

Carnap's Turn to the Thing Language

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Résumé : Les contributions de Carnap au Congrès de 1935 marquent un triple changement dans sa philosophie : son tournant sémantique ; ce qui sera appelé plus tard « la libéralisation de l'empirisme » ; et son adoption du « langage des choses » comme base du langage de la science. C'est ce troisième changement qui est examiné ici. On s'interroge en particulier sur les motifs qui ont poussé Carnap à adopter le langage des choses comme langage protocolaire de la science unifiée et sur les vertus de ce langage, comparé aux autres types de langage protocolaire.

Abstract: Rudolf Carnap's contributions to the Paris 1935 Congress for scientific philosophy signal three important changes in his philosophy: his semantic turn; what would later be called the "liberalization of empiricism"; and his adoption of the so-called thing language as a basis for the language of science. This paper examines this third change. In particular, it considers Carnap's motivation for adopting the thing language as the protocol language of unified science and the virtues of the thing language in comparison with other types of protocol language.

Three important changes, or turns, in Rudolf Carnap's philosophy can be observed, perhaps for the first time in Carnap's works, in his contributions to the Paris 1935 Congress for scientific philosophy.¹ The first is what was later called the "liberalization of empiricism", effected to a large extent by the introduction of the notion of a reduction sentence. The second is Carnap's semantic turn. Although this turn would be properly realized only some years after the Paris Congress, it was at Paris that Carnap for the first time embraced the new science of semantics, discussed in more detail there by Alfred Tarski [Tarski 1936] and Maria Kokoszyńska [Kokoszyńska 1936]. The third—and, I believe, a less appreciated—turn in Carnap's philosophy signalled at the

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1. The French title of the Congress was *Congrès international de philosophie scientifique*, the German title *Erster Kongress für Einheit der Wissenschaft*; for details, see [Stadler 1997, 402–412].

Paris Congress is his introduction of the so-called thing language as a basis for the language of science. This thing language had been hinted at in some of Carnap's earlier writings, but it is only around the time of the Paris Congress that Carnap came to realize that it may serve as a basis for the whole language of unified science.

Carnap's turn to the thing language was definitive, not renounced in later work; and it was important for several reasons. As I shall argue in section 2 below, the thing language, as well as any language built up from it, readily allows for the confrontation of its sentences with experience. It will be shown in section 1 that whether such confrontation is at all possible had been put into doubt by Neurath and was not obvious from Carnap's account of the language of unified science during his "syntactic period". Moreover, as a protocol language the thing language is intersubjective, in contrast to the protocol language assumed by Carnap previously, which was "solipsistic" (section 3). Adopting the thing language, finally, facilitates an account of how the quantitative concepts of physics are formed on the basis of the qualitative concepts of our everyday "life-world" (section 4).²

1 Language and world

Otto Neurath insisted that the attempt to compare a sentence with the world involves a "senseless duplication" and is tantamount to metaphysics [Neurath 1931b, 403]. In place of reality we should speak only of the class of accepted sentences, and that a sentence is true can only mean that it agrees with all of the sentences of this class [Neurath 1931a, 299].³ Hence, as philosophers, or rather, scientists—for Neurath there is no discipline of philosophy separate from unified science—we must remain at the level of language:⁴

Language is essential for science; all transformations of science take place *within* language, not by confrontation of language with a "world", a totality of "things", the manifold of which language is to represent. To attempt that [sc. such a confrontation] would be metaphysics. [Neurath 1931a, 300]

2. All translations from German into English are my own.

3. "Wenn eine Aussage gemacht wird, wird sie mit der Gesamtheit der vorhandenen Aussagen konfrontiert. Wenn sie mit ihnen übereinstimmt, wird sie ihnen angeschlossen, wenn sie nicht übereinstimmt, wird sie als 'unwahr' bezeichnet und fallen gelassen, oder aber der bisherige Aussagekomplex abgeändert, so daß eine neue Aussage eingegliedert werden kann; zu letzterem entschließt man sich meist schwer. *Einen anderen 'Wahrheitsbegriff' kann es für die Wissenschaft nicht geben.*"

4. "Die Sprache ist für die Wissenschaft wesentlich, innerhalb der Sprache spielen sich alle Umformungen der Wissenschaft ab, nicht durch Gegenüberstellung der Sprache und einer 'Welt', einer Gesamtheit von 'Dingen', deren Mannigfaltigkeit die Sprache abbilden soll. Das versuchen wäre Metaphysik."

Neurath directed these protestations against the idea of comparing a sentence with a world at least in part against Carnap. In Carnap's book *Der logische Aufbau der Welt* [Carnap 1928] a sentence was deemed to have a "verifiable sense" only if it was possible to reduce it to a sentence about elementary experiences [Carnap 1928, §§ 179–180], namely by successively replacing within it defined terms by their *definienda* until a sentence containing only primitive terms of the constitution system resulted [Carnap 1928, § 119]. In a manuscript from 1930 Carnap writes:⁵

In order to verify a sentence p , I have to compare p with the state of affairs that p expresses. [Carnap 1930a, 9]

Thus, in 1930 Carnap still thinks that the idea of comparing a sentence with the world, in particular with a state of affairs, is in good standing. Before completing "Die physikalische Sprache als Universalsprache der Wissenschaft" [Carnap 1931a] about two years later, Carnap must, however, have changed his mind, for in that paper one finds no trace of the idea of comparing a sentence with a world. That Neurath had been instrumental in bringing about this change of mind Carnap himself remarks in a footnote in "Universalsprache" [Carnap 1931a, 452]. Indeed, Carnap says in that footnote that by drawing the distinction between the formal and the material mode of speech, and working out the consequences of this distinction, he has reached "results that fully justify the Neurathian standpoint" [Carnap 1931a, 452].

In "Universalsprache" [Carnap 1931a] and its twin article "Die Psychologie in physikalischer Sprache" [Carnap 1932b], to verify a sentence p does not mean to compare p with a state of affairs or with anything else of a non-linguistic nature, but rather to derive from p sentences of the so-called protocol language and then to see whether the derived sentences belong to the actual protocol:⁶

The verification of system sentences by a subject S takes place thus, that from these sentences sentences of S 's protocol language are derived and compared with the sentences of S 's own protocol. [Carnap 1932b, 108]

Likewise, in "Überwindung der Metaphysik", a word a is deemed meaningful only if it has been laid down from which protocol sentences the so-called elementary sentence associated with a can be derived [Carnap 1931b, 224]. Carnap thus assumes that there is a certain language, called the protocol language, the sentences of which are said, in the material mode of speech, to concern "the given" [Carnap 1931a, 438]. A subject's protocol is a collection

5. "Um einen Satz p zu verifizieren, muss ich p mit dem Sachverhalt vergleichen, den p besagt."

6. "Die *Nachprüfung* (Verifikation) von Systemsätzen durch ein Subjekt S geschieht dadurch, daß aus diesen Sätzen Sätze der Protokollsprache des S abgeleitet und mit den Sätzen des Protokolls des S verglichen werden. Die Möglichkeit derartiger Ableitungen von Sätzen der Protokollsprache macht den *Gehalt* eines Satzes aus."

of sentences of the protocol language reporting what is actually given to the subject. The protocol in effect functions as the ultimate arbiter of which sentences the subject is to accept: the sentences in a protocol “are not in need of confirmation, but serve rather as the foundation for all other sentences of science” [Carnap 1931a, 438]. By 1932, the linguistic notion of a protocol has thus taken the place of the world (however this world is specified more precisely) with which sentences were to be compared according to Carnap’s earlier writings.

When a class of sentences comes to play the role of the arbiter of truth and confirmation it is natural to ask on what basis this class rests: on what basis is a protocol sentence accepted? Carnap’s most extended discussion of this question is found in his response to Edgar Zilsel’s reflections on Carnap’s “Universalsprache” [Zilsel 1932]. Zilsel contends that logic does not have the resources to single out the true protocol sentences; by means of logic we may be able to say whether a given set of protocol sentences is consistent, but logic alone cannot tell us whether a given protocol sentence is true [Zilsel 1932, 153]. To insure that the unified science constructed on the basis of a set of protocol sentences is the science of our actual experience one must admit into science an unsayable component, namely a posited connection between the accepted protocol sentences and experience [Zilsel 1932, 153, 159–161]. Carnap agrees that it is not for the logic of science to say which protocol sentences are the true ones. He disagrees, however, that this forces one to admit an unsayable component into science. The true protocol sentences are, according to Carnap, simply those sentences that scientists write down in their protocols [Carnap 1932a, 179–180]. What the true protocol sentences are can therefore be ascertained by investigating the words and works of scientists.

Carnap continues his response to Zilsel by arguing that the idea of the unsayable is empty [Carnap 1932a, 182], before he returns to the question of what basis the protocol rests on [Carnap 1932a, 182–183]. What Carnap’s conclusions on this question are in his response to Zilsel is not so easy to decipher; but they may well support a reading such as that defended by Coffa [Coffa 1991, chap. 19], according to which Carnap in this paper must be taken to endorse a coherence criterion of truth.⁷ It is at least possible to count acceptance by a community of scientists as a coherence criterion of truth: given a protocol sentence, see whether it agrees with the sentences the community of scientists has accepted so far—including the current protocol—and accept or refuse it accordingly. If, however, Carnap ever did endorse a coherence theory of truth, his endorsement must have been short-lived. Towards the end of “Über Protokollsätze” [Carnap 1932c], a paper appearing in *Erkenntnis* only some 30 pages after the response to Zilsel, Carnap makes pronouncements that would seem to entail the view that the make-up of a protocol rests on the

7. A similar conclusion is assumed by Hempel [Hempel 1935, 54]. Carus [Carus 1999] argues that Carnap did not defend a coherence theory of truth, but he does not explicitly engage with Carnap’s response to Zilsel.

perceptions of those writing it. It is an obvious fact, Carnap says there, that a subject can test a given sentence in the last instance only on the basis of its own perceptions [Carnap 1932c, 227].⁸ The kernel of truth in “methodological solipsism”, he says further, is “the fact that testing rests on the perceptions of the tester” [Carnap 1932c, 227].⁹ These pronouncements would seem to entail the view that in deciding whether a given protocol sentence is to be included in the protocol one has to test it against one’s own experience. Precisely this view is expressed in §82 of Carnap’s book *Logische Syntax der Sprache*, where one reads that it is the task of the “physicist making observations” to decide which sentences are part of the protocol at any given time [Carnap 1934, 244].¹⁰ The physicists determine the make-up of the protocol: that was Carnap’s expressed view already in his response to Zilsel. Two years later, in *Syntax*, he adds that physicists formulate their protocols on the basis of their observations.

Carnap seems indeed never to have shared Neurath’s conviction that the idea of comparing a sentence with a state of affairs is tantamount to metaphysics. Carnap thought that his distinction between the formal and material mode of speech justified the Neurathian standpoint concerning the idea of comparing language and world. The problem with the material mode of speech was, however, not that it as such was a metaphysical mode of speech, but rather that it easily could lead to pseudo-problems and other confusions [cf. Carnap 1931a, 456].¹¹ In the material mode of speech a connection between language and world is, however, presupposed, for in this mode one speaks of non-linguistic objects and their properties. Hence, simply drawing the distinction between the material and the formal mode of speech does not mean that one thinks that the idea of comparing language and world is non-sensical.

That it is possible—and indeed necessary for anyone wishing to call himself an empiricist—to speak of a comparison, or rather a confrontation, of language and world is perhaps the main message of Carnap’s Paris contribution “Wahrheit und Bewährung” [Carnap 1936d]. In this paper Carnap is as explicit as one can be that for at least some sentences it makes sense to talk about their direct confrontation with a world through observation. One does need a notion of the confirmation of a sentence as its coherence with sentences already taken to be sufficiently confirmed. But to hold that this is the only viable

8. “Wenn *S* (sprechend, schreibend oder denkend) einen bestimmten Satz aufstellt und nachprüft, so geschieht das unmittelbar nur auf Grund von eigenen Wahrnehmungen.”

9. “Diese Tatsache, daß die Nachprüfung auf den Wahrnehmungen des Nachprüfenden beruht, bildet den berechtigten Kern des ‘methodologischen Solipsismus.’”

10. “Die Protokollsätze aufzustellen, ist Sache des beobachtenden, protokollierenden Physikers.”

11. “Ihre [sc. der inhaltlichen Redeweise] Verwendung ist nicht an sich schon ein Fehler oder sinnlos”; or consider the title of [Carnap 1934, §81]: “The admissibility of the material mode of speech.”

notion of confirmation—hence to reject altogether the notion of confirmation as agreement with observation—is, thus Carnap [Carnap 1936d, 23], to abandon empiricism.¹²

It should be noted that it is consistent to hold that the protocol both rests on experience and is revisable.¹³ In “Universalsprache” and “Psychologie” Carnap regarded the protocol as immune to revision. Neurath, in a paper responding to Carnap’s “Universalsprache”, objected that no sentence, not even a protocol sentence, is immune to refutation [Neurath 1932]:

Like sailors are we, who must rebuild their ship on the open sea. . .
[Neurath 1932, 206]

There is no dry land of protocol sentences for the ship to stand on during a restoration of it. In “Über Protokollsätze” Carnap granted this point, noting indeed that the belief in irrefutable protocol sentences was a remnant of “absolutism”, of a kind with what Carnap calls the realist absolutism of objects and the idealist and positivist absolutism of the given [Carnap 1932c, 228]. That the protocol may be revised was then explicitly assumed in the account of the physical language in *Syntax* [Carnap 1934, § 82]: if a sentence derivable from a set of physical laws contradicts a sentence of the protocol, then not only the physical theory—including its logical fragment—may be revised, but also the protocol [Carnap 1934, 245–246].¹⁴ Paired with the view that the protocol rests on experience, the revisability of the protocol may be taken to reflect the fallibility of experience; and it is certainly consistent to hold that experience, understood as the totality of our knowledge of the natural world, is fallible. The further course of one’s experience may speak against what one previously took to be one’s experience and wrote down in the protocol. What one thought one observed was in fact not what one observed. One’s experience was deceptive, the protocol requires revision.

2 The thing language

The fact that it was only at Paris 1935 that Carnap is entirely explicit about the possibility of confronting language with the world is often explained by the fact that it was only around this time that Carnap learned about

12. Cf. the similar remark of B. Russell: “This doctrine [sc. Neurath’s], it is evident, is a complete abandonment of empiricism, of which the very essence is that only experiences can determine the truth or falsehood of non-tautologous propositions” [Russell 1940, 148].

13. Coffa [Coffa 1991, chap. 19] seems to presuppose otherwise, since he speaks of the position that the protocol is cut off from experience as *fallibilist*.

14. It is here worth recalling that the author of *Two Dogmas of Empiricism*, while visiting Prague in the winter of 1933, “read his [Carnap’s] *Logische Syntax* page by page as it issued from Ina Carnap’s typewriter” [Quine 1976, 41].

Tarski's definition of the concept of truth in formalized languages.¹⁵ This explanation seems natural in light of the fact that Carnap opens "Wahrheit und Bewährung", the paper in which the need for accepting the possibility of such confrontation is stressed, by praising Tarski's definition. There are, however, reasons to be wary of this explanation, or at least reasons to think that it requires supplementation. Firstly, Carnap says in his discussion of Tarski's definition that "one cannot expect from it that it will deliver a criterion of confirmation such as we seek in epistemological reflections" [Carnap 1936d, 19].¹⁶ But Carnap takes confrontation of a sentence with experience to be a criterion of confirmation, hence he cannot regard Tarski's definition as relevant to rehabilitating the idea of confrontation. Indeed, Carnap mentions Tarski's definition in the beginning of his paper only to set it aside for the rest of it, his main concern there being, precisely, the notion of confirmation. Secondly, the idea of confrontation is incorporated in Carnap's first major work after the Paris Congress, "Testability and meaning" [Carnap 1936a, 1937] where, however, no trace can be found of semantics in the sense of Tarski. It is only in the booklet *Foundations of Logic and Mathematics* [Carnap 1939] published four years after the Paris Congress, that semantics in this sense falls within the compass of Carnap's work. "Testability and meaning", by contrast, continues in what may be called the "syntactic style" characteristic of "Universalsprache" and *Syntax*.

In light of these considerations it seems worthwhile to look for other changes in Carnap's thinking around 1935 that may help to explain his restored commitment to the idea of confronting language with experience. I will here propose what may be called Carnap's turn to the thing language as such a change in Carnap's thought. Although the thing language is hinted at already in "Universalsprache" (see below), it is only at the Paris Congress that Carnap has seen that this language may serve as a foundation for the whole language of unified science [cf. Carnap 1936b, 65].¹⁷ According to Carnap's new view of unified science, developed in detail in "Testability and meaning", the language of unified science is to be built up on the basis of the thing language. This conception of unified science differs from the more abstract conception defended in "Universalsprache", "Psychologie", and *Syntax*, according to which a purely quantitative language, which Carnap calls the physical language, is to serve as the language of unified science. It is not

15. An explanation along these lines is offered by, e.g., [Coffa 1991, 370–374], [Carus 1999, 22–23], and [Uebel 2007, 335–340].

16. "Von der Definition für 'wahr' muß man nicht erwarten, daß sie uns ein Bewährungskriterium liefert, wie wir es in erkenntnistheoretischen Überlegungen suchen."

17. "Eine nähere Untersuchung würde zeigen, daß es dabei nicht darauf ankommt, ob man die physikalische Sprache auf die schon im Alltagsleben verwendeten Ausdrücke beschränkt oder ob man die in der wissenschaftlichen Physik verwendeten Ausdrücke mit hinzunimmt, da nämlich diese Ausdrücke auf jene reduziert werden können." See also the first sentence of [Carnap 1936b, 68].

entirely clear how to understand the relation between this purely quantitative language and experience.¹⁸ Carnap's description of the thing language, by contrast, leaves no doubt that he takes its basic sentences to be confirmed or disconfirmed through their direct confrontation with experience. And if the thing language thus rests on experience, so will a language of unified science built on the basis of the thing language also rest on experience.

As an initial characterization of the thing language Carnap calls it "the language which we use in everyday life in speaking about the perceptible things surrounding us" [Carnap 1936a, 466]. The two central formal characteristics of the thing language are: it is a first-order language whose variables range over space-time points; and its predicates are required to be what Carnap calls observable. It is by virtue of this property of observability that the atomic sentences of the thing language may be confronted with experience. A predicate P is observable for a subject if for some arguments, among them, say, a , the subject "is able under suitable circumstances to come to a decision with the help of a few observations about a full sentence, $P(a)$, i.e., to a confirmation of either $P(a)$ or $\neg P(a)$ " [Carnap 1936a, 455]. Here it is important that only a few observations are required. Simply by looking at the cover of a book in front of me, I can determine that "blue" is true of a certain space-time point; and by taking an ice cube in my hand I can determine that "cold" is true of a space-time point. These are therefore observable predicates. By contrast, neither "temperature" nor "weight" are observable predicates (or, functions), since determining whether any of these holds of a given space-time point (or, what their values are at a given point) requires measurement by an instrument, and the use of instruments requires that we have made preliminary observations; in particular, more than "a few" observations are necessary in order to determine whether these predicates are true of a given space-time point. That only a few observations should be necessary for judging whether an observable predicate P is true of a space-time point a is in effect to say that one should be able to confront the relevant sentence $P(a)$ directly with experience; thus Carnap glosses "observable" as "can be directly tested by perceptions" [Carnap 1937, 9].

The programme (or at least one of the programmes) Carnap carries out in "Testability and meaning" is to show that the language of unified science may take the thing language as a basis. All predicates of the scientific language may be introduced on the basis of the thing language through a series of explicit definitions and so-called reduction sentences. The notion of reduction sentence was first introduced by Carnap in one of his other Paris contributions, "Über die Einheitssprache der Wissenschaft" [Carnap 1936b]. Together with the thing language the notion of reduction sentence forms the main novelty in Carnap's account of unified science in "Testability and meaning". Carnap argues that not all concepts of science, in particular not dispositional concepts,

18. Cf. the discussion of the relation between the protocol language and the language of physics in [Klev 2016, 60–63].

can be introduced from the suitable primitive basis by means of explicit definition alone: also reduction sentences are required. Whereas an explicit definition introducing a predicate takes the form

$$\forall x(Rx \iff \varphi(x)),$$

a reduction sentence introducing R has the form¹⁹

$$\forall x(\psi(x) \supset (Rx \iff \varphi(x))).$$

Thus in a reduction sentence the meaning of R is specified only for space-time points x for which $\psi(x)$ holds. In particular, $R(x)$ will not necessarily be everywhere replaceable by $\varphi(x)$, but only where $\psi(x)$ is true. Reduction sentences therefore differ from explicit definitions, which everywhere guarantee the replaceability of the *definiendum* by the *definiens*.

The thesis of unified science in “Testability and meaning” says that all predicates of science can be either explicitly defined from or reduced to predicates of the thing language.²⁰ If science is unified in this sense, then the whole language of science will be rooted in experience provided the predicates of the thing language are so rooted. That the predicates of the thing language are so rooted is secured by their being observable. The property of observability therefore secures that the thing language, and consequently the whole scientific language, is what may be called an empiricist language: it allows for confirmation of a kind that Carnap thinks any empiricist must endorse, namely the confrontation of a sentence with experience.

That the language of the *Aufbau* allowed for the confrontation of some, if not all, of its sentences with experience was obvious, since the first-order variables of that language were taken to range over so-called elementary experiences. It was precisely against a language of this kind that Neurath's criticisms were directed: the idea that we can compare sentences with experience is tantamount to metaphysics. Carnap's response was the introduction of the protocol language, a linguistic counterpart, as it were, to the stream of experience. Verification and confirmation did no longer consist in comparison with experience, but rather in comparison with the accepted protocol sentences. As the so-called protocol sentence debate progressed, however, it became less and less clear what the relation of the protocol sentences to experience was supposed to be: could one speak of

19. More precisely, a sentence of this form is called a *bilateral* reduction sentence for R [Carnap 1936a, 443]. The more general concept is that of a reduction pair for R , which is a pair of sentences of the form

$$\forall x(\psi_1(x) \supset (\phi_1(x) \supset R(x))) \quad \forall x(\psi_2(x) \supset (\phi_2(x) \supset \neg R(x))).$$

20. More details on Carnap's changing conceptions of the thesis of unified science can be found in [Klev 2016].

any such relation at all?²¹ Carnap's adoption of the thing language—in effect the protocol language in Carnap's account of scientific language in “Testability and meaning”—may be regarded as an unequivocal Yes in answer to this question.

3 Intersubjectivity and subjectivity

Since also the language of the *Aufbau* allowed for confrontation with experience, it is natural to ask why Carnap, in order to reinforce his empiricism, simply did not return to this language? The conception of the language of unified science in “Testability and meaning” is indeed quite close to the conception in the *Aufbau*. In “Universalsprache” and related writings from Carnap's “syntactic period” the language of unified science was identified with the language of physics, and establishing the thesis of unified science meant to show that any other language of science (provided it had been precisely formulated) could be translated into the language of physics. In “Testability and meaning” as well as in the *Aufbau*, by contrast, the language of unified science is thought to be built up from a certain minimal basis, in the *Aufbau* only by means of explicit definitions, in “Testability and meaning” also by means of reduction sentences.

That Carnap could not simply return to the language of the *Aufbau* and its conception of unified science had to do with intersubjectivity. The language of the *Aufbau* was “solipsistic” or “phenomenalistic”,²² for its first-order variables ranged over so-called elementary experiences, which are private to the subject. It was therefore not obvious how such a language could sustain an intersubjective science. In the *Aufbau*, Carnap provided an account (in fact, two accounts) of how intersubjective science nevertheless is possible.²³ Around 1930 Carnap must, however, have become dissatisfied with this account (or, these accounts), since he then came to hold that only physical concepts can serve as the basis for an intersubjective science:

But how is “unified science” possible? If the sentences of science are to be intersubjectively communicable, physical concepts must be taken as basic concepts. All other concepts of science are derivable from these.²⁴ [Carnap 1930b, 77]

21. See [Uebel 2007, chap. 8–9] for a detailed account of this stage of the protocol sentence debate.

22. This latter term is used in [Carnap 1963, 869].

23. See [Richardson 1998, chap. 3] for a discussion of Carnap's two accounts of intersubjectivity.

24. “Wie aber ist ‘Einheitswissenschaft’ möglich? Damit die Sätze der Wissenschaft intersubjektiv übertragbar sind, müssen als Grundbegriffe die physikalischen Begriffe genommen werden. Alle andern Wissenschaftsbegriffe sind aus diesen ableitbar.”

A solipsistic basis for the language of unified science was thus excluded; the basis had to be intersubjectively accessible. As may be inferred from the quoted passage Carnap appears first to have held that only the physical language is intersubjective. In “Universalsprache” Carnap in fact asserted that “besides the physical language (and its sublanguages), no intersubjective language is known” [Carnap 1931a, 448]. By the time of “Testability and meaning”, however, Carnap holds that also the thing language—a qualitative language in contrast to the purely quantitative physical language—is intersubjective [Carnap 1937, 12].²⁵ That a language of unified science built on the thing language will itself be intersubjective seems clear enough.

In Carnap's new account of unified science, the thing language plays the role of a protocol language. The thing language is the ultimate arbiter in questions of confirmation and meaningfulness. Indeed, what may be the earliest attestation of the thing language in Carnap's writings occurs in a list he gives of the various forms that the protocol language can take.²⁶ In the material mode of speech the protocol language is said to speak about the given, or the immediate contents of experience. Different forms of protocol language will therefore result from different answers to the question of what should be regarded as the given. Carnap provides three answers to this question, to each of which there therefore corresponds a protocol language. The first answer is the answer of Machian positivism, according to which sense data constitute the given; the second answer is the answer of the *Aufbau*, according to which elementary experiences constitute the given; according to the third answer ordinary things as such constitute the given. The thing language should, to my mind, be regarded as the protocol language corresponding to this conception of the given as ordinary things as such. The thing language is, after all, precisely a language that speaks about the ordinary things we perceive around us.

As an intersubjective language the thing language differs from the protocol language that Carnap had assumed in his earlier work. In “Universalsprache” and “Psychologie” the protocol language assumed corresponds to the second answer above, namely to the conception of the given as elementary experiences. This protocol language is therefore of a kind with the language of the *Aufbau*, whose first-order variables ranged over elementary experiences. Since the protocol was to serve “as the basis for the entire construction of science” [Carnap 1931a, 461], a certain solipsistic element thus remained in Carnap's conception of unified science also after his turn to physicalism. Carnap himself must have been aware of this, for he suggests calling the conception of the scientific language as based on the protocol language “methodological solipsism” [Carnap 1931a, 461].

25. Cf. [Carnap 1963, 869]: “It is an essential characteristic of the phenomenal language that it is an absolutely private language which can only be used for soliloquy, but not for common communication between two persons. In contrast, the reistic [i.e., the thing-] and the physical languages are intersubjective.”

26. See [Carnap 1931b, 222–223], and, in more detail, [Carnap 1931a, 439].

Carnap's turn to physicalism, as well as his introduction of the notion of the protocol language, had been at least in part instigated by Neurath's criticism of the *Aufbau*-account of unified science. Neurath did, however, still find reason to criticize Carnap's revised account of unified science in "Universalsprache". Indeed, Neurath dedicated a whole paper to such criticism [Neurath 1932], and his main concern was Carnap's conception of the protocol language. Neurath thought that Carnap, through his conception of the protocol language, was committed to the idea of the ego, "familiar from idealistic philosophy" [Neurath 1932, 211]. And he criticized Carnap for still embracing methodological solipsism, an idea Neurath already earlier had deemed "a residue of idealist metaphysics" [Neurath 1931b, 401]. Carnap's adoption of an intersubjective protocol language in "Testability and meaning" may be regarded as a response to these criticisms.

Yet, also after adopting the thing language Carnap does not seem prepared to embrace an entirely egoless philosophy such as that defended by Neurath. Carnap does seem to want a place for the knowing subject in epistemology. In "Testability and meaning", Carnap officially bids farewell with the term "methodological solipsism". In doing so, however, he emphasizes that he thinks this term points to a "trivial" and "simple fact". He had wished in using the term:

to indicate by it nothing more than the simple fact, that everybody in testing any sentence empirically cannot do otherwise than refer finally to his own observations; he cannot use the results of other people's observations unless he has become acquainted with them by his own observations, e.g., by hearing or reading the other man's report. No scientist, as far as I know, denies this rather trivial fact. [Carnap 1936a, 423–424]

A similar sentiment is found in the passage already quoted further above to the effect that the kernel of truth in methodological solipsism is "the fact that testing rests on the perceptions of the tester" [Carnap 1932c, 227]. Carnap thus seems to have taken it for granted that an account of knowledge sooner or later must refer to subjective experience. Indeed, the notion of observability—which Carnap invokes to insure that the thing language, and consequently the whole language of unified science, is an empiricist language—would seem to involve the notion of subjective experience, for "observability" is glossed as "can be directly tested by perceptions", and perceptions are part of subjective experience.

Observability Carnap takes to be a concept of psychology [Carnap 1936a, 454]. As a logician of science Carnap must therefore assume the concept of observability as primitive. It is not for the logician of science, but for the psychologist, to elucidate this concept further. To say this is, however, not to deny that there is such a phenomenon as observability; it is only to say that it is not for the logic of science to account for what it consists in. Carnap thus accepts the concept of observability and thereby, it would seem, also the

concept of subjective experience; he denies only that it falls to philosophy to say what subjective experience is; that task falls rather to the empirical science of psychology.

In unified science as conceived of by Carnap, however, psychology is behaviouristic; and behaviouristic psychology does not know the concept of subjective experience: it knows only physical states of affairs involving behaviour. Carnap devotes a whole paper [Carnap 1932b] to arguing that all sentences of psychology, including those of an apparently "introspective" character, can be phrased in a physical, intersubjective terminology, in particular in a terminology concerning behaviour. Subjective experience, *qua* subjective, cannot be the object of intersubjective science; talk about subjective experience can only be understood as talk about behaviour; what cannot be thus understood is not science, but metaphysics. But if subjective experience is an object neither of science nor of epistemology (understood as the logic of science), then the knowing subject would seem to be expelled from epistemology after all. Indeed, the psychology Carnap takes the notion of observability to belong to, is "a biological or psychological theory of language as a kind of human behaviour, and especially as a kind of reaction to observations" [Carnap 1936a, 454]. The concept of subjective experience would seem to be foreign to such a theory.

There seems thus to be an unresolved tension in Carnap's philosophy around 1935. Physicalism demands the expulsion of the knowing subject and the notion of subjective experience from epistemology, while what Carnap takes to be correct about methodological solipsism seems to require a place for these things in epistemology. A similar tension is recognizable in Carnap's Paris contributions. The message of one of his contributions, "Von der Erkenntnistheorie zur Wissenschaftslogik" [Carnap 1936c], is that epistemology, when cleared of nonsensical elements and clearly separated from the empirical sciences, including psychology, is nothing but the logic of science, and the logic of science is nothing but the logical syntax of scientific languages. According to this view, epistemology should be concerned solely with the formal structure of languages, whence it will have nothing to say about the relation between language and experience. In "Wahrheit und Bewahrung" Carnap argues, by contrast, that the idea of confronting language with experience must be included in any empiricist account of confirmation; since it is for epistemology to account for confirmation, epistemology has to countenance the idea of confrontation after all. This tension in Carnap's conception of epistemology is perhaps resolved once semantics is admitted as part of the logic of science, which it is by Carnap from 1939 and onwards. Epistemology, understood as the logic of science, can then be said to concern itself with the confrontation of language with experience in one of its subdisciplines, namely in the discipline of semantics.

4 Physical concept formation

We have seen how Carnap's adoption of the thing language consolidates the conception of the language of unified science as an empiricist and intersubjective language. I now wish to consider another merit of the thing language. The view of the language of unified science as built up from the thing language readily suggests a view of how the quantitative concepts of physics relate to the qualitative concepts of the everyday "life-world": the view, namely, that physical concepts as it were emanate from qualitative concepts through explicit definitions and reduction sentences. In "Testability and meaning", Carnap does not give any detailed examples showing how a quantitative concept can be arrived at in this way; but one can easily construct such examples by considering Carnap's model of what he calls "physical concept formation" [*physikalische Begriffsbildung*] in his earlier book dedicated to that topic [Carnap 1926].²⁷ In this book, Carnap outlines a general procedure for how the quantitative concepts of physics arise from immediate experience, and he illustrates this procedure in the case of length, temperature, time, mass, and electrical charge. One first singles out a domain D of homogenous phenomena, the phenomena that are to be measured by the concept in question. Then two relations are defined on D , namely an equivalence relation, \sim , and an asymmetric, transitive relation, $<$. For any a and b in D we are to have precisely one of $a \sim b$ or $a < b$ or $b < a$. Hence we may think of $<$ as a total linear ordering of the equivalence classes generated by \sim . Finally, a number $\mu(a)$ is assigned to each phenomenon a in D such that the following conditions are satisfied: if $a \sim b$, then $\mu(a) = \mu(b)$; and if $a < b$, then $\mu(a) \leq \mu(b)$. In the case of the concept of length, D is the range of solid bodies with two designated neighbouring edges. The relation $a \sim b$ holds if and only if a and b can be placed in contact in such a way that the designated edges coincide with each other. The relation $a < b$ holds if and only if the designated edges of a fall inside those of b . The function μ is required to satisfy $\mu(a) = \mu(b)$ if and only if $a \sim b$;²⁸ $\mu(a) = 1$ for some a (in effect, a certain standard meter); and $\mu(a \oplus b) = \mu(a) + \mu(b)$, where $a \oplus b$ is the body got by "gluing" together a and b at a designated edge.²⁹

27. Carnap returns to this topic in his *Philosophical Foundations of Physics* [Carnap 1966, 51–121]. *Physikalische Begriffsbildung* [Carnap 1926] may be regarded as an early contribution to what is now called measurement theory. Carnap's place in the history of measurement theory deserves further study; he is, for instance, not mentioned by [Díez 1997].

28. In general $\mu(a) = \mu(b)$ need not imply $a \sim b$.

29. The specifications given of μ do not exclude that the range of μ includes irrational numbers, for instance that for some $d \in D$, we have $\mu(d) = \sqrt{2}$. This point seems not to be sufficiently appreciated by Hempel [cf. Hempel 1952, 67–68], who in effect criticizes the model of physical concept formation outlined by Carnap on the grounds that it does not allow irrational numbers as values of measurement.

It seems clear that physical concept formation along these lines can be phrased in terms of reduction sentences. For instance, the relation \sim for length above may be introduced by

$$(D(x)\wedge D(y) \wedge P(x, y) \wedge P(y, x)) \supset (x \sim y \iff Q(x, y)),$$

where $P(x, y)$ is read “the designated edges of x are in contact with y ” and $Q(x, y)$ is read “the designated edges of x and y coincide”. It is reasonable to assume the relations P and Q to be observable, or else explicitly definable from observable predicates; assuming this, it follows that the relation \sim can be reduced to observable predicates. The relation $<$ may be introduced likewise, and the definition of μ should not present further difficulties. For instance, where a is the standard meter, we set

$$D(x) \supset (\mu(x) = 1 \iff x \sim a).$$

The relation $z = x \oplus y$ (which one may read as “this thing z is the body got by ‘gluing’ together x and y ”) is observable, or explicitly definable from observable predicates, whence we may further specify

$$(D(x)\wedge D(y)\wedge D(z)) \supset (\mu(z) = \mu(x) + \mu(y) \iff z \sim x \oplus y).$$

Thus utilizing Carnap's model of physical concept formation we can see how, through explicit definitions and reduction sentences, the quantitative concepts of physics can be arrived at from the thing language.³⁰

It was noted above that the thing language, once Carnap adopts it, plays the role of a protocol language. When the language of unified science is thought of as built up from the thing language, the protocol language thus becomes part and parcel of the language of unified science. In “Universalsprache” and *Syntax* the relation between the protocol language and the physical language is quite differently conceived. The physical language is there not thought of as emanating from the protocol language; rather, the physical language and the protocol language are two separate languages, and the relation between them is established by translation: the protocol language can be translated into the physical language, and *vice versa*.³¹ By virtue of such a translation the physical language gains whatever meaning it has and, moreover, becomes an intersubjective language.

30. Hempel [Hempel 1952, 31–32] claims that no quantitative terms can be introduced through reduction sentences from observation terms; but the above considerations would seem to show that quantitative concepts arrived at according to Carnap's model can also be introduced through reduction sentences.

31. In *Syntax*, Carnap speaks as if the protocol language were a part of the physical language [Carnap 1934, § 82]. It is, however, difficult to reconcile such talk with how the physical language is described in [Carnap 1934, §§ 40, 82], namely as a purely quantitative language, built up from functions and predicates over real numbers. The protocol language, by contrast, contains qualitative predicates; it speaks, for instance, of colours, heat, heaviness and lightness. In the purely quantitative physical language there is no room for such predicates.

Carnap's most extended (and perhaps only) discussion of the translation between the protocol language and the physical language is found in [Carnap 1931a, §§ 5–7]. These are certainly not the most lucid passages in Carnap's oeuvre, but one can extract from them a view of the nature of the protocol sentences entering into this translation: these protocol sentences report observations of measurement instruments (whence, perhaps, the name "protocol sentence"). For instance, the protocol sentence translating the physical sentence that the temperature at a certain space-time point is 5°C reports an observation of a thermometer showing 5°C at the space-time point in question. In general, an atomic sentence of the physical language assigns a real number or n -tuple of real numbers to a space-time point or space-time region, and Carnap's thought appears to be that the translation of such an atomic sentence into the protocol language reports an observation of a suitable measurement instrument.

This conception of the relation between the physical language and the protocol language does not readily yield an account of physical concept formation, since one cannot here think of the protocol language as describing "original phenomena" on the basis of which the concepts of the physical language are formed. The protocol language is now taken to report observations of measurements, but these are not the kind of phenomena out of which physical concepts arise, at least not according to Carnap's model. The concept of temperature, for instance, is not formed on the basis of observations of a thermometer, but—at least according to Carnap's analysis [Carnap 1926, 16–20, 35–37]—on the basis of the phenomenon of heat transfer: two bodies stand in the relation \sim if neither gets hotter or cooler when they are placed in contact; they stand in the relation $<$ if one gets hotter and the other cooler when placed in contact. The thermometer's showing 5°C will be meaningless to anyone who does not have the concept of temperature; whence the concept of temperature cannot in the rational order of things be taken to arise from observations of thermometers, but rather from the more original phenomena of heat transfer.³² Physical concept formation is thus presupposed rather than accounted for when the relation between the protocol language and the physical language is thought of in terms of translation and the protocol sentences entering into this translation taken to report measurement observations. That the account of the language of unified science as built up from the thing language is easily made to include an account of physical concept formation certainly counts in its favour.

32. Our everyday concept of temperature is of course not arrived at in the rationalized manner described by Carnap, but rather through our experience in matching thermometer measurements with feelings of heat and cold combined, perhaps, with knowledge of the kind that water freezes at 0°C and boils at 100°C , that bread is baked at around 200°C , etc.

5 Concluding remarks

Carnap appears to have come to doubt shortly after the publication of “Testability and meaning”, whether in fact the whole of physics can be built on the slender basis of the thing language by means of explicit definitions and reduction sentences. In *Foundations of Logic and Mathematics* [Carnap 1939, § 24] this conception of the physical language is juxtaposed with another conception, closer to that found in *Syntax*. According to this other conception the terms of the physical language are not to be derived from the thing language through definition and reduction. Rather, the fundamental terms of physics are to be introduced as primitive and uninterpreted terms, in the manner in which Hilbert introduced the fundamental terms of geometry [Hilbert 1899]. By means of chains of explicit definitions terms intuitively signifying more specific concepts are reached from these primitive terms. These chains of definitions eventually issue in terms that can be interpreted by means of observable phenomena. Through the interpretation of these more specific terms, all terms involved in the relevant chains of definition are thought to acquire meaning. The meaningfulness or otherwise of the—initially uninterpreted—terms of physics is thus to be gauged by their impact on a language describing observable phenomena, in effect the protocol language, which Carnap now calls the observation language. Hempel [Hempel 1950] noted that only this second conception of the physical language could find a place for abstract physical concepts such as electric field and wave-function. Carnap reached a similar conclusion and spells out his new conception of the physical language in his later article, “The methodological character of theoretical concepts” [Carnap 1956].

The details of this new account of the language of physics and the question of how this account relates to those found in *Syntax* and “Testability and meaning” will not concern us here. In closing this paper I wish only to emphasize that the thing language continues to play the role of the protocol language in Carnap's account. Carnap does not in describing his new conception use the term “thing language”,³³ but the primitive predicates of the protocol language—which, again, he now calls the observation language—designate “observable properties of events of things (e.g., ‘blue’, ‘hot’, ‘large’, etc.) or observable relations between them (e.g., ‘ x is warmer than y ’, ‘ x is contiguous to y ’, etc.)”; and its first-order variables range over “observable events (including thing-moments)” [Carnap 1956, 40–41]. This protocol language is therefore the thing language, rather than the solipsistic language assumed in “Universalsprache” and *Syntax*. What has changed in Carnap's

33. The term is used in [Carnap 1950], and in [Carnap 1963, 868–871]. In these places the context is different, namely a discussion of ontology, but the meaning of the term is the same; e.g., in the latter place the thing language (there also called the *reistic language*) is said to “describe intersubjectively observable, spatio-temporally localized things or events”.

conception of the language of science is thus not his view of the make-up of the protocol language—the protocol language is, as before, the thing language; what has changed is rather his view of the relation between the protocol language and the physical language. Carnap's turn to the thing language around the time of the Paris Congress was thus a definitive turn, a turn he would not later renounce.

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