepted this solution for not having any better one at hand, or so it seems. Therefore I think to have given some support to Demopoulos/Friedman (1985) and van Fraassen (2008). Hence the conclusion of my thesis is that the Newman problem is a threat for the particular constructional system Carnap developed in the *Aufbau* as well as for construction theory as a whole. Above that

Carnap simultaneously discovered the very same problem as Newman did and interestingly enough also thought of the same strategy of solving the issue. The only difference being, that Newman rejected such a solution while Carnap embraced it, although he clearly was aware of the insufficient nature of this solution.

What is of interest from the perspective of a historical and exegetical approach to Carnap's *Aufbau* is the intimate connection to structuralist accounts of scientific knowledge that seems to exist and is also mentioned in Demopoulos/Friedman (1985) as well as in van Fraassen (2008). However one must bear in mind, that Carnap's project cannot straightforwardly be identified with modern structural realism. There are at least four differences that I want to mention here.

1.) The method of ramsification

What distinguishes the programme of the *Aufbau* from the structuralist accounts, or at least some of these, under discussion here is, that the *Aufbau* does not use or rely in any way on the method of ramsification (cf. Ketland 2004, 287-288; Ladyman 1998, 411; Demopoulos/Friedman 1985, 622-623, 625)

2.) The observable/unobservable distinction

For positions of structural realism, the question of the status of the unobservable or theoretical entities of a theory is important (cf. Worrall 2007a, 274). The system of the *Aufbau* does not make any such distinction. On the contrary, the programme intends a complete formalization of any concept whatsoever (cf. Demopoulos/Friedman 1985, 625).

3.) A theory of theories

Structural realism can be interpreted as a theory of theories. This means that it is concerned with questions about the content of scientific theories and its preservation through phases of theory change (cf. Worrall 2007a 270-271; Ladyman 413-415).²⁹ The system of the *Aufbau* in contrast cannot be described in this way. Carnap is not concerned with issues of theory change or the preservation of content of theories. The programme of the *Aufbau* would have to be described

²⁹ See Ladyman (2011), which provides an interesting and illuminating discussion of the historic case of phlogiston theory as an example for preservation of structure during phases of theory-change.

rather in epistemological terms (cf. Friedman 1999, 116)

4.) Structure and Ontology

In section 2.1.2 above I have raised the question, whether any account of structural realism as a position of epistemology would not collapse into structuralism as a theory about ontology after all. On the other hand we have also seen, that the *Aufbau* claims to be ontologically neutral. So it seems that also in this respect there is a difference between structural realism and the programme of the *Aufbau* since the aim of construction theory is not at all to defend any particular form of realism. However of course the question raises, whether this claimed ontological neutrality can be upheld consistently at all.

I therefore think, that a straightforward structuralist reading of the *Aufbau* has some problems from the beginning but certainly not insurmountable ones.

There is a lot of further work to do. First of all I think there can be said a lot more about the Newman problem and its consequences for any constructional system. In this respect one would have to investigate further into the direction of Friedman (1999). In a footnote Friedman adds the following interesting remark on the issue: “I no longer view the difficulty of §§ 153-5 of the *Aufbau* as such a fundamental one.” (Friedman 1999, 105 footnote) It would exceed the scope of my thesis however, to investigate further in that direction.

Above that it would be an interesting line of reasoning to explore further the affinities and relations between the programme of the *Aufbau* on the one hand and structural realism on the other. Of particular interest would be the question what there is to be said about the relation between the modern positions and construction theory in general, without reference to the particular construction system Carnap developed in the *Aufbau*. In this respect the project of Hannes Leitgeb (2011) of trying to develop an alternative, modified construction theory, which should preserve the spirit while correcting the shortcomings of the original would be of central interest. However I must also leave this investigation for future work to do.

Maybe my discussion here can lay the foundations for a future interpretation of the *Aufbau* as an ancestor of modern structural realism now that we know that it suffers from the same problem, as does Russell’s structuralism.

4. Literature

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5. Appendix

5.1 Abstracts

5.1.1 Abstract – English

My thesis will be a philosophical and to some extent historical study on a very specific passage in Rudolf Carnap's classic *Der Logische Aufbau der Welt/The Logical Structure of the World*, first published in 1928. In the *Aufbau* Carnap tries to establish a system of consecutive definitions, called the constructional system. Equipped with the logical apparatus of the then newly developed methods of the theory of types, Carnap tries to define concepts in a way that two conditions are fulfilled: 1.) Every definition of a concept at any stage in the system can be reduced to one or more basic concepts which stand at the bottom of the system; 2.) Every definition contains just the symbol for the basic concept plus logical vocabulary, so that the only non-logical sign in any constructional-definition is the sign for the basic concept. The main thesis of the *Aufbau* is that it is possible to define any concept used in any science in a way, that the definition fulfills conditions (1) and (2). The problem which will be central for my thesis arises, because Carnap still wants to go a step further and show, that even the basic concept can be defined in a way, that it contains only logical-vocabulary. Carnap calls this process "elimination of the basic relation". After eliminating the basic concept however, a problem arises, since the constructional definitions now lack every empirical content and will be satisfied by *any* concept, which has the same formal properties of the eliminated basic concept. At this point I want to have a look at positions which state, that the problem Carnap faces because of the elimination of the basic concept, has a structural analogue which was discovered just about the same time as the *Aufbau* was written. In 1927 the mathematician Henry Newman published critical remarks against Bertrand Russell's *The Analysis of Matter*. The very core of this criticism, the so called trivialization-problem, is nowadays referred to as the Newman-Problem. Briefly it states, that the statement, that a set M of objects exemplifies a structure S does not contain any important information on M , since any set M' can be arranged so as to instantiate structure S , provided M and M' have the same cardinality. William Demopoulos and Michael Friedman were the first to argue, that Carnap is facing the very same problem in the *Aufbau*, because of the elimination of

the basic relation. The aim of my thesis is to put this view under closer scrutiny and to show in detail how the Newman-problem arises in the conception of the *Aufbau*.

5.1.2 Abstract – Deutsch

Die vorliegende Arbeit versteht sich als philosophische und in gewissem Maß historische Studie zu einer bestimmten Passage in Rudolf Carnaps klassischem Werk *Der logische Aufbau der Welt*, das 1928 erstmals veröffentlicht wurde. Carnap unternimmt im *Aufbau* den Versuch, ein System von aufeinander aufbauenden Begriffsdefinitionen zu erstellen, das sogenannte Konstitutionssystem. Ausgestattet mit den formalen Methoden der damals neu entwickelten Typentheorie, sollen Begriffe so definiert werden, dass die Definitionen folgende Bedingungen erfüllen: 1.) Jede Definition eines Begriffs, auf jeder beliebigen Stufe des Systems ist reduzierbar auf ein oder mehrere Grundbegriffe, die die Basis des Systems bilden; 2.) Jede Definition enthält nur das Symbol für den Grundbegriff und logische Zeichen, so dass das einzige nicht-logische Zeichen in einer beliebigen Definition dasjenige für den Grundbegriff ist. Die Hauptthese ist, dass es prinzipiell möglich ist, alle Begriffe aus allen Wissenschaften so zu definieren, dass die Definitionen diesen zwei Bedingungen genügen. Das Problem das in der vorliegenden Arbeit im Zentrum steht hat damit zu tun, dass Carnap noch einen Schritt weiter gehen und zeigen möchte, dass selbst der Grundbegriff eines Konstitutionssystems, so definiert werden kann, dass die Definition keine nicht-logischen Zeichen enthält. Carnap bezeichnet diese Definition als *Eliminierung der Grundrelation*. Nach dieser Definition des Grundbegriffs stellt sich aber ein schwerwiegendes Problem, denn die Definitionen des Konstitutionssystems haben nun keinerlei empirischen Inhalt mehr und können von jedem Begriff erfüllt werden, der die selben formalen Eigenschaften hat, wie der zuvor eliminierte Grundbegriff. An diesem Punkt möchte ich einen Blick auf Positionen werfen, denen zufolge der britische Mathematiker M.H.A. Newman genau dasselbe oder zumindest ein analoges Problem in Bertrand Russell's *The Analysis of Matter* identifiziert hat. Im Jahr 1927 veröffentlicht Newman seine Kritik am Strukturalismus Russells, deren Kern, das sogenannte Trivialisierungsproblem, heute auch Newman-Problem genannt wird. Es besagt, dass die Aussage, dass eine Menge M eine Struktur S exemplifiziert, keine andere Information über die Menge M liefert als eine Angabe über ihre Kardinalität, weil trivialerweise die Elemente in jeder Menge und so auch insbesondere in M' so angeordnet werden können, dass sie die Struktur S exemplifizieren, vorausgesetzt nur M und M' haben dieselbe Kardinalität. William Demopoulos und Michael Friedman waren die ersten die dafür argumentiert haben, dass das Problem auf das Carnap im Zuge der *Eliminierung der Grundrelation* im *Aufbau* stößt, im Grunde genommen das Gleiche ist wie das, das Newman in Russells Strukturalismus entdeckt

hat. Ziel meiner Arbeit ist es, diese Argumentation einer genauen Untersuchung zu unterziehen und im Detail nachzuvollziehen, wie das Newman-Problem im *Aufbau* aufkommt.

5.2 Curriculum Vitae

Robert Frühstückl
robert.fruehstueckl@univie.ac.at

Ausbildung und berufliche Laufbahn

- 2006:** Matura mit gutem Erfolg am BORG Grieskirchen, OÖ
- 2006:** Zivildienst für die Caritas der Diözese Linz
- 2007:** Aufnahme des Studiums der Philosophie an der Universität Wien.
- 2009:** Studienassistent bei Prof. Dr. Antje Kapust im WS 2009/10 am Institut für Philosophie an der Universität Wien.
- 2009:** Gründungsmitglied des Wiener Forums für Analytische Philosophie.
- 2010:** Bakkalaureat mit Auszeichnung in Philosophie mit Arbeiten über Richard Rorty und Ernst Tugendhat.
- 2010:** Aufnahme des Masterstudiums History and Philosophy of Science.
- 2011:** Seit 1.10.2011 Studienassistent für die Doktoratsstudienprogrammleitung der Fakultät für Philosophie und Bildungswissenschaft.
- 2012:** Seit 04.12.2012 Mitarbeiter am Studienservicecenter Philosophie an der Fakultät für Philosophie und Bildungswissenschaft der Universität Wien.

Wissenschaftliche Aktivitäten

- Vorträge:** „*Kripke and the Unity of the Proposition – a Relation between Rigid Designators?*“ gehalten am 28. November 2010 im Rahmen der Third Joint Conference of the Philosophy Division of the WU Vienna University of Economics and the Vienna Forum for Analytic Philosophy (WFAP). Topic: Predication and the Unity of the Proposition.

„*Rigidity of General Terms - A Case for Essential Properties?*“ gehalten am 2. Juni 2011 am 9. Kongress der Österreichischen Gesellschaft für Philosophie.

„*I have my reasons - Edward Craig on Testimony and Epistemic Justification*“ gehalten am 34. Internationalen Wittgenstein Symposium in Kirchberg 10. August 2011.

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