ANOTHER WAY FROM DAVOS: CAVAILLÈS' CRITIQUE OF CARNAP'S *LOGISCHE SYNTAX DER SPRACHE*

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ABSTRACT

In *A Parting of the Ways*, Friedman narrates the Davos debate as a catalysator in the genesis of two diverging trajectories within twentieth-century philosophy. In this paper, I introduce a participant of the Davos debate, Jean Cavaillès, who does not adhere to Friedman's bifurcation and who was able to zigzag between the developments in phenomenology and logical positivism. To show how this French epistemologist was able to connect these two traditions, I detail Cavaillès' encounter with the Vienna Circle, explicate his Kantianism, and chronicle the place of Bolzano in his account of the (historical) development of philosophy of science. After that, I examine Cavaillès' critique of Carnap's *Logische Syntax der Sprache* and argue that Cavaillès' theory of science is much closer to Carnap's logical analysis than either he himself or the secondary literature suggests. Both philosophers, in fact, argue for the importance of constructing the unity of science, affirm the autonomous development of science, and conceptualize a dynamic notion of the *a priori*. In the conclusion, I disclose the similarities between Cavaillès' conceptualization of the dynamic *a priori* and Friedman's relativized *a priori*, and argue for the importance of extending Friedman's account of the interwar developments in philosophy of science.

KEYWORDS:

DAVOS. JEAN CAVAILLÈS. RUDOLF CARNAP. RELATIVIZED A PRIORI. TRANSCENDENTAL NATURALISM

1. INTRODUCTION

In his seminal book, *A Parting of the Ways* (2000), Michael Friedman investigates the origins of the split between analytic and continental philosophy by recounting and rethinking the Davos encounter between Ernst Cassirer and Martin Heidegger in March 1929. This defining debate between these two eminent philosophers, one an aberrant student of the Marburg school of Neo-Kantianism, the other steeped in the new developments in phenomenology, consisted of a difficult but fierce discussion about the breadth of philosophy: is philosophy able to reach for the infinite or is it confined to the finite? Although the ground on which the debate took place was primarily Immanuel Kant's critical philosophy, the ramifications of each interpretation stretched far beyond the work of the Königsberger philosopher: the two competitors fundamentally reconsidered the horizon of reason, the possibility of metaphysics, and the value of mathematical physics (Friedman 2000; Gordon 2010).

As Friedman and Peter E. Gordon relate, the Davos debate attracted an international audience of over two hundred students and professors who felt they were present to 'not merely an academic quarrel between professors but rather a confrontation between two epochs' (Herrigel 1929 as quoted in Gordon 2010, 214). One participant of the debate that Friedman singles out in his book is the prospective Vienna Circle member, the philosopher Rudolf Carnap. In his historical narrative, Friedman details his interactions at Davos and reconstructs his position *vis-à-vis* the two debating philosophers. At Davos, Carnap became fascinated by Heidegger's philosophy and the next year he was engaged in an intensive study of *Sein und Zeit* (1927/2010). Two years later, when he presented drafts of his paper *Überwindung der Metaphysik durch logische Analyse der Sprache* (1931), it is precisely from Heidegger's work that he took the pseudo-sentences exemplary of metaphysical nonsense. According to Friedman, this decision engendered a critical break within their shared horizon, and out of this rift arose the outlines of the two diverging trajectories within twentieth-century philosophy.

However, apart from Carnap, there was another attendant who also came to develop a philosophy of science committed to analyzing the logic of science, but along the way managed to stay sensitive to the innovations in phenomenology due to Heidegger. This philosopher accordingly introduces an alternative pathway on the roadmap that Friedman reconstructs. He represents a tradition of philosophy present at Davos that Friedman completely neglects in *A Parting of the Ways*, namely French epistemology. Born in 1903 in Mid-West France, this participant, Jean Cavaillès, was educated in the French epistemological tradition, became gripped by the age-old questions of the nature of rationality and truth, and played a key role in the blossoming community of European epistemology and philosophy of science in the 1930's. After passing the *agrégation*, he began to prepare his dissertation under the philosopher Léon Brunschvicg.[1] During his research, he traveled twice to Germany, where he absorbed the cultural and intellectual developments of the time. He attended Heidegger's seminars on Plato's concept of truth, met up with the ageing and embittered Edmund Husserl in St. Märgen, and worked with Emmy Noether on the publication of the Cantor-Dedekind (1937) correspondence. In his two highly technical doctoral theses, Cavaillès combines a historical approach to the foundations of mathematics with a rationalist philosophy of demonstration, necessity, and autonomy.

The difficult work of this French philosopher stands out for its capacity to mediate between numerous philosophical traditions, including Neo-Kantianism, phenomenology, and logical positivism, and his ability in coming to terms with the new conceptions of logic and mathematics. As such, Cavaillès' philosophical itinerary reveals another pathway in twentieth-century philosophy that takes on the challenges of both 'technical problems in the logical or linguistic analysis of language' and 'central philosophical problems that are of truly general concern

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[1] Other notable students of Brunschvicg include Simone de Beauvoir, Emmanuel Levinas, and Gaston Bachelard. Brunschvicg, together with Albert Spaier, also attended the Davos encounter. For an account of Brunschvicg's life and philosophy, see Boirel (1964). For Brunschvvicg's relation to Cavailles, see Cauvin (2014) and Michel (2020). For a re-evaluation of Brunschvicg's work, see Terzi (2022)

beyond a small circle of narrow specialists' (Friedman 2000, IX). Sadly enough, his life was cut short by the war. Cavaillès was executed for his role in the French resistance in 1944. His last major work, *Sur la logique et la théorie de la science* (1947/2021), lacks a much-needed introduction.

There are intriguing similarities between the two attendees of the Davos debate. Questions concerning the foundations of mathematics and especially the discussions between the various advocates and innovators of the logicism of Bertrand Russell, the formalism of David Hilbert, and the intuitionism of L. E. J. Brouwer form the impetus for both Carnap's *Logische Syntax der Sprache* (1934/1937) and Cavaillès' *On Logic and the Theory of Science*. The two philosophers, however, shared not only a background in philosophical traditions, namely Neo-Kantianism, conventionalism, and early analytic philosophy, but also a set of problems concerning the unity of science, and the relations between logic, mathematics, and science.[2] Unfortunately, the subsequent reception of the work of these two philosophers has fundamentally estranged them.

Most scholars of Cavaillès' work place him in a tradition of French philosophy that originates in the reception of Husserl's phenomenology and that runs from Suzanne Bachelard to Jean-Toussaint Desanti and Jacques Derrida: they document his role in the French intellectual climate of the 1930s and 1940s, narrate his consideration and critique of distinguished philosophers of mathematics, and chronicle his influence in phenomenology and on (post-)structuralism (Dosse 1997; Thompson 2008; Peden 2014; Benis Sinaceur 2013). As a result, his interactions with the broader European community of philosophers of science are often disregarded, and his philosophy is hardly ever aligned him with the tradition of scientific philosophy of which he considered himself to be part.[3] Generally speaking, there is little attention for his dialogue

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[2] In addition, both were inspired by and involved in the German Youth Movement of the 1920's, see Bouveresse (2012). For Cavailles' account of the movement, see Cavailles (1932). For an extensive discussion of Carnap's involvement in the German Youth Movement, see Carus (2007).
[3] For exceptions, see Cassou-Noguès (2001) and Halimi (2020). Despite their extensive accounts of Cavailles' intellectual milieu, these authors do not discuss Cavailles' critique of Carnap in detail. Ramirez (1986), Soulez (2018), and Peña-Guzmán (2020) do discuss Cavailles' critique of

with logicians and mathematicians such as Gottlob Frege, Kurt Gödel, and Alfred Tarski – tellingly, these are precisely the figures who compose the shared horizon of Cavaillès and Carnap's philosophical itinerary.

The reception of Carnap's work is a different story. His work is taken to be quintessential for the development of analytic philosophy, and his work is crucial for understanding the blossoming of analytic philosophy in the second half of the twentieth century (Carus 2007; Soames 2014). Although the following generation of American philosophers, including W. V. Quine, Hilary Putnam, and Thomas Kuhn, forcefully critiqued Carnap's philosophy, they continued to develop their position in dialogue with the logical empiricists. Today, there is still a vibrant community of diverse interpreters of his work (Awodey and Klein 2004; Friedman and Creath 2007; Wagner 2009). Nonetheless, there is hardly any interpreter who reads his work as part of the blossoming community of European epistemology that includes, for example, Italian and French epistemology. This paper will be one of the first steps in enlarging and diversifying the intellectual context of Carnap's philosophical project.

In this paper, I will attempt to show that the reception of these two philosophers - shaped by the lenses of two diverging traditions - has led Cavaillès' interpreters to overemphasize and Carnap scholars to neglect Cavaillès' critique. Even today, the positions that these two philosophers hold within their variant traditions still circumscribes philosophical itineraries. A few decades after the demise of logical empiricism, we have seen the appearance of renewed (historical) interest in their trajectory (Friedman 1999; Limbeck-Lilienau 2007). At the same time, we see an increasing interest in the developments of twentieth-century French epistemology (Brenner 2014; Chimisso 2016). Although both contemporary French epistemology and recent reconsiderations of logical positivism bring in similar problems to philosophy of science, the two fields have, nonetheless, largely developed in isolation. This paper aims to take some

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Carnap in more detail, but their accounts are incomplete and often dismissive of the parallels between the two philosophers. For an overview of the secondary literature on Cavailles, see Cortois (2020).

steps in bridging the divide between these two fields. Cavaillès' critique of Carnap will thus not only help us in exploring a philosophical trajectory that Friedman does not take into account, but will also help us in connecting the concerns and considerations of French epistemology to the re-appraisals of logical positivism.

The structure of the paper is as follows. First, I will explore the historical background to Cavaillès' encounter with the Vienna Circle. In the following section, I give a Neo-Kantian reading of the first part of Cavaillès' book *On Logic and the Theory of Science*. Next, I explicate the place of Bernard Bolzano's philosophy in Cavaillès' historical narrative, elucidate the problems posed by the history of science, and explain his distinction between two procedures of mathematical experimentation. After that, I will analyze his twofold critique of Carnap's work in *On Logic and the Theory of Science*. In the conclusion, I return to Friedman's work and will argue that Cavaillès' conception of the *a priori* can extend Friedman's account of the (historical) development of the relativized *a priori*. I end with a brief remark about Cavaillès' (1929/2021) review of the Davos meeting.

2. THE ENCOUNTER WITH THE VIENNA CIRCLE

A year after attending the Davos debate, Cavaillès acquired a Rockefeller scholarship that allowed him to return to Germany to investigate the German Youth Movement. In the years 1930-1931, he traveled around Germany, read rare books in the Berlin library, and met the German theologians Karl Barth and Romano Guardini. In the first months of his stay in Berlin, he also met a fellow countryman: Jacques Herbrand.[4] This brilliant young logician had just finished his doctoral thesis, *Recherches sur la théorie de la démonstration* (1930), and would soon discover two fundamental theorems in mathematical logic. The encounter with Herbrand proved to be decisive: his innovative project profoundly

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[4] For an account of his life and work, see Wirth et al. (2009).

influenced Cavaillès' work. Unfortunately, the next year, while climbing a mountain in the French Alps, the young man fell to his death. In 1939, Cavaillès would attest that 'his absence, for those who knew him, philosophers and mathematicians both, is still felt cruelly every day' (4).

After reading an article in the library on Cantor, Cavaillès becomes curious about the unpublished writings of Georg Cantor and sends the author, the mathematician Abraham Fraenkel, a letter to consult him about Cantor's manuscripts and correspondence. In his reply, Fraenkel informs him about the Cantor-Dedekind correspondence housed by the Göttingen library. After receiving this letter, Cavaillès immediately goes to Göttingen and there he meets Noether, Helmut Hasse, and upon a return in 1936, Gerhard Gentzen. The Mathematical Institute at the University of Göttingen was, at the time, the epicenter of the new developments in mathematics. In 1895, Hilbert had been appointed as a professor of mathematics and during the next two decades, he had supervised a great number of dissertations by aspiring logicians and mathematicians - including John von Neumann, Alonzo Church, Hermann Weyl, and Wilhelm Ackermann. In Cavaillès' oeuvre, the works of Hilbert and his Göttingen students feature prominently. In a letter to his sister written in 1936, he affirms how much he felt at home in Göttingen (Ferrières 1982/2000, 97).

It is more than likely that Cavaillès first came into contact with the works from the Vienna Circle in Göttingen, but the first proof of him having read any works by members of the Vienna Circle only comes three years later. In a letter to his sister from the 1st of October 1934, he writes: 'the Vienna Circle is hard going and I'm making slow progress' (86). Despite this difficulty, the next year, he displays a profound understanding of the developments of the Vienna Circle in a review of a panel devoted to Logical Positivism at the International Congress of Philosophy in Prague. This review begins by remarking that Moritz Schlick had been alone in presenting the views of the Vienna Circle in Oxford, but that in Prague 'the new School could affirm with full force the unity of its views and the interest of the results already acquired' (Cavaillès 1935/1994, 565; my translations). According to Cavaillès, 'the point of departure of the Vienna Circle'

is Wittgenstein's *Tractatus* (1921/2013) and especially the following three theses: (1) 'language is the image of the world', (2) 'the propositions of logic have no content, they are tautologies', and (3) 'there are no propositions about propositions' (565-566). The Vienna Circle only the accept the first two of these theses, they avowedly reject the third. The *Erkenntnis* philosophers, including Schlick, Philipp Franck, and Hans Reichenbach, have spent much time elaborating 'the correspondence between language and reality' (569). The presentations of Carnap and Otto Neurath in Prague are also devoted to this issue.

At the conference, Carnap presented the content of his book *Logical Syntax of Language*. Unfortunately, Cavaillès review of the presentation is, for the most part, a simple summary of this work – accompanied by only a couple of critical remarks. Nevertheless, on close inspection, the focal points of his summary, together with his critical remarks, do give us a clear indication of his understanding of Carnap's work in 1934, and they already contain hints of their points of contact and roads of departure.

Cavaillès begins by elaborating Carnap's attempt to formulate a language that contains the definitions of its own rules. In the *Logical Syntax*, Carnap had defined the syntax of a language I using the procedure of arithmetization of Gödel. In this way, he had transformed 'the pure syntax (the only syntax in Wittgenstein's sense) … into arithmetic theorems' (569). Next, Cavaillès stresses the importance of Carnap's distinction 'between a diversity of languages and the determination of their mutual relations' (569). While Wittgenstein only admits of one (logical) language, Carnap affirms the possibility of constructing a multitude of languages. Each one of these languages is characterized by their determination of what consequences follow from what set of propositions. These consequences can be divided into logical and physical consequences. With this distinction in place, a language can be constructed so that it satisfies each one's need - whether one is intuitionist, formalist or logicist. Unsurprisingly, Cavaillès ends the discussion of this second point with a quotation of the famous statement of the principle of tolerance: "[i]n logic, there are no morals: everyone can construct

their form of language, as he sees fit. All that is required of him is that, if he wishes to discuss it, he must state his methods clearly, and give syntactical rules instead of philosophical arguments" (Carnap 1934, 45 as quoted in Cavaillès 1935/1994, 570).

In what follows, Cavaillès analyses Carnap's notions of translation and partial languages. A partial language (S2) is any language of which all propositions can be expressed in another language (S1), and of which 'every consecutive relation of classes of S2 can be preserved in S1' (570). When all the relations of a partial language can be contained in another language, complete translation is possible. According to Carnap (1934), there exists such a language in which all partial languages can be translated: the universal language of physicalism - as elaborated by Neurath (1931). Cavaillès claims that by affirming the possibility that every partial language is translatable into a universal language, Carnap is able to align the principle of unity and the principle of tolerance. In his view, this concern is shared by most of the members of the Vienna Circle: together, they aspires to attain unity in science by constructing a universal language that has the expressive resources to contain all the results of the specialized sciences. At this point in the text, Cavaillès gives us a hint of his attitude towards Carnap's solution. He argues that the propositions defined in the constructed language of the *Logical Syntax* cannot produce or be accorded new meaning: 'it cannot create anything unintelligible' (571). Consequently, the only task left for the philosopher is a simple monitoring of science: 'the only reality being the scientific edifice' (571). Although he does not say so explicitly, the tone of his remarks reveal that he finds this account of the role of philosophy too restrictive: philosophy should do much more than merely keeping an eye on the progress of science.

In the conclusion of the review, Cavaillès insists that the autonomy and unity of scientific knowledge accomplished by 'th[is] triple effort of systematization, homogenization, and verification' is the defining characteristic of neo-positivism (575). Although he doubts whether this conception of science and logic truly eliminates the problems concerning correspondence and

foundation, he still praises the clarity in presentation and argumentation in the works of the Vienna School.

Four years later, Cavaillès finishes his doctoral theses *Remarks on the Development of Abstract Set Theory* (1938a/1994), a historical account of the emergence of set-theory in the nineteenth century, and *Axiomatic Method and Formalism* (1938b/1994), an intervention in the debate on the foundations of mathematics. In the conclusion of the latter, he discusses the defects of formalism, logicism, and intuitionism as solutions to the problems in the foundations of mathematics. First, he recounts his previous characterization of the Vienna Circle project of reducing logic to a set of tautologies - now comparing it to Russell's view of logic. While this definition validates logic, it is still insufficient because 'the demonstration of non-contradiction is nothing but confirmation, no foundation' (Cavaillès 1938b, 165; my translations).

After another exposition of Carnap's principle of tolerance, he poses the following critical question: 'but does this tolerance not risk destroying the essential theses of logicism?' (167). Cavaillès answers his own question by arguing that the principle of tolerance effaces the primitivity of logic, thereby undermining the foundation of logicism and making logic dependent upon the demonstrations that define the sequences of syntax. In addition, Carnap's transformation of logical syntax into arithmetic theorems leads to a collapse of the distinction between logic and mathematics: '[p]ure syntax [or logique] is a part of arithmetic' (167). This gives rise to a problem that Cavaillès will develop extensively in his critique of Carnap in *On Logic and the Theory of Science*. He argues that by blurring the distinction between logic and mathematics, logicism can no longer account for the possibility of scientific progress. If Carnap's logical syntax is intended to encompass the groundwork for all possible mathematics, this means that his system purposes to be closed: thereby, it bars the possibility for fundamental conceptual changes and, therefore, cannot account for the dynamics of reason. At the very least, it should contain parts left unspecified, but even then, it will merely 'codify what has actually been achieved in the writings of physicists' and 'except for a few simplifications and unifications', it will still

lack the resources for the possibility of 'new physical theor[ies] (169). Cavaillès ends the section by remarking that Carnap's project leads to 'a kind of philology of science rather than a foundation of logic' (169). His logical syntax of science is 'nothing but an empty framework' and a 'surprising return to Wittgenstein' (169).

3.   A NEO-KANTIAN READING OF ON LOGIC AND THE THEORY OF SCIENCE

In his final work, *On Logic and the Theory of Science*, Cavaillès presents his most elaborate critique of Carnap. This sixty-page essay - posthumously published by his friends Georges Canguilhem and Charles Ehressmann - was written in prison during the last months of his life. Although he was privileged enough to receive some books through his family and friends, he was still, in Gaston Bachelard's words from the preface to the 1960 edition, 'far away from books' (Cavaillès 2021, 16; translation modified). We know that he requested a copy of Carnap's *Logische Syntax der Sprache* from his friend Albert Lautman, but apparently he was not able to deliver it to him (Benis Sinaceur 1987). Therefore, when reading this text, we should keep in mind that Cavaillès could only draw on to those parts of Carnap's philosophy that he knew by heart - which explains the misquotation of the principle of tolerance (Cavaillès 2021, 36).

The book is divided into three parts. In the first, he discusses Kant's logic and philosophy of science, and the Kantian heritage in Brunschvicg, Brouwer, and Bolzano. The second part is an exposition of formalism in philosophy of science, and here we find his critique of Carnap. The last part is an extensive reading of Husserl's views on logic as sketched in his book *Formale und Transzendentale Logik* (1929/1969): there, Cavaillès argues that Husserl does not grasp the unique character of mathematics, that he underestimates the role of the history of mathematics, and reduces mathematics to logic (Cauvin 2020). In the last paragraphs, we also find the clearest expression of his own views and the distinction made famous by Michel Foucault in the preface to Canguilhem's *Le*

normal et le pathologique (1966/1991): '[i]t is not a philosophy of consciousness but a philosophy of the concept that can yield a doctrine of science' (Cavaillès 2021, 58).

As noted above, my reading of Cavaillès' philosophy will foreground it's Neo-Kantianism.[5] I will argue that his philosophical project has an intrinsic Kantian character: it is transcendental, its aim is to reflect on the necessary conditions of knowledge. As he puts it in a discussion with Lautman: "I do not seek to define mathematics, but, by way of mathematics, to know what it means to know, to think; this is basically, very modestly reprised, the question that Kant posed" (Cavaillès 1939, 20).

By inquiring into what constitutes reason and taking mathematics to be the exemplification of pure reason, Cavaillès aligns himself with the epistemological readings of the first critique by the Marburg Neo-Kantians. Of course, this is a contested reading of Kant (Longuenesse 1993/2001). The question here is not, however, whether Cavaillès reading of Kant is accurate, but what concepts of logic, reason, and necessity are developed through this distinctive but idiosyncratic interpretation.

Although Cavaillès conducts a transcendental inquiry, he is not after the necessary conditions of possible experience: instead, he aims to conceptualize the necessary conditions of a given situation of science and its possibilities for progress. By means of a reflection on the dynamics of reason, on the historical character of conceptual development, Cavaillès attempts to understand how necessity and progress are possible in science. In this regard, Hourya Benis Sinaceur (2006, 330) calls his move '[a] truly Ptolemaic revolution'. Instead of prioritizing the activity of consciousness by beginning his transcendental inquiry with experience, Cavaillès detaches consciousness from the progress of reason by taking as his starting point the necessary, autonomous development of science. This is the experience for which he aims to explicate the necessary conditions –

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[5] Most interpretations of Cavailles stress his distance from Kant, see Cassou-Noguès (2001) and Peden (2014). Benis Sinaceur (2006) gives a more nuanced view. For a critique of Cavailles' reading of Kant, see Longuenesse (1993/2001).

yet throughout his inquiry, the understanding of this experience is repeatedly transformed and transfigured. Thus arises a dialectics of the concept – autonomous, necessary, and independent of the activities of consciousness. For Cavaillès (2021, 48) 'if there is consciousness of progress, there is no progress of consciousness', instead 'progress is material or between singular essences, and its motor the demand that each of them must be surpassed'.

Despite the precedence of the dialectics of the concept and the acknowledgement of the constant reworking of science, I will argue that there is still an *a priori* at work in the movement of science defined by Cavaillès. Not the Kantian synthetic *a priori*, which is necessary and immutable, but a relativized a priori for which explication is needed for it to emerge and be able to illuminate the rationality of science. The former *a priori* is the one that Cavaillès rejects when he writes that we should 'abandon all *a priori*' (1938b, 180; my translation). The latter is the one that he conceptualizes throughout *On Logic and the Theory of Science*. He clarifies its status as follows: 'the theory of science is an a priori; it is not anterior to science, it is the soul of science; it has no external prerequisites, but it necessitates science' (2021, 31).

Let us now turn to Cavaillès' reading of Kant. In the first paragraph of the book, he straightaway spells out this debt to Kant. He simply opens the first part with rehearsing the following characterization of logic:

> In his *Course on Logic*, Kant says that [in defining logic,] to have any recourse to psychology would be 'just as absurd as to derive morals from life'. 'In logic,' he says, the question is not about contingent but about necessary rules; not how we think, but how we ought to think. The rules of logic must thus be derived not from the contingent but from the necessary use of the understanding, which one finds in oneself apart from all psychology (Cavaillès 2021, 20).

We are immediately confronted with the two main themes of the essay: (1) a rejection of all forms of psychologism, and (2) the conviction that rationality consists of rules that have an 'unconditioned normative character' (20). According to Cavaillès, logic cannot be grounded in the acts of consciousness, a study of consciousness merely reveals the empirical, contingent conditions that

human beings require to be able to think, it does not at all inform us about the necessarily conditions for non-anthropomorphic rationality. The study of consciousness, or empirical psychology, is a mere descriptive discipline, it can only tell us how we think: whereas reason aims to determine how we should think and thus requires a normative character. Needless to say, Cavaillès is deeply sympathetic to the above definition of logic: it is this definition that he will use throughout his essay to evaluate the theories of science that he analyses.

But Cavaillès does not simply reiterate Kant's philosophy in *On Logic and the Theory of Science*. After quoting Kant's definition of logic, he begins to argue that the German philosopher does not stay true to his own definition. In his view, Kant eventually falls prey to the very psychologism that he intended to overcome because he takes the faculty of understanding to be the source of the necessary rules that compose logic. Kant's definition of logic thus becomes parasitic on the authority of the understanding. Understanding, however, is conceptualized as a faculty of consciousness in Kant's philosophy. As a result, the threat of psychologism returns only a few steps after he has turned his back on it. By grounding logic in the understanding, he effectively subordinates logic to consciousness. This raises the question how consciousness can determine the necessary and normative character of logic. By arguing that reason and understanding adhere to form, Kant aspires to solve this problem. He proceeds by means of 'a twofold process of elimination' (21).

The Kantian notion of the *a priori* epitomizes the first gesture. The contingency and heterogeneity of the appearances of consciousness are sieved in the positing of a formal knowledge that is independent of all experience. By purifying the philosophy of consciousness of all its empiricity, Kant wants to acquire the necessity needed to ground logic. The *a priori* is his way to determine the necessity of logic by means of formalization. Kant's double affirmation of the radical singularity of experience and the conceptual purity of the *a priori*, however, makes it extremely difficult for him to later convene the empirical and the *a priori*. This aporia is '[o]ne of the fundamental difficulties of Kantianism' (21).

Cavaillès does see a way to resolve this problem within Kant's philosophy. In his view, Kant's philosophy of consciousness can still ground logic 'by means of the intelligible sequence of the contents themselves' (21; translation modified). In other words, the securing of the legislative character of consciousness can be achieved by grounding it in the development of the content of experience. It can be effectuated by locating necessity in the unfolding determination of sequences. In this way, Kant would make his philosophy of consciousness completely autonomous. If Kant would have taken this path, his philosophy of consciousness would turn out to be the dynamism of reason that Cavaillès aspires to.

The problem with this solution is that in Kant's philosophy, the *a priori* also serves as a necessary, formal condition for experience. This raises the question of how to convene the conditioned and the condition, or the empirical and the transcendental. We see the aporia return - but on another level. The condition and conditioned still need to relate within a higher system for mathematics to serve physics or the representation of space to correlate with perception. According to Cavaillès, this leads to a situation wherein the relation between the condition and conditioned must be assumed, or repeatedly realized within science itself. The first cannot suffice because we cannot assume that the empirical and transcendental congregate. Philosophy needs to give an account of their relation. When we endorse the second possibility, it is no longer 'a question of purification' since the *a priori* is no longer independent of experience (21). As a result, Kant's *a priori* lacks the potential needed for consciousness to determine the necessary character of the rules of logic.

The second process of elimination in Kant's philosophy is an isolation of 'the formal from the material' (22). By radically abstracting from the objects and content of knowledge, Kant wants to reach a point where the act of thinking coincides with the formal. He wants to have the assurance that logic exists even when every object is set aside. Through radical abstraction, logic can become a formal universal language – in this situation, the relation between understanding and logic would resemble the relation between a concrete language and a universal grammar. According to Cavaillès, this cannot do. One is always

abstracting from a concrete language and pure logic thus remains parasitic on the understanding and hence upon consciousness. Furthermore, the only concepts that we could gain from such a radical abstraction are unity, plurality, and representation. These are clearly not enough for a theory of science. In Kant's philosophy, and philosophy in general, the concepts of matter and form will always be too entangled for either one to realize its full potential and to function independently. The concept of matter is nothing but 'a limit notion' (22). The concept of form is nothing but a void abstraction without content.

Because Kant endorses a formalist conception of logic and abstracts from all content and objects, he ends up with a logic that consists only of the emptiness of logical identity. His philosophy of consciousness lacks the 'differentiation internal to thought' needed for thinking to be more than agreement of thought with itself, or 'eternal repetition' (22). His philosophy desperately needs a theory of the object, an ontology to determine the necessity of logic. He needs a distinction between though and object, or subject and predicate. Without such a distinction, his logic is empty. Regrettably, Kant dismisses the possibility of a dialectical or transcendental logic, as he also 'refuses to see logic as 'an algebra, with whose help hidden truths can be discovered'' (23). For Cavaillès, this is the ultimate defect of the philosophy of consciousness. Kant's formal logic is decidedly not transcendental, but as Cavaillès demonstrates: '[i]n a philosophy of consciousness, either logic is transcendental or it is no logic at all' (24).

At this point in his argument, Cavaillès notes that: '[n]onetheless, Kant's analysis opens up two possibilities for the doctrine of science, depending upon whether the emphasis is placed on the notion of a demonstrative system or that of a mathematical organon' (26). The latter trajectory is the one pursued by philosophers of immanence such as Brunschvicg and Brouwer. The first lineage runs from Bolzano to Husserl and Carnap. It is this Kantian line of thought - which prioritizes the dialectics of the concept over the acts of consciousness - that Cavaillès will also develop.

4. BOLZANO, HISTORY AND DEMONSTRATION

Before examining Cavaillès' critique of Carnap, let us consider his exposition of Bolzano's philosophy near the end of the first part - as his work comprises a crucial stage in the history of philosophy and science that he is constructing. According to Cavaillès, Bolzano is one of the first philosophers to reflect on what constitutes scientific progress while also rigorously conceptualizing the role of necessity in justification: he represents a development in nineteenth century philosophy that abandoned 'intuitive self-evidence' for 'a greater emphasis on the notion of proof' (Cavaillès 1939, 3). In the philosophical movement of which Bolzano is part, 'self-evidence gave way to demonstrability' (3). By placing this early nineteenth century philosopher at the beginning of a tradition that effectively identifies mathematics with demonstration or logic, Cavaillès implicitly transforms him into a precursor of later logicists such as Frege and Russell.

In Bolzano's work, science no longer represents the absolute, a conceptual scheme, or an element in a system, but 'an object sui generis, original in its essence and autonomous in its movement' (Cavaillès 2021, 29). Although we can discern discrete manifestations of science across cultures and epochs, science cannot be reduced to this apparent multiplicity. Science requires unity, but the unity it requires is not given. According to Cavaillès, there is not one science that simply appears as cloaked, confused, or disparate. The (hierarchical) relations between science have to be clarified, and the unity of science is to be explicated and constructed by a theory of science. In his own words: 'a theory of science can only be a theory of the unity of science' (29).

This unity cannot be attained all at once. Science is constantly developing, and the labor of philosophers of science is always situated within this movement. We cannot assume science to be fully realized or attempt to work with an ideal concept of science, we must acknowledge that we are always situated in an incomplete system that is dependent upon and even craves progression. More importantly, the progression of science is not continue: it is characterized by

ruptures, by transformations of assumptions and results, it is not a linear development where each stage naturally emerges out of a previous one with science remaining identical. The becoming of mathematics or science is thus 'a true becoming', 'it is unpredictable', and the novelties that scientists produce are real novelties (Cavaillès 1939, 6). Precisely because science is dependent upon development over time, we cannot infer all knowledge in one historical situation within one single, extended demonstration. As Cavaillès puts it: '[o]ne cannot, through the mere analysis of notions already in use, discover the new notions already within them' (6).

It is this double problem that the history of science poses, namely the necessary character of scientific progress and the unpredictability of progress, that he struggles with throughout his oeuvre (Granger 1996). Cavaillès aims above all to affirm the necessary character of science. He wants to stay true to Kant's definition in the opening quote and hence does not surrender to taking the results of science as simply provisional. As a result, the work of the philosopher of science is situated at the intersection of historicity and necessity. She must retrospectively trace and discover the necessary development of science by studying the history of science, and, at the same time, explicate the definitions that we use while exploring the inferences and ramifications of propositions and theories.

Here, Cavaillès' philosophy of science discloses itself as a transcendental naturalism. He is a naturalist due to his conviction that 'in the dimension of describing and explaining the world, science is the measure of all things, of what is that it is, and of what is not that it is not' (Sellars 1963, 173). His naturalism is transcendental, however, because it aims to investigate the necessary conditions of science and, in particular, scientific progress. For Cavaillès, science is a distinctive undertaking, it is unlike our common sensical understanding of the world or our everyday experience. He perceives radical differences between 'sensation or right thinking and science'. This difference is also present when examining the scientist's understanding of his own work and a scientific understanding of his work, a scientist might understand his own work in a

unscientific manner (Cavaillès 2021, 30). For this reason, scientific progress needs explication, the kind of works done by philosophers and historians of science. According to Cavaillès, philosophy of science must aim to become a part of science: 'a science of science, and hence a part of itself' (30).

In the end, what Bolzano has shown, is that 'science is first and foremost demonstrated theory' (28). Demonstration is the essence of science: '[i]f there is science, then it is demonstration through and through, which is to say, it is logic' (31). What Bolzano lacks in his philosophy is an adequate account of logic and science in its movement. The double problem of the historicity and necessity of science is not fully explored by Bolzano. His theory of demonstration lacks an account of the ruptures within the history of science.

5. A TWOFOLD CRITIQUE OF CARNAP'S *LOGISCHE SYNTAX DER SPRACHE*

The second part of the book begins by explicating a theory of demonstration that aims to give an account of such ruptures. Cavaillès discerns two forms of demonstration: paradigmization and thematization.[6] In an earlier work, he had already conceptualized these two dimensions as being two procedures of mathematical experimentation and had defined a mathematical experiment as follows: 'by experiment, I understand a system of gestures, rule-governed and subject to conditions independent of these gestures' (Cavaillès 1939, 6). In contrast to a 'heterogenous', physical experiment, a mathematical experiment is thus a procedure in which a novel mathematical situation is developed out of an existing part of a sequence by means of new rules and operations (6). A demonstration or experiment can extend and expand the sequence but can also amend or revise its succession.

The first procedure of experimentation, namely paradigmization, coincides with the first dimension of demonstration and can be characterized as

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[6] For a more extensive account of this distinction than I can give here, see Cortois (1993) and Cauvin (2020).

'*longitudinal*' or 'coextensive with the demonstrative sequence' (Cavaillès 2021, 33; translation modified). This mode of experimentation superimposes new notions, gestures, and signs upon the old base. As examples, Cavaillès names rules of substitution and judgements of identity in logical analysis. Here, the 'demonstrated adheres to the demonstration to the point of being indistinguishable from it' (33). The problem with this kind of demonstration is that it presupposes a rigid distinction between matter and form, or meaning and act. Although we can 'raise ourselves to a degree of abstraction that yields the illusion of an irreducible formalism' like Gottfried Wilhelm Leibniz did when modeling a *mathesis universalis*, the distinction between matter and form always remains present as 'a continuous fault line' (34).

The second dimension of demonstration, thematization, 'takes the sequence as its starting point, but this time grasped in mid-flight, on a trajectory which moves toward meaning' (35; translation modified). This procedure can be defined as 'vertical' or transversal and establishes 'a new system of interconnection on the basis of the old one' (33). Instead of 'working out a general model' and increasing the level of abstraction, we inaugurate a new intelligible development by adding another level to the system (35). As examples for thematization, Cavaillès names theories of groups, topological transformations, and linear operations.

It is at this moment in the text that Cavaillès begins to present the outlines of the problematics that he perceives in Carnap's project. He argues that every act that aims to ground the distinction between matter and form in a scientific sequence is itself subject to such a distinction. The new level that thematization adds to a system is immediately transformed into the base of a new gesture of paradigmization: the two processes are inseparable, there is always a 'dual interplay' of paradigmization and thematization (35). The problem that we are faced with resembles that of Baruch Spinoza's 'idea of the idea' (36). There is an 'unlimited intelligible complication' that shows us that (1) the distinction between matter and form is too simplistic and (2) that we need a more thorough understanding of the notion of form (36). In other words, we need to

reconceptualize the dialectics of form and matter, and disclose how the two notions are indissociable.

This time, Cavaillès introduces Carnap with some brief remarks on his logicist predecessors Frege and Richard Dedekind. These two mathematicians were the first to take up the logicist project of identifying the theory of science with the totality of formal systems. They aimed to reduce mathematics to logic by arguing that 'there is nothing more in mathematics than certain formal systems' (36). But Carnap's project shows an advance over this older form of logicism: instead of identifying logic with the totality of formal systems, he defines logic as 'the set of syntaxes of all formal systems' (36). Although Cavaillès notes that he cannot develop a thorough analysis of Carnap's definition of syntax in this essay, 'a close examination of the logicist position requires the actual definition of syntaxes and so cannot be attempted here', he immediately adds that 'two essential difficulties appear from the outset'.

The first difficulty lies in the inadequacy of Carnap's formalism as a foundation for a theory of science. According to Cavaillès, formalizing is a process of founding, and every formalization generates philosophical questions concerning the foundation of the act of formalizing. In this regard, he praises Tarski (1935) for being the first to clearly distinguish between 'the plane of the primary formal system and that of its syntax' (Cavaillès 2021, 36). This distinction leads to 'a deeper study of syntax' (36). However, if any syntax is to be definitive, it also needs to formalize the syntax of the demonstration used while constructing the syntax. In the Carnapian terms that he employs: 'there is no formalism without syntax, and no syntax without another formalism that develops it' (36). Although the indefinite regression that results from this demand is inoffensive since the regression is productive, it may lead to novel findings and new configurations of syntax, Cavaillès does discern another problem within this approach. As we have seen, he views scientific progress not as solely due to 'mere increase in volume by juxtaposition, the prior subsisting in the new, but [it] must [also] be a perpetual revision of contents by way of deepening and erasure' (58). Carnap's philosophical position in *Logische Syntax*

der Sprache, however, does not admit such radical revisions of the nature of syntax: its defect is that the regression involved in defining the syntax lacks the potential to generate new constellations of syntax and science.

Inevitably, the resources that Carnap employs for the demonstration of the syntax in his book are derived from the contemporaneous state of science: hence, it is parasitic upon the logic and science of its day. But like every other state of science, this state will become subject to reconsideration, revision, and elimination and, therefore, Carnap risks limiting the scope of science in an artificial and obstructive manner. As Cavaillès puts it: '[b]y way of the several details he provides, one can even show that the pathways predicted in advance, pathways that were supposed to have been taken by later science, have remained barren' (37).

Nevertheless, the problem of false prediction does not get to the heart of the problem. The principal problem of Carnap's project is that he misunderstands the very nature of scientific progress. Progress is brought about by ruptures between paradigms and is fundamentally dependent upon development over time. We cannot reconstruct out of one state of science or space-time all the possible syntaxes of formal systems: 'the fact that everything does not happen all at once has nothing to do with history, it is the characteristic of the intelligible' (2021). Any attempt to perform such a single construction will inevitably get lost in an empty abstraction that will exist only ephemerally.

In what follows, Cavaillès discerns another dimension to this first difficulty that arises out of reducing the process of founding to mere formalization. He once again praises Tarski (1935) for clarifying what is at stake. His distinction between semantics and syntactics has foregrounded the importance of defining the objects of the syntax. For Carnap's syntax to acquire meaning, it must define the objects and contents that it describes. In the *Logical Syntax*, he separates descriptive and logical syntax, but this distinction is only possible for an incomplete formalization. Only during the process of formalization do act and meaning graciously distinguish themselves. They 'legitimate themselves as such in their very completion' (Cavaillès 2021, 38).

By separating descriptive and logical syntax, Carnap ends up with two systems that 'owe nothing to the outside' and thus are 'closed' (38). The distinction between positing and posited meaning, then, becomes inherent to the system and thus must be demonstrated by that system. For Cavaillès, this raises not only the question how the two systems are related, for example, in mathematical physics, but also how to contrive the ground for both or how to construct the general syntax. Carnap and the logical positivists try to solve this problem by equating objects with sensible representations. In taking this pathway, they reduce logic to a structure whose sole potential lies in defining and demarcating the scope of scientific inquiry. The objects or contents that give meaning to the syntax are subsequently defined by means of the results of experiments and empirical research. In other words, the concrete basis of the syntax is restored by this second gesture of adding sensible representations.

It is this division that Cavaillès views as inherently problematic. The sensible representations are not simple givens and 'the sign is not a worldly object' (38-39). We cannot equate the sensible representation with an object that we detect out there in the world and the sensible representations in Carnap's philosophy end up only referring 'to the acts that utilise it' (39). Once more, an indefinite regression appears: 'what it [Carnap's project] takes for an absolute beginning is in fact an implicit invocation of prior acts and sequences' (39; translation modified). The two sequences or gestures, namely the construction of syntax and the adding of sensible representations, turn out to be intertwined – as the notions of form and matter in Kant's philosophy.

As Cavaillès argues, the act of formalizing is dependent upon the representative characteristics of the signs and symbols. The activity is thus already mathematical, and the symbols can be 'neither its point of departure nor its genuine result' (39). The grounding of the syntax is only an opening towards an indefinite regression and, therefore, Carnap cannot lay claim to having found a solid ground by distinguishing between syntax and sensible representations. This contamination of the syntax by semantics guarantees the failure of his project. The general syntax can never be completely spelled out; his enterprise

assumes a static nature of syntax and science. New elements can be superimposed, but there is no possibility for novel elements at the level of the general syntax. In the eyes of Cavaillès, the failure of formalism is complete, and he concludes: '[f]ormalisations may help clarify and specify the theory of science; they are not *constitutive* of such a theory' (39; my emphasis).

The second difficulty of Carnap's philosophy of science lies in the ontology or theory of objects that it requires. To determine the demonstration involved in constructing the general syntax, he must, as we have seen, refer to objects that fix their meaning. The difficulty with his solution becomes especially pressing when considering his interpretation of the relation between mathematics and experiments in mathematical physics. He tries to explain the relation using a theory of protocol sentences. These sentences define physical propositions by means of stipulation and are formalizations of physical relations and events. For Cavaillès, however, this does not solve the problem. Protocol sentences simply 'presuppose what is in question, namely mathematical relations which are the translation or reduction of physical experience' (39) and ultimately, the logical empiricist solution of protocol sentences returns us to a 'traditional image of formalisms as having a kind of internal void which experimental matter comes to replenish' (40).

Interestingly enough, Carnap is not the only one to discern a strict distinction between experiments and mathematics. In Cavaillès' theory of science, the two also have a different essence: the two sequences are viewed as *sui generis* and as progressing independently. On the face of it, his distinction appears even more rigid than that of Carnap: experiments and mathematics are not even situated on the same plane, they share no ground. Certainly, the existence of mathematical physics testifies to the possibility of an intersection of the two sequences. According to Cavaillès, it is the result of a coordination of mathematics and experiments. This coordination, however, escapes all formalization and cannot be defined by protocol sentences. An experiment is much more than an attempt to fill the emptiness of the formalist system: '[t]he true experimental process lies elsewhere, in the intending, use, and actual

construction of instruments, the entire cosmico-technical system wherein its meaning is revealed — a system whose unity and relation to autonomous mathematical development constitute the fundamental problem of the epistemology of physics' (40).

At this point, the problem with the theory of the object in Carnap's project begins to show itself 'in its full acuity' (40). There are ultimately only two solutions left for Carnap when it comes to defining the relation between experiments and mathematics in mathematical physics, namely presupposing the ontology of the object or simply letting the object be defined by the acts involved. In other words, Carnap's project 'hesitates between Wittgenstein's naive realism and Schlick's pragmatism' (40). Regardless of his final choice of either realism or pragmatism, his syntax has lost its ability to be independent of a theory of objects. His alliance of syntax and physics makes the former parasitic upon the latter and the syntax and theory of objects, like form and matter, end up being indissociable.

For his syntax to be both self-sufficient and constitutive of physics, Carnap can only presuppose the affinity between his formalist syntax and the objects that it intends to describe. His philosophy lacks an account of the correspondence between the two - as much as Kant lacks an account of the correspondence between the empirical and the transcendental. It is Carnap's solution to the question of the relation between mathematics and physics in mathematical physics that reveals how his formalism is guided by and dependent on a theory of objects and hence upon the sensible world. His syntax is not an 'exhaustive definition of operatory processes supposedly sufficient unto themselves' (41). The failure of constructing a syntax independent of ontology has become evident. The notion of the object inherent to physics has become part of the scope and definition of syntax. As Cavaillès concludes:

> [j]ust as the direct theory of the sciences or of science depends upon a theory of demonstration, so the latter turns out to require an ontology, a theory of objects that finally fixes the relative position of authentic meanings and the dependent or independent beings to which they refer or which supposedly ground them (41).

6.   CONCLUSION: RECONTEXTUALIZING THE RELATIVIZED A PRIORI

Cavaillès' acute critique of Carnap profoundly influenced the reception of the Vienna Circle in France. Many post-war philosophers, including Gilles-Gaston Granger and Jules Vuillemin, based their assessment of logical positivism upon Cavaillès' reading of Carnap (Granger 1960/1983; Vuillemin 1971). Since his reading of Carnap, at first glance, seems predominantly critical and even dismissive, most French philosophers did not feel the need to further elaborate upon it, let alone try to rehabilitate the Vienna Circle project. In addition, in the post-war years, prejudices concerning the political commitments of logicians reinforced the disregard for logical positivism in France. Because of the association of logical positivism with the American world and Louis Rougier, logicians were thought to incorporate 'technocratic capitalism' (Hallward and Peden 2012, 255) and to belong to the extreme-right (Engel 2007, 34). Consequently, historians of French philosophy have argued that there was from the start little to no prospect for logical positivism in France, and that the reception of the Vienna Circle in France was a failed reception (Lecourt, 1981; Soulez, 2006; for an exception, see Schöttler, 2015).

Even though Cavaillès' critique clearly illustrates the differences between his and Carnap's trajectory, his polemical tone should not blind us to the similarities between the two philosophers in considerations and concerns. In effect, both philosophers pronounce the importance of constructing the unity of science, attest to the autonomous development of science, and emphasize the difference between logical analysis and empirical or experimental inquiry. These connections between the two are heedlessly lost, when we pay too much attention to Cavaillès' polemical style, detach his work from the culture of logic and mathematics of which he was part, and read him, for example, solely as a harbinger of the philosophical trajectory of Foucault or Derrida.

The affinity between their trajectories becomes even more striking when we nuance Cavaillès' critique by considering that Carnap does admit the possibility

for revising logical and physical rules in *Logical Syntax of Language*. In section 82 of the book, Carnap writes:

> [n]o rule of the physical language is definitively secured; all rules are laid down only with the proviso that they may be altered as soon as it seems expedient. That holds not only for the P-rules, but also for the L-rules including mathematics (Carnap, 1937, 317-319; see also Friedman, 2001, 72).

In other words, Carnap, contrary to Cavaillès' contention, does admit the possibility of revising the rules of syntax, and hence denies the possibility of constructing the logical analysis of science 'all at once' (Cavaillès 2021, 37). Yet, he does not explore the dialectics that result from this assertion, and he starkly rejects the metaphysical questions that it might give rise to. In contrast, Cavaillès centralizes these questions in his philosophy of science, and argues that the meta-philosophical and metaphysical questions that concern the foundations of logical analysis are inescapable. For him, any theory of science is intrinsically bound up with metaphysical and ontological concerns. Foundational commitments are and should be inherent to every theory of science, and thus at least part of our construction and evaluation of theories of science takes place on ontological ground. This becomes even more apparent when we pay close attention to the method Cavaillès employs in his critique of Carnap. His method consists of first explicating the metaphysical commitments of Carnap's theory of science, and subsequently questioning the validity of its presuppositions while examining its value in explaining the development of science.

This method is constantly employed by Cavaillès throughout his oeuvre: explicating and assessing foundational commitments is his principal concern. Ultimately, the search for foundations in Cavaillès' philosophy itinerary is a venture to explicate the *a priori* constitutive conditions of a scientific situation. More importantly, when he considers a philosophical project, he is constantly questioning whether it can account for the possibility of scientific progress. In his view, a philosophy of science must do justice to the autonomous, internal becoming of science. The philosophy of science that he himself aspires to construct is one in which foundational commitments are determined as logical *a*

priori elements, they are 'the soul of science' (Cavaillès 2021, 31). Like the logical rules of Carnap's syntax, these *a priori* elements compose the inferential framework of science. In contrast to Carnap, however, Cavaillès does not be believe that this logic can be formalized - because the relation between form and content in the development of science is dialectical, contents are constantly transformed into forms and *vice versa*. Due to this dialectic and the ruptures present in the history of science, these constitutive conditions cannot be explicated in one progressive deduction. The *a priori* elements of Cavaillès' theory of science - but also those of Carnap – need to be revised, transformed, and eradicated: they are thus truly dynamic.

In his lecture series *Dynamics of Reason* (2001), Friedman also elucidates the outlines of a similar conceptualization of the *a priori*, namely the relativized *a priori*. Drawing upon his previous historical studies on the 'developments of scientific philosophy from Kant … to logical empiricism … and concurrent developments taking place within the sciences', he sketches the development of this concept in twentieth-century philosophy of science (Friedman 2001, xi). His notion of the relativized *a priori* draws upon Reichenbach's (1920/1965) disentanglement of the two characteristics of the Kantian *a priori*: 'necessary and unrevisable, fixed for all time, one the one hand, and "constitutive of the concept of the object of [scientific] knowledge," on the other' (Friedman 2001, 30). While Friedman considers the first characteristic of the *a priori* to be untenable after the emergence of non-Euclidean geometry and Einsteinian physics, the second is, according to him, still in force during contemporary scientific investigations. For Friedman, relativized *a priori* elements are those parts of our scientific theories that we need to presuppose to be able to even begin (empirical) inquiry: they are *a priori* because they are constitutive of scientific research, and relativized because they change during the development of science.

With this rethinking of the *a priori*, Friedman aims to resolve some of the problems brought about by Kuhn's understanding of paradigm shifts in his book *The Structure of Science Revolution* (1962/2012) and Quine's rather strong rejection of analyticity in his *Two Dogmas of Empiricism* (1951). In Cavaillès' theory of

science, both considerations are also at play. As we have seen, he is constantly shifting and reconsidering the relation between form and content, the empirical and the transcendental, contingency and necessity, and history and philosophy. His solution is similar to that of Friedman, namely conceptualizing and determining the horizon of a paradigm or situation of science, and retrospectively reconstructing the (inter-)paradigm or the dialectics that brought about the new paradigm or situation of science. Like Friedman, Cavaillès also wants to stay true to a Kantian concept of the *a priori*, and both philosophers affirm the constitutive role of philosophy in explicating the paradigm of science.

Undoubtedly, there are also far-reaching differences between their conceptualizations of the *a priori* - their assessment of the relation between physics and mathematics or the role of philosophy in paradigm shifts, to name just two. Nevertheless, Cavaillès' philosophy acutely presents us with an uncharted context in which we can trace the emergence of the relativized *a priori*. By connecting the philosophical development of Cavaillès and other French epistemologists such as Brunschvicg, Lucien Lévy-Bruhl, and Hélène Metzger, to the broader community of European epistemology, we can begin to construct a more comprehensive account of the interwar discussion on epistemology occasioned by the groundbreaking developments in logic, mathematics, and physics. In sum, Cavaillès' philosophy presents us with a unique context in which Friedman's historical and philosophical problems come together in a new light.

What Cavaillès' critique of Carnap, in the end, shows us is that at the Davos encounter, there was another pathway present that does not strictly adhere to the bifurcation that Friedman perceives, and that was able to zigzag between the developments in phenomenology and logical positivism. Cavaillès himself was most certainly aware of the differences in tendencies, colours, and concerns of the (philosophical) traditions of his day. For him, the importance of the Davos meeting lay precisely in its attempt to reconcile national, intellectual, and academic traditions - an inspiration that would shape the rest of his philosophical itinerary. The organizers 'essential objective' was 'the struggle against the spirit

of particularism in all its forms' because, ultimately, 'like those fulgurations with which Leibniz's God engendered the monads, it is the same spiritual universe that is expressed by French rationalist reflection and German phenomenology' (Cavaillès 1929/2021, 10). In his eyes, it was 'obvious that they will benefit from coming out of their splendid isolation (like two inland seas), to open up between them channels of communication that will procure for both of them greater movement and fecundity' (10). If there was any gain in the Davos meeting, it was a *rapprochement* of particularisms. Today, Cavaillès' philosophy might still help us in realizing such a rapprochement of traditions: his theory of science provides us with a distinctive horizon to assemble the considerations of French epistemology and reappraisals of logical positivism.

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