‘Physics is a kind of metaphysics’: Émile Meyerson and Einstein’s late rationalistic realism

‘Physics Is a Kind of Metaphysics’: Émile Meyerson and Einstein’s Late Rationalistic Realism

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Gerald Holton has famously described Einstein’s career as a philosophical “pilgrimage”. Starting on “the historic ground” of Machian positivism and phenomenalism, following the completion of general relativity in late 1915, Einstein’s philosophy endured (a) a speculative turn: physical theorizing appears as ultimately a “pure mathematical construction” guided by faith in the simplicity of nature and (b) a realistic turn: science is “nothing more than a refinement” of the everyday belief in the existence of mind-independent physical reality. Nevertheless, Einstein’s mathematical constructivism that supports his unified field theory program appears to be, at first sight, hardly compatible with the common sense realism with which he countered quantum theory. Thus, literature on Einstein’s philosophy of science has often struggled in finding the thread between ostensibly conflicting philosophical pronouncements. This paper supports the claim that Einstein’s dialog with Émile Meyerson from the mid 1920s till the early 1930s might be a neglected source to solve this riddle. According to Einstein, Meyerson shared (a) his belief in the independent existence of an external world and (b) his conviction that the latter can be grasped only by speculative means. Einstein could present his search for a unified field theory as a metaphysical-realistic program opposed to the positivistic-operationalist spirit of quantum mechanics.

> Man does metaphysics as he breathes, involuntarily and, above all, usually without realizing it
>
> Meyerson, 1908

> But every four- and two-legged animal is *de facto* in this sense a metaphysician
>
> Einstein to Schlick, Nov. 28, 1930

1 Introduction

Gerald Holton’s account of “The Philosophical Pilgrimage of Albert Einstein” (Holton, 1968) has often been the object of controversy in the literature (cf. e.g. Howard, 1993; Ryckman, 2014). Toward the end of the 1960s, Holton questioned the dominant public image of Einstein as a positivist or an instrumentalist. He claimed that Einstein underwent a *realistic turn* following the completion of general relativity toward the end of 1915, when he abandoned the operationalist rhetoric of his earlier works (Holton, 1968). At a closer look, however, even Einstein’s early positivism appears suspicious in light of his youthful atomistic worldview (Renn, 1997; Renn, 2005). Yet, it is possible to find passages in which Einstein deems ‘realism’

as meaningless [1] alongside with others in which he seems to consider the common sense belief in the observer-independence existence of an external world as the basis of all physics.[2] Thus, not surprisingly, the question whether Einstein was indeed a realist has never ceased to intrigue scholars, particularly those focusing on his interpretation of quantum mechanics (Fine, 1986, ch. 6; Howard, 1993; Lehner, 2014).

Scholarship on general relativity and the unified field theory-project seems to have concentrated on a different but equally puzzling issue. After the completion of general relativity, Einstein appears to have undergone a *rationalistic turn*, moving away from the moderate empiricism of his youth (Janssen, 2006). As a self-described 'mathematical ignoramus,',[3] Einstein previously dismissed advanced mathematics as a dispensable luxury. As Einstein recalled in his 1933 Herbert Spencer Lecture at the University of Oxford (Einstein, 1933a), it was the success of general relativity that convinced him of the heuristic and creative power of mathematical simplicity (Norton, 1995; Corry, 1998; Norton, 2000). Nevertheless, also after general relativity, Einstein continued to express skepticism toward a purely formal approach to physics, lacking a solid contact with empirical facts.[4] Thus, it remains controversial whether the Spencer lecture should be regarded as a reliable account of Einstein's path to the field equations (Norton, 2000) or as a later rational reconstruction (Janssen and Renn, 2007) that served to justify Einstein's unification program (Dongen, 2010; cf. Ryckman, 2014).

These two branches of the literature, with some notable exceptions, (Dongen, 2004, 2010),[5] have often developed independently of one another, which seems to have left an elephant in the room: Einstein's mathematical constructivism that supports his unified field theory program appears to be, at first sight, hardly compatible with the common sense realism with which he countered quantum theory. As it is has been emphasized (Howard, 1998), the difficulties might arise from our attempt to apply categories, like realism, positivism, and rationalism, as they are commonly used in the current philosophical debate,

[1] In a letter to the mathematician Eduard Study, commenting on the latter's booklet *Die realistische Weltansicht und die Lehre von Raume* (Study, 1914), Einstein wrote this often-quoted remark: "'The physical world is real'; [...] The above statement appears to me, however, to be, in itself, meaningless, as if one said: 'The physical world is cock-adoodle-doo' [...] I concede that the natural sciences concern the 'real,' but I am still not a realist" (Einstein to Study, Sep. 25, 1918; CPAE, Vol. 8, Doc. 624). The following year, Einstein defined Study's realism as a "nebulous point of view" (Einstein to Vaihinger, May 3, 1919; CPAE, Vol. 8, Doc. 33). Toward the end of his life, Einstein chose the Kantian formula that the real is *nicht gegeben, sondern aufgegben* (Einstein, 1949, 680), to emphasize that the question the physics construction corresponds to the world as it 'really is' is empty. Fine (1986, 87ff.) has famously labeled Einstein's attitude 'entheorizing realism.' Einstein seems to deny the possibility of a theory-free standpoint from which what is real can be judged. Electrons are what a physical theory says they are, and our only warrant for knowing that they exist is the success of that theory.

[2] In Einstein's view, science assumes that electrons, electromagnetic fields, etc., exist in the same way as a table or a tree, independently of whether or not we observe them. This is what Einstein meant when he famously asked Abraham Pais whether he "really believed that the moon exists only if I look at it" (Pais, 1982, 5). The same example was used by Einstein in Einstein, 1953. It is one of the "macroscopic incompleteness arguments" that Einstein put forward against quantum mechanics, starting from the chemically unstable pile of gunpowder that he had introduced in a letter to Erwin Schrödinger in 1935 (Einstein to Schrödinger, Aug. 8, 1935; ESBW, Doc. 215). Fine (1986, 109ff.) has labeled this form of realism 'motivational realism.' Even if, say, electrons are ultimately theoretical constructs, we prefer theories that claim that electrons exist out there even if we do not look at them just like macroscopic objects. This is the only assumption that makes sense of scientific inquiry even if it cannot be proved.

[3] Einstein to Paul Hertz, Aug. 22, 1915; CPAE, Vol. 8, Doc. 111.

[4] In 1912, while starting to work on a new theory of gravitation, Einstein wrote to Sommerfeld that he had "gained enormous respect for mathematics, whose more subtle parts" he was used to consider "as pure luxury" (Einstein to Sommerfeld, Oct. 29, 1912; CPAE, Vol. 5, Doc. 421). However, in 1917, he complained with Felix Klein that "the value of formal points of view" is "overrate[ed]". "These may be valuable when an already found truth needs to be formulated in a final form, but they fail almost always as heuristic aid" (Einstein to Klein, Dec. 5, 17; CPAE, Vol. 8, Doc. 408). Similarly in 1918, Einstein reacted indignantly to Besso's suggestion that general relativity owed its formulation to speculation rather than experience: "I believe that this development teaches [...] the opposite, namely that for a theory to deserve trust, it has to be built on generalizable facts". "A truly useful and deep theory," Einstein concluded, "has never been found in a purely speculative fashion" (Einstein to Besso, Aug. 28, 1918; CPAE, Vol. 8, Doc. 607; cf. also Einstein to Besso, Sep. 8, 1918; CPAE, Vol. 8, Doc. 612. Relativity theory, Einstein insisted, "was absolutely not the result of mathematical speculations, as many thinks" (Einstein, 1920, 245[p. 1]).

[5] Dongen, 2010 explicitly emphasized the interplay of both rationalism and realism, which lurks in Einstein's unified field theory-project. To a large extent, this paper provides a historical-philosophical counterpart of van Dongen's book by focusing on Einstein's dialog with the philosophical community rather than on his scientific work.

instead of trying to understand how they were used in the philosophical debates in which Einstein was actually involved. Some important work in this direction has indeed been done (Howard, 2014). Einstein's attitude toward Poincareian conventionalism (Friedman, 2002; Ben Menahem, 2006, ch. 3) and Duhemian holism (Howard, 1990) has been investigated, as well as his relationship to philosophical schools that were dominant in the 1920s. Einstein's appreciation for the work of Moritz Schlick in the 1920s and his role in the emergence of logical empiricism (Hentschel, 1982, 1986; Howard, 1994; cf. also Giovanelli, 2013) is well known; some work has been done on Einstein's subtle criticism of neo-Kantianism, which is already in the decline (Hentschel, 1987; Ryckman, 2005; cf. also Giovanelli, 2015). However, surprisingly, little attention[6] has been given to Einstein's fascination for Émile Meyerson's work—particularly for his 1925 book *La déduction relativiste* (Meyerson, 1925)—in a period marked by the emergence of quantum mechanics and the progressive marginalization of a field-theoretic approach. This paper, relying on some unpublished material, argues that Einstein's surprising change in philosophical allegiance, 'from Schlick to Meyerson,' offers the possibility, so to speak, of killing two birds with one stone: to understand both Einstein's rationalistic and realistic turns (cf. Ryckman, 2017, ch. 9 and 10), which melted in what Holton had rightly called a 'rationalistic realism' (Holton, 1968, 657).

At the turn of 1900, Meyerson was an unknown Polish-born trained chemist (Telkes-Klein, 2003, 2004) who worked as an administrative in Paris (Mayorek, 1999) and cultivated some amateurish interests for the history of chemistry in his spare time (Meyerson, 1884, 1888, 1891). The publication of his first monograph *Identité et réalité* (Meyerson, 1908), when he was nearly 50 years (Telkes-Klein, 2010), transformed Meyerson from a relatively obscure philosophical autodidact into a well-connected member of the Parisian intellectual community (Bensaude-Vincent and Telkes-Klein, 2009, 2016, ch. 10). In *Identité et réalité*, Meyerson laid down what would remain the tenets of his '*épistémologie*',[7] an attempt to discover the *a priori* principles of the human mind (in the weak sense of inherent instincts) *a posteriori*, i.e., through a historical[8] investigation of the mind's products, particularly scientific theories.

In Meyerson's view, (a) *science is explanatory.* It does not simply aim to describe and predict the phenomena, as the positivists claim, but strives to explain them. According to Meyerson, to explain means to identify, that is to establish the identity between prior and subsequent state, by showing that the latter contains as much as the former (*causa aequat effectum*). In this sense, 'to explain' what happens ultimately means to show that nothing has actually happened (Meyerson, 1908, 207; tr. 1930b, 227). To satisfy this ideal, science substitutes the variegated world of common sense with a pale world of abstract entities (atoms, phlogiston, electrical and magnetic fluids, *vis viva*, etc.) whose total quantity does not change in time. These theoretical entities, however abstract they might be, are treated by scientists as 'things' that exist independently of observation just like the objects of common sense (Meyerson, 1911,

[6]A counterexample might be the work of Elie Zahar (1980; 1987) who, however, seems to be concerned with Meyerson's philosophy itself rather with the Meyerson–Einstein relationship (Zahar, 1989, sec. 1.3). An account of the latter is given in Balibar, 2010, which rightly emphasizes that the dialog was hampered by reciprocal misunderstandings. However, in my view, Balibar does not consider all textual evidence, thus underestimating the importance of Meyerson's philosophy (or at least Einstein's simplified and distorted version of it) to understand Einstein's philosophical views in the 1925–1933 period.

[7]Still useful expositions of Meyerson's thought appeared already during his life (Brunschvicg, 1926; Harpe, 1925; Høffding, 1925; Koyré, 1931; Lichtenstein, 1928). Meyerson's disciple, André Metz, wrote the first monograph on Meyerson (Metz, 1927), followed by Stumper, 1929; Abbagnano, 1929; Boas, 1930; Sée, 1932. Possibly because of Gaston Bachelard's (1934) influential critique of Meyerson's *chosisme*, the interest for Meyerson's work started to decline after his death in 1933. Renewed interest emerged in the 1960s (Marcucci, 1962; Mourélos, 1962; LaLumia, 1966; Manzoni, 1971). The more recent and authoritative overall exposition of Meyerson's philosophy is Fruteau de Laclos, 2009. For a recent biography of Meyerson, see Bensaude-Vincent and Telkes-Klein, 2016. The monographic number of the journal *Corpus* dedicated to Meyerson (Bensaude-Vincent, 2010) entails some excellent contributions. For Meyerson's interpretation of relativity theory, see Hentschel, 1990, sec. 4.11.2; Ryckman, 2005, ch. 9; Ben Menahem, 2010. For recent literature on Meyerson in English, cf. Mills, 2014, 2015. In the following, I shall draw freely from this literature.

[8]Meyerson's historical approach to the philosophy of science is probably the most actual aspect of his philosophical heritage. It is possible to speak of a 'Meyerson Circle' (Howard, 2011) that comprises historians/philosophers of science like Alexandre Koyré (1961) and Héléne Metzger (1929, cf. Chimisso and Freudenthal, 2003; Chimisso, 2016, ch. 5). Kuhn (1962) famously mentions Meyerson, Koyré, and Metzger as major influences on his work.

129). In this sense, according to Meyerson, (b) *science is ontological*, and scientists, whether they know it or not, are metaphysicians by nature.

It is worth emphasizing that this is *not* Meyerson's own philosophy of science. It is Meyerson's description of the 'spontaneous philosophy of the scientists' (Althusser, 1967). In this sense—in his second, two-volume monograph *De l'explication dans les sciences* (Meyerson, 1921)—Meyerson denounces an '*epistemological paradox*' (Meyerson, 1921, ch. 17). Scientists are driven by a deep need for a complete deduction of the *rationality* of the real that is comparable to the speculative philosophical systems of Descartes or even Hegel. However, this need can never be satisfied. The real (as shown, in particular, by Carnot's discovery of irreversibility) is fundamentally *irrational*, recalcitrant to the tendency of the human mind to explain away change. The scientific enterprise is a constant struggle between the mind that tries to impose identity and a differentiated reality that resists such an imposition. It is a "Sisyphean task" (Heidelberger, 1988), a constant oscillation between hopes and disappointments, rather than a linear progress toward a final encompassing theory.

With *La déduction relativiste* (Meyerson, 1925), Meyerson aimed to show that relativity theory, in spite of the positivistic-phenomenalistic rhetoric in which it was usually presented, was the manifestation of the same insuppressible need for a 'global deduction' which characterizes scientific rationality from its inception. As Meyerson put it half-jokingly, it seems that "Einstein invented the theory of relativity to provide a modern justification of my doctrines" (Lefevre, 1926). As we shall see, Einstein was indeed impressed by Meyerson's book that he mentioned approvingly on numerous occasions, endorsing Meyerson's quite bold comparison between his unified field theory-project and Hegelian philosophy. Nevertheless, in spite of the numerous manifestations of reciprocal admiration in their private correspondence, Einstein showed little interest or even understanding for nearly all main themes of Meyerson's epistemology—explanation as identification, the spatial nature of explanation, the irrational, etc. Einstein took from Meyerson's work what suited his purposes and left away the rest. In this sense, Meyerson did not shape Einstein's philosophical views, which developed independently under the pressure of his work as a physicist. However, this paper shows that Einstein's idiosyncratic appropriation of Meyerson's work offers an important insight into Einstein's epistemology at the turn of the 1930s.

Einstein felt that Meyerson had well expressed the physicists' 'motivations for doing research' (Einstein, 1918), their deep-seated desire to understand nature and not simply to describe it. Against the wide-spread positivistic-operational reading of relativity theory invoked by quantum theoreticians, Meyerson suggested a rationalistic and realistic interpretation that was cognate to Einstein's unified field theory-project. Relativity theory does not simply attempt to predict the behavior of rods and clocks, test particles, etc.; it attempts to explain the result of our measurements and observations by regarding the electromagnetic and gravitational fields (or the 'total field' in which they would be ultimately unified) as basic elements of reality. In Einstein's view, this interpretation could serve to underpin his speculative quest for a unified field theory and counter the link between what is observable and what is physically meaningful embraced by quantum theoreticians. "No matter how pure a 'positivist' he may fancy himself"—as Einstein put it toward the end of his life—any physicist is ultimately a "tamed metaphysician" (Einstein, 1950, 13).

2 Einstein's first meeting with Meyerson

Einstein met Meyerson for the first time on April 6, 1922 during a discussion on relativity that took place at a meeting of the *Société française de philosophie* (Einstein et al., 1922) in Paris (CPAE, Vol. 13, Introduction, sec. V; Canales, 2015, ch. 1). Xavier Léon, the founder and animator of the *Société*, cherished the good relationship between philosophy and the sciences. Thus, the invitation of scientists at the *Société*'s meetings was not unusual. Others like Jean Perrin (1910, Perrin et al., 1910), and Paul Langevin (1911) served as speakers in the past, as did the chemist André Job (1912). However, as Léon predicted in his opening remarks, "the date of April 6" was indeed destined to make "history in the annals of [the]

society" (Einstein et al., 1922). Einstein's fame attracted not only the attention of the Parisian press and the general public but also the invitation of a German scientist after the war was charged with cultural, if not political and diplomatic, significance (Biezunski, 1992).

Uncomfortable in delivering a lecture in French, Einstein suggested that the meeting would take the form of an open discussion (Einstein to Nordmann, Mar. 28, 1922; CPAE, Vol. 13, Doc. 120). Among the participants, there were leading French mathematicians, such as Jacques Hadamard, Élie Cartan, and Paul Painlevé; physicists, like Paul Langevin, Jean Perrin, and Jean Becquerel; and philosophers, like Henri Bergson, Léon Brunschvicg, and, of course, Meyerson, who had published his second major monograph *De l'explication dans les sciences* (Meyerson, 1921). Meyerson, although not an academic, was well connected with the circle of intellectuals gravitating around the *Société*, for which he played the unofficial role of a scientific advisor (Bensaude-Vincent and Telkes-Klein, 2009).

Some participants at the meeting made rather long remarks concerning technical or philosophical aspects of relativity theory to which Einstein gave a usually succinct reply. Meyerson asked Einstein to clarify two points, which, as he pointed out, had "less to do with the foundation of his conceptions than with the way in which they are often presented and with the conclusions people seem to want to draw from them" (Einstein et al., 1922, 110).

Time in special relativity. Meyerson emphasized that, in special relativity, contrary to what it is usually claimed, time is fundamentally different from space.[9] One can freely move in every spatial direction, but as Einstein once put it, 'one cannot telegraph into the past' (Einstein et al., 1922, 110).[10] Thus, relativity theory introduced a fundamental difference between space and time which was foreign to Newtonian physics. This difference depends on the fact that in the formula for the interval, the time variable is preceded by a sign different from those of the spatial variables; it reflects also, and above all, the existence of an objective 'irreversible' causal order.

Relativity theory and Mach's positivism. As Meyerson remarked in his contribution, relativity theory "is generally represented as being the fulfillment, the concrete realization, one might say, of the program outlined by Mach" (Einstein et al., 1922, 109). However, Meyerson explained that Mach's positivism seems to be extraneous to the way of thinking of a physicist like Einstein who, early on, was deeply convinced of the existence of atoms and light quanta.[11] "There seems to be no really close or necessary connection between Mach's conceptions and Einstein's theory", Meyerson insisted that "One can quite easily support the relativity of space and nevertheless be convinced [...] that no science is possible unless one first posits an object situated outside consciousness" (Einstein et al., 1922, 110). In this sense, Meyerson felt quite confident "that Mr. Einstein himself is far from sharing Mach's opinion in this area" (Einstein et al., 1922, 110).

[9]Meyerson dedicated to this issue some paragraphs of *De l'explication dans les sciences* (Meyerson, 1921). Meyerson was aware that the connection of space and time in a four-dimensional mathematical structure was not in itself a novelty of Einstein's theory. He refers to "the more than a century-old statement of Lagrange" (Meyerson, 1921, 2:376; tr. 1991, 538) that mechanics can be regarded as a geometry of four dimensions (Lagrange, 1797, 223). According to Meyerson, this reflects a tendency of scientific thought to spatialize time and eliminate the flow of time (Meyerson, 1921, 2:376; tr. 1991, 538). Nevertheless, special relativity cannot be considered the coronation of this process "as is seen by Einstein's fundamental argument, which points out that 'one cannot telegraph into the past'" (Meyerson, 1921, 2:377; tr. 1991, 538). Cf. next footnote.

[10]The phrase "[u]sing hyperlight velocities we could telegraph into the past" was attributed to Einstein by Arnold Sommerfeld in the discussion session following Ignatowski, 1910. Meyerson's source is Langevin, 1911, 44.

[11]Meyerson was perhaps one of the first scholars to challenge the myth of Einstein's early positivism. In *De l'explication dans les sciences* (Meyerson, 1921), he mentioned as counterexamples Einstein's work on 'Brownian motion,' which was meant to prove the reality of atoms (Einstein, 1905a), and his attitude toward the microstructure of radiation (Einstein, 1905b). In particular, Meyerson quoted Einstein's remarks at the 1911 Solvay conference (Einstein et al., 1914), in which he insisted on the necessity of constructing a model of light quanta, a request that testifies for his refusal of a phenomenological approach to physics: "To speak only of Einstein, what motivates his *whys* and *how-can-it-be*? How can one explain the constant intervention of the image, the physical model, and the fervor with which he demands it? What could the accusation of unlikelihood possibly mean if it were not a question of an actual hypothesis about how phenomena are produced, about what is *really going on?*" (Meyerson, 1921, 1:40; tr. 1991, 38).

Einstein replied very shortly, but approvingly to Meyerson's first question: "In the four-dimensional continuum definitely not all directions are equivalent" (Einstein et al., 1922, 110). Concerning the second issue, Einstein gave a more articulated answer, in which he again agreed with Meyerson. He denied that, "from the logical point of view", there is "any close relationship [...] between the theory of relativity and Mach's theory" (Einstein et al., 1922, 110). He labeled Mach as "a good student of mechanics [*mécanicien*], but a deplorable philosopher", whose "shortsightedness about science led him to reject the existence of atoms" (Einstein et al., 1922, 111). Science is no catalogue of facts of experience, but a conceptual system (Einstein et al., 1922, 110f.). Both issues raised by Meyerson touched upon the central aspects of his philosophy (the 'elimination of time' and the critique of positivism). However, this probably would have not been transparent to someone not familiar with Meyerson's lengthy monographs. Thus, Einstein did not seem to have recognized Meyerson's remarks concerning the shape of a consistent interpretation of relativity theory and did not appear to have been impressed by Meyerson after this first encounter.

At the time, Einstein was at the inception (Einstein, 1919, 1921) of what it would turn out to be a life-long search for a classical field theory, capable of unifying electromagnetic and gravitational field and reducing matter to the field (cf. Sauer, 2014 for an excellent non-technical overview; for more details cf. Goenner, 2004; Vizgin, 1994). The prevailing strategy, championed by Hermann Weyl (1918, 1919, 1921a, 1921b, 1921d), was to weaken the compatibility condition between the metric $g_{\mu\nu}$ and affine connection $\Gamma^{\tau}_{\mu\nu}$ in the attempt to find a geometrical setting with more mathematical degrees of freedom than Riemannian geometry. Such additional degrees of freedom could be exploited to accommodate in the structure of spacetime (that is to 'geometrize') not only the gravitational field but also the electromagnetic field. The hope was to find a set of field equations governing the gravitational-cum-electromagnetic field, which allowed for central spherical symmetric solutions corresponding to the elementary particles. At the beginning of 1921, Arthur S. Eddington (1921) had attempted to go beyond Weyl, exclusively relying on the $\Gamma^{\tau}_{\mu\nu}$. Einstein himself tried to follow an intermediate path soon thereafter (Einstein, 1921). After exploring Kaluza's (1921) five-dimensional formalism without success (Einstein and Grommer, 1923), Einstein seems to have become disillusioned with the whole shebang: "I believe that, to really advance, we must again find a general principle eavesdropped from nature" (Einstein to Weyl, Jun. 6, 1922; CPAE, Vol. 13, Doc. 219), something comparable to the equivalence principle in general relativity. The real "cannot be found by pure speculation. The Lord goes his own way" (Einstein to Zangger, Jun. 8, 1922; CPAE, Vol. 13, Doc. 241).

Einstein's attitude changed toward the end of 1922. During a trip to Japan, Einstein became infatuated with Eddington's (1921) purely affine theory, which he found more promising than Weyl's (1918) semi-metrical approach (Travel Diary; CPAE, Vol. 13, Doc. 379; December 30; p. 28v; Einstein to Bohr, Jan. 10, 1923; CPAE, Vol. 13, Doc. 421). In Eddington's theory, the affine connection is defined separately from the metric and did not have the ambition to have a direct physical meaning (Einstein, 1923e,f,g). Einstein argued that the only justification for the use of the affine connection as a fundamental variable was that this choice leads, via the action principle, to recover Einstein and, in the case of weak fields, Maxwell vacuum field equations, which is "almost a miracle" (CPAE, Vol. 13, Appendix H, 88). As Weyl ironically remarked, Einstein was following "the same purely speculative paths which [he was] earlier always protesting against" (Weyl to Einstein, May 18, 23; CPAE, Vol. 13, Doc. 30; cf. Weyl to Seelig, May 19, 1952;, cit. in Seelig, 1960, 274f.).

Einstein was aware that he was undertaking a risky endeavor: "Everything that Weyl, Eddington, and I have been doing recently," Einstein wrote to his old friend Heinrich Zangger, "is purely mathematical speculation and perhaps entirely erroneous. The sole point of view is internal consistency" (Einstein to Zangger, May 29, 1923). As Einstein indicated in his Nobel prize lecture in June 1921, the search for a unified field theory was not guided by a "principle" based on empirical facts (equality of the inertial and gravitational mass) as in the case of relativity but relied only on the "criterion of mathematical simplicity, which is not free from arbitrariness" (Einstein, 1923d, 9). While the choice of $g_{\mu\nu}$ as the gravitational

potentials was motivated by the equivalence principle, the choice of the $\Gamma^{\tau}_{\mu\nu}$ as a fundamental variable was justified only on formal grounds.

Wolfgang Pauli complained about this issue in a long letter to Eddington in September of 1923 (Pauli to Eddington, Sep. 23, 1923; WPWB, Doc. 45). "I have studied [...] Einstein's the last paper in the *Berliner Berichte*," he wrote, "and I don't think it brings us closer to the solution of the [quantum] problem" (Pauli to Eddington, Sep. 23, 1923; WPWB, Doc. 45). In Pauli's view, "[t]he greatest achievement of relativity theory was to have brought the measurements of clocks and measuring rods [...] [in connection with the $g_{\mu\nu}$]", via the equivalence principle. In contrast, in the Eddington–Einstein theory "the magnitudes $\Gamma^{\tau}_{\mu\nu}$ cannot be measured directly" (Pauli to Eddington, Sep. 23, 1923; WPWB, Doc. 45) but only derived through calculations starting from the $g_{\mu\nu}$. Thus, one ends up with a curious theory in which the measurable quantities, the $g_{\mu\nu}$ and the $\varphi_{\mu\nu}$, are derived from more fundamental, but non-measurable ones, the $\Gamma^{\tau}_{\mu\nu}$. In addition, as Pauli explained in his 1921 Encyclopedia article on relativity (Pauli, 1921), the field quantities thus derived are, in principle, not definable inside of elementary particles so that a field-theoretical approach to the problem of matter is flawed from the outset (Pauli to Eddington, Sep. 23, 1923; WPWB, Doc. 45). In Pauli's view, the quantum problem must "be answered purely phenomenologically, without regard to the nature of the elementary electric particles" (Pauli to Eddington, Sep. 23, 1923; WPWB, Doc. 45; cf. Heisenberg to Pauli, Oct. 9, 1923; WPWB, Doc. 47)

Pauli's requirement that an abstract concept, like the $\Gamma^{\tau}_{\mu\nu}$, should only be permissible in physics when it can be established whether it applies in concrete cases of observation does not seem far from the view that Einstein often defended in the past. However, Einstein realized that this requirement was too severe. Possible experiences, he claimed, must correspond not to an individual concept but to the system as a whole (Einstein, 1924a, 1692; cf. Giovanelli, 2014). If starting from $\Gamma^{\tau}_{\mu\nu}$ leads to a promising set of field equations, then the use of $\Gamma^{\tau}_{\mu\nu}$ as a fundamental variable is justified even if they cannot be directly defined in an operational way. "The mathematics is enormously difficult," he wrote to Besso, "the link with what can be experienced is unfortunately becoming increasingly indirect" (Einstein to Besso, Jan. 5, 1924; CPAE, Vol. 14, Doc. 190). However, Einstein was still convinced that a field theory that might offer the solution to the quantum problem (Einstein, 1923b) was at least "a logical *possibility*, to do justice to reality without *sacrificium intellectus*" (Einstein to Besso, Jan. 5, 1924; CPAE, Vol. 14, Doc. 190), that is, without retreating to a positivist-phenomenalist agnosticism.

In Pauli's "positivistic" reading of relativity theory, the gravitational and electromagnetic fields were tools used to summarize the behavior of probes. This view considerably influenced the Göttingen strategy of setting up quantum theory as "a formal computational scheme" to derive the values of some observable quantities (Born, 1925, 113) rather than constructing a field-theoretical model of the elementary particles. On the contrary, Einstein's hope of deriving the atomistic and quantum structure from a continuum theory presupposed the field, not simply a mathematical tool to summarize the behavior of probes, but as something having an independent existence just like matter. The positivistic reading of the relativity theory, although useful as a stepping stone, was fundamentally inadequate. Einstein distanced himself from the logical positivists' insistence on the need to coordinate every fundamental concept of a theory to a "piece [*Ding*] of reality" (Reichenbach, 1924, 5; tr. 1969, 8), although they did not seem to have taken notice. However, the more rationalistic attitude of neo-Kantian philosophers like Ernst Cassirer (1921) and his followers (Winternitz, 1923; Elsbach, 1924) did not seem to offer a valid alternative (Einstein, 1924b,a). According to Einstein, science extensively uses non-empirical 'ideal' conceptual constructions (say the $g_{\mu\nu}$, the $\Gamma^{\tau}_{\mu\nu}$, etc.) (Einstein, 1924a, 1691). However, these are in no way *a priori* conditions of all possible science, but at most freely chosen conventions, the legitimacy of which depends only on their success in accounting for our experiences (Einstein, 1924a, 1689). Moreover, in Einstein's view, neo-Kantian idealism, not different from positivist phenomenalism, did not do justice to scientists' instinctive inference from the success of our conceptual constructions to the hypothesis of their reality.[12]

[12]The opening paragraph of Einstein, 1924a testifies to the importance that Einstein attributed to the issue of the relation between "experienced reality (as opposed to merely dreamed experience) and thing reality (e.g., sun, hydrogen atom)". It is worth quoting a

It is against this background that Einstein read *La déduction relativiste* (Meyerson, 1925). The idea of the book, Meyerson wrote in the 'Preface', "arose out of a conversation with Paul Langevin (Bensaude-Vincent, 1988) on the eve of Einstein's arrival in Paris" in 1922 (Meyerson, 1925, XV; tr. 1985, 7). Meyerson further discussed the theory in private correspondence particularly with André Metz (Hentschel, 1990, sec. 4.11.3; During, 2010), a French general and engineer who has become the major popularizer and defender of relativity in France (Metz, 1923; cf. Einstein to Metz, Dec. 25, 1923; CPAE, Vol. 13, Doc. abs. 234; see also Canales, 2015, 166–171). Meyerson published some excerpts of the book on major French journals (Meyerson, 1924a,b,c) before the manuscript was sent to the publisher in March 1924. *La déduction relativiste* was meant to be an application to relativity of the philosophical system he developed into two previous much longer monographs (Meyerson to Félicien Challaye, undated; EMLF, ca. 1924, 109). Einstein, as we shall see, initially resisted Meyerson's insistence on the 'Hegelian' traits of relativistic physics, its ambition to deduce nature, to understand it as rational and necessary. However, he soon realized that Meyerson well expressed the philosophical motivations behind his physical undertaking, his "profound, almost religious, belief in the unity and simplicity of the principles of the structure of the Universe" (Einstein, 1923c; see also Einstein, 1923a).

3 Einstein's reading of Meyerson's *La déduction relativiste*

After his return from Japan in 1923, Einstein was supposed to embark on a long trip to South America, which was planned for March 1925. According, to his travel diaries, Einstein read Meyerson's book *La déduction relativiste* (Meyerson, 1925) on the shipboard on March 12, 1925, on a morning "so warm that one does not feel if the cabin windows is open". Einstein, in his short annotations, described the book as "ingenious" (*Geistreich*).[13] However, Einstein still found Meyerson's account "unfair" "as the escapades by Weyl and Eddington are considered to be essential parts of the theory of relativity" (CPAE, Vol. 14, Doc. 455, 6; March 12). It is only because he puts all of these theories under the same category, which,

relevant passage at length: "Doesn't an experienced reality exist that one senses directly and that is indirectly also the source of what science denotes as 'real'? Aren't, furthermore, the realists right, after all, along with all scientists (who don't happen to be philosophizing), when by the highly astounding possibility to arrange experiences within a [...] conceptual framework they allow themselves to assume that real, existing things are independent of their own thinking and being? Isn't the incomprehensibility of being able to build a conceptual framework that connects experiences just as painful to the idealistic philosopher (from the logician's point of view) as accepting the reality hypothesis of the realistic philosopher and of the nonphilosophizing person (and animal)? Is there indeed a difference at all between assuming that the totality of observations, or experiences, permits a logical conceptual framework, which connects them with each other, and accepting the reality hypothesis?" (Einstein, 1924a, 1685).

[13]To understand the philosophical background against which Einstein might have read the book, it is useful to consider a not well-known text written about the same time. Toward the end of 1924, Carl D. Groat, the Berlin correspondent of the news agency United Press from Berlin, asked Einstein whether he would be willing to write a series of articles for *La Prensa*, a prestigious Argentinian journal which used United Press services. The articles were supposed to be published after Einstein's arrival in Buenos Aires. In one of these articles 'La física y la esencia de las cosas', which was published in May of 1925, Einstein offers a simple account of what he thought it was the task of a physicist. The physicist does not limit herself to describe, she "wants to understand" the observable phenomena, say heat, electromagnetism, matter "and know their essence". However, she "does not know in advance if heat is a phenomenon of movement, if bodies are made of atoms, if electromagnetic phenomena must be explained as the movement of a matter that fills space, et cetera" (Einstein, 1925b). In this sense, Einstein wrote, the physicist is similar to someone that tries to understand how a machine works, for instance a loom, but cannot "remove the loom from a box that is impenetrable to the eye, and who must understand its construction through the qualities of the cloth alone or by the sound the loom makes when it is operating" (Einstein, 1925b). The physicist must try to elaborate a model of the internal structure of the machine. There are ways to limit the range of possible models one can come up with (e.g., a model that does not satisfy energy conservation had to be rejected in advance). However, ultimately, the physicists can only make reasonable and educated guesses about the mechanism responsible for the warp and weft of the cloth. Thus, the "internal structure will always be *hypothetical*", since there is no way to open the box, to look directly how the mechanism would 'really' look like. Nevertheless, the physicist "knows what is *real* about the machine more perfectly than someone who is satisfied with proving perceivable phenomena" (Einstein, 1925b, my emphasis), that is, describing the exterior of the box. It is hard to establish whether Einstein wrote this brief article before or after reading Meyerson's book. In either case, Einstein's insistence that the physicist wants to understand the 'real' and not simply describe it is an undeniably "meyersonnian" theme. Either the text shows Meyerson's early influence on Einstein or, at least, explains why Einstein found Meyerson's book appealing.

according to Einstein, Meyerson "comes to the comparison with the Hegelry [*Hegelei*]" (CPAE, Vol. 14, Doc. 455, 6; March 12).

In general relativity, this was probably Einstein's reasoning, the equality of inertial and gravitational mass gave empirical support to the connection between gravitation and Riemannian geometry. On the contrary, Weyl and Eddington had to resort to speculative guessing in the search for a suitable geometrical structure that would incorporate electromagnetism. Einstein's skepticism toward Weyl and Eddington's work is testified by some remarks that he jotted down a few days later: "Night, sweating properly [...] the conviction of the impossibility of the field theory in the current sense becomes stronger" (CPAE, Vol. 14, Doc. 455, 9; March 17).

These doubts became certainties when Einstein returned to Europe. "On June 1, I got back from South America," Einstein wrote to Besso, "I am firmly convinced that the whole line of thought Weyl-Eddington-Schouten [14]does not lead to anything useful from a physical point of view and I found a better trail that is physically more grounded" (Einstein to Besso, Jun. 5, 1925; CPAE, Vol. 15, Doc. 2). Just thereafter, Einstein met Jakob Klatzkin who was working on the project of a German-language *Encyclopaedia Judaica* with Nahum Goldmann's Eshkol Publishing Society (Klatzkin and Elbogen, 1928–1934). Klatzkin asked Einstein to recommend him to Meyerson, who he hoped could be part of the scientific committee. Einstein gave Klatzkin a note, in which, beside recommending the encyclopedia, he also made the following remark: "I would like to take this opportunity to express my high esteem for your book on relativity that I have studied with great interest and pleasure" (Einstein to Meyerson, Jun. 16, 1925; CPAE, Vol. 15, Doc. 9).

At the beginning of July of 1925, Einstein presented at the Academy of Science the new trail he anticipated to Besso, a further attempt at a unified field theory (Einstein, 1925a), in which both the affine connection and the metric were considered as fundamental variables without assuming their symmetry. Einstein commented to Millikan with the usual initial enthusiasm: "I now think I have really found the relationship between gravitation and electricity" (Einstein to Millikan, Jul. 13, 1925; CPAE, Vol. 15, Doc. 20). However, during the summer, Einstein had already started to nurture some skepticism (Einstein to Ehrenfest, Aug. 18, 1925; CPAE, Vol. 15, Doc. 49; Einstein to Millikan, Jul. 13, 1925; CPAE, Vol. 15, Doc. 20; Einstein to Ehrenfest, Sep. 18, 1925; CPAE, Vol. 15, Doc. 71). The paper was published at the beginning of September, and by that time, Einstein probably already moved on (Einstein to Rainich, Sep. 13, 1925; CPAE, Vol. 15, Doc. 106; see Einstein, 1927d).

In November, Heisenberg's *Umdeutung* paper (Heisenberg, 1925) appeared in the *Zeitschrift für Physik*. "Heisenberg laid a big quantum egg," Einstein wrote two days later, "[i]n Göttingen they believe in it (I do not)" (Einstein to Ehrenfest, Nov. 20, 1925; CPAE, Vol. 15, Doc. 114). As is well known, the opening of Heisenberg's paper was dominated by the positivistic rhetoric of the Göttingen-group (Heisenberg, 1925). Only quantities observable in principle, that is, spectroscopical data, should be introduced in a physical theory, avoiding any attempt to construct a model of the atom and thus forgoing the use of unobservable kinematical variables such as an electron's position, velocity, etc. (Born, 1926a, 68f. cf. Beller, 1988). This renunciative approach, as it was often claimed, was after all not different from Einstein's rejection of concepts like absolute simultaneity, aether, and inertial frame because they are observable in principle (Born, 1926a, 68f.). The second paper, by Born and Pascual Jordan, was published 10 days later, translating Heisenberg's results into matrix mechanics (Born and Jordan, 1925). Einstein began correspondence with Jordan (Jordan to Einstein, Oct. 27, 1925; CPAE, Vol. 15, Doc. 98) and Heisenberg (Heisenberg to Einstein, Nov. 16, 1925; CPAE, Vol. 15, Doc. 112). In his letters, which are no longer extant, Einstein raised technical objections, but he also probably complained about the theory's refusal to provide an intuitive spacetime model of the atom. In his reply, Heisenberg insisted that after some failed attempts, he realized that there was no way out, "if one does not restrict oneself to magnitudes that are observable in principle" (Heisenberg to Einstein, Nov. 16, 1925; CPAE, Vol. 15, Doc. 112). On the very same day, *Zeitschrift für Physik*

[14]Schouten (1924) claimed that it was possible to overcome a shortcoming of Einstein-Eddington's affine theory (in which no electromagnetic field can exist in a place with vanishing electric current density) by dropping the assumption of the symmetry of the affine connection.

received the third paper, (the so-called, *Dreimännerarbeit*) which, by applying the matrix formalism to systems with infinite degrees of freedom, resorted to the same rhetoric of the "observable quantities" (Born and Jordan, 1925, 858). By the end of the year, Paul Adrienne Dirac established the relationship between commutators, and Poisson brackets gave the theory, so to say, the final touch (Dirac, 1925).

4 Einstein's second meeting with Meyerson

On December 20, 1925, Meyerson wrote directly to Einstein for the first time. Since he received most of his education in Germany, Meyerson mastered German perfectly, often indulging in an elaborate and flowery prose. In his first letter to Einstein, Meyerson recounted that he had met Klatzkin who gave him Einstein's flattering note and must have added some more positive commentaries: "It's not hard for me to imagine that he—with the best intentions of course—might have laid it on thick [*die Farben eher etwas stark aufgetragen hat*]" (Meyerson to Einstein, Dec. 20, 1925; CPAE, Vol. 15, Doc. 134). Thus, Meyerson dared to ask Einstein some more details: "Since you took the trouble to read the book (I must say, I was hardly expecting it), or at least to go through it, would you not want to sacrifice another quarter-hour to write to me about it?" (Meyerson to Einstein, Dec. 20, 1925; CPAE, Vol. 15, Doc. 134). Meyerson promised Einstein that his remarks would have remained private. Meyerson's reassurance was necessary after the case of Lucien Fabre, a French engineer and writer who apparently forged Einstein's 'Preface' to his book on relativity (Fabre, 1921; cf. Einstein to Solovine, Mar. 8, 1921; CPAE, Vol. 12, Doc. 85) Meyerson was sincerely interested in Einstein's opinion about his interpretation of relativity theory, in addition to about his views of the 'philosophy of scientists' and suggested him a good German summary of his philosophy written by his friend Harald Høffding, which appeared in the *Kant-Studien.*[15]

At the end of December of 1925, Klatzkin wrote to Einstein that he met Meyerson in Paris and that Einstein's recommendation had the hoped-for effect of convincing Meyerson to be part of his encyclopedia-project. Meyerson, Klatzkin added, would have been pleased not only to have a private commentary from Einstein but possibly a few lines about *La déduction relativiste* in a professional journal (Klatzkin to Einstein, Dec. 30, 1925; CPAE, Vol. 15, Doc. 238a). Klatzkin thanked Einstein for inviting him for a philosophical walk in the following weekend. Klatzkin, a trained philosopher, was apparently used to discuss philosophical matters with Einstein (Klatzkin, 1931). The meeting, however, had to be rescheduled since Einstein was still in Paris for the inauguration of the International Institute of Intellectual Cooperation (Jacoby to Klatzkin, Jan. 11, 1926; EA, 120-612). Nevertheless, Klatzkin wrote to Meyerson that according to Einstein's secretary, Einstein was indeed planning to write something about Meyerson's book (Klatzkin to Meyerson, Jan. 11, 1926; CZA, A408/34).

While Einstein was in Paris, Meyerson invited him to have dinner at his home at 16 rue Clément Marot, along with Metz who had become his disciple (Metz to Einstein, Jan. 8, 1927; CPAE, Vol. 15, Doc. 157). An appointment slip asking to arrive "today after six" has been preserved. The slip should be dated January 15, 1926. In the letter to Elsa Einstein written on January 17, 1926, Einstein, in fact, mentioned that the "day before yesterday (Friday) in the evening" he had dinner "with the philosopher Meyerson, a famous old man". Einstein was enthusiastic: "It was the best thing that I have experienced in Paris" (Einstein to Elsa Einstein, Jan. 17, 1926; CPAE, Vol. 15, Doc. 169). If we credit Metz's later reconstruction of the dinner (which Einstein explicitly confirmed), it was on that occasion that Einstein recognized that, after some initial resistance, he had been won over by *La déduction relativiste* (Meyerson, 1925) (see below in sec. 5).

As planned, Klatzkin met Einstein after his return from Paris at the end of January. According to his recollections, during that conversation, Einstein, while making disparaging comments about other

[15]Høffding was a Danish philosopher, Meyerson's friend, a correspondent (Høffding and Meyerson, 1939) and, the irony of the fate, is usually credited to have had a substantial influence on Bohr's work (Faye, 1991). It is hard to say if Einstein did read the paper. However, he might have found there a turn of phrase that he would often use, somehow tongue in cheek, until the end of his life: "*the physicist is and always remains a metaphysician*" (Høffding, 1925, 488; my emphasis).

philosophical literature, "strongly praised Meyerson's book on the theory of relativity" which he held "in the highest regard" (EA, 86-574). Immediately thereafter, Klatzkin reported Einstein's commentary to Meyerson and confirmed again Einstein's intention to review the book. "By the way," Klatzkin added, "Einstein told me that you [Meyerson] had a long conversation with him" (Klatzkin to Meyerson, Jan. 25, 1926; CZA, A408/34). Einstein probably felt that Meyerson's book was an important card to play in a philosophical game that he perceived as increasingly hostile to his undertakings as a physicist.[16]

Göttingen theoreticians, not least Heisenberg in his April visit to Berlin (cf. Heisenberg, 1966, 63 and Heisenberg and Kuhn, 1963, Session VIII), had often used a positivistic and phenomenalistic reading of relativity theory to justify quantum mechanics' restriction to observable quantities. Meyerson, on the contrary, suggested a rationalistic and realistic interpretation of the theory, which Einstein believed to be closer to the spirit of his work on the unified field theory. On May 27, 1926, the publisher Springer replied to Einstein's suggestion to have Margerete Hamburger—a philosopher and among Einstein's acquaintances in Berlin—translate Meyerson's book into German. Springer wrote that Einstein's endorsement made the project worth pursuing, even if the situation of the book market was not favorable (Springer to Einstein, May 27, 1926; CPAE, Vol. 15, Doc. 476a). Springer did not seem to have followed up on the translation project, but Einstein would try again to find a publisher a few years later (cf. below in sec. 6).

In the meantime, quantum mechanics was rapidly developing. In July, Erwin Schrödinger lectured in Berlin and Munich, presenting his wave mechanics, which he developed over the course of the year (Schrödinger, 1926a,b,c,d). As is well known, initially, Schrödinger tried to attribute a real physical meaning to the wave-function ψ, suggesting a model of the electron as an oscillating charge cloud, evolving continuously in space and time according to a wave equation. Even if this interpretation turned out to be untenable (Lorentz to Schrödinger, May 27, 1926; ESBW, Doc. 73; cf. Kox, 2012), more conservative physicists, including Einstein, expressed preference for Schrödinger's more intuitive formulation (Einstein to Sommerfeld, Aug. 28, 1926; CPAE, Vol. 15, Doc. 353), even if a wave in configuration space was hard to swallow. In contrast, the Göttingen–Copenhagen group was skeptical, if not outwardly hostile, toward Schrödinger's model-like approach, Schrödinger's demonstration of the equivalence of matrix and wave mechanics (Schrödinger, 1926e) notwithstanding. After Born's (1926b) and Pauli's statistical interpretation (Pauli to Heisenberg, Oct. 19, 1926; WPWB, Doc. 143), the ψ-function was finally reduced to an abstract mathematical algorithm generating predictions (Jordan, 1927b,a; Thirring, 1928; Halpern and Thirring, 1928; cf. Wessels, 1980; Beller, 1990). Einstein's dislike for a dice-playing God is too well known to have to be repeated here (Einstein to Born, Dec. 4, 1926; CPAE, Vol. 15, Doc. 426).[17]

5 Einstein's review of Meyerson's *La déduction relativiste*

In January of 1927, a few days after Einstein's and Jakob Grommer's famous paper on the equations of motion (Einstein and Grommer, 1927) was submitted to the Academy, Metz wrote to Einstein to ask for a confirmation of some remarks that he made at the Paris dinner. Metz wanted to use them in his

[16]In hindsight, Einstein's correspondence and writings in the immediately following months already give us a glimpse into what Einstein found interesting in Meyerson's book. A few days after he met Meyerson, Einstein sent to Moritz Schlick a brief celebratory article honoring Mach (Einstein to Schlick, Jan. 22, 1926; CPAE, Vol. 15, Doc. 176), who was, however, rather critical of Mach's sensualism and phenomenalism (Einstein, 1926). Moreover, between March and April 1926, Einstein corresponded with Reichenbach, agreeing with him (Einstein to Reichenbach, Apr. 8, 1926; CPAE, Vol. 15, Doc. 235) that general relativity was not in the first instance a geometrization of the gravitational field (Giovanelli, 2016). The name of Meyerson was not mentioned in either correspondence. However, both the critique of Mach's positivism and even more the essential role of geometrization in physics were central issues of Meyerson's book.

[17]Meyerson was able to follow quite closely these developments through his friend Høffding, which was a friend of Bohr. In a letter written at the end of 1926, Høffding explained to Meyerson that Bohr presented a communication to the Royal Academy on wave mechanics (Bohr, 1926–1927). In Høffding's reconstruction, Bohr suggested "that we cannot decide whether the electron is a wave motion [...] or a particle [...]. Certain equations lead us to the former inference, certain others to the latter. No picture, no term corresponds to all equations". According Høffding, Bohr was increasingly more "convinced of the necessity of symbolization if we wish to express the latest findings of physics" (Høffding to Meyerson, Dec. 30, 1926; Høffding and Meyerson, 1939, 131).

forthcoming book (Metz, 1927) on Meyerson's philosophy (Metz to Einstein, Jan. 20, 1927; CPAE, Vol. 15, Doc. 460). Metz's insistence to obtain an official *placet* from Einstein was again motivated by the Fabre-*affaire* (see above in sec. 4). Metz, in a letter in French, asked Einstein whether he confirmed his skepticism toward Eddington's theory. Moreover, he suggested the following description of the Paris meeting: "Deeply struck by the theses expressed there [in *La déduction relativiste*], he wanted to come to visit Mr. Meyerson on a trip to Paris to express his full approval and pay the tribute of his admiration". In Metz's reconstruction, Einstein claimed that Meyerson well described the scientists' "*démon de l'explication*", their deep-rooted need to understand the real and not simply to describe it. "What?", Einstein apparently exclaimed that same 'demon' that "you [Meyerson] have found in Descartes and others and seemed so foreign to me: Am I, therefore, possessed by it myself? This is something I was a hundred leagues from suspecting. Well, I have read your book, and, I must confess, I am convinced ..." (Metz to Einstein, Jan. 20, 1927; CPAE, Vol. 15, Doc. 460).

Einstein confirmed that Metz had "characterized our conversation correctly" and that he had "no objection to the publication" (Einstein to Metz, Jan. 23, 1927; CPAE, Vol. 15, Doc. 463).[18] He agreed that he was now fully persuaded of the "impracticality of the Weyl-Eddington theory" (Einstein to Metz, Jan. 23, 1927; CPAE, Vol. 15, Doc. 463). Einstein had, in fact, just submitted to the Academy a paper on five-dimensional Kaluza-Klein theory (Einstein, 1927f). Most of all, Einstein elaborated on Metz's characterization of Meyerson's philosophy. In doing so, as it would often happen, Einstein seemed to present his own philosophical views, rather than describe those of Meyerson: "The physicists—the true theoretical physicists—strive for nothing but a logical construction which corresponds to the causal reality [*kausalen Wirklichkeit*]" (Einstein to Metz, Jan. 23, 1927; CPAE, Vol. 15, Doc. 463). In this sense, the physicist is similar to Descartes or even Hegel, a comparison that Einstein found to be "quite fitting". The only difference is that in physics "without a subtle empirical basis [*subtile Empirie*], it is impossible to find a suitable basis for deduction" (Einstein to Metz, Jan. 23, 1927; CPAE, Vol. 15, Doc. 463).

In Einstein's view, it was quantum mechanics that had been unfaithful to the task of a true theoretical physicist (cf. Einstein's remarks in Einstein, 1927e,c,a). Einstein's sensibility at that time is well expressed by a conversation that he had with Klatzkin on March 27, 1927. According to Klatzkin's recollections, Einstein recognized that the quantum method of probability led to astounding results. Nevertheless, Einstein felt that his "metaphysical need" could not be satisfied in this way (EA, 86-578). "My colleagues laugh at me" and claim that I'm "unfaithful to myself" (EA, 86-578). However, Einstein apparently continued, "[i]t seems to me that it is the Jewish in me [*das Jüdische in mir*], that I have to search for the last secrets of nature, and—despite of the successful calculation-methods—I do not find any peace, as long as I have not found the last epistemological foundation" (EA, 86-578).

In March Klatzkin wrote to Meyerson that Einstein was indeed ready to review *La déduction relativiste*. The only problem was to find a suitable journal (Klatzkin to Meyerson, Mar. 18, 1927;Klatzkin to Meyerson, Mar. 28, 1927; CZA, A408/34). Both Meyerson and Einstein were friendly with Lucien Lévi-Bruhl who was the editor of *Revue philosophique*, which turned out to be a natural outlet for the article. On April 14, 1927, Metz got back to Einstein since he wanted to use the article or part of it as a preface for the book (Metz, 1927) on Meyerson that he was writing (Metz to Einstein, Apr. 14, 1927; CPAE, Vol. 15, Doc. 825). In mid-May of 1927, Einstein answered that he was indeed carefully studying *La déduction relativiste* to write about it, but he was proceeding slowly. He had nothing against Metz's request if also Lévi-Bruhl agreed: "the main thing remains, that the review must first be written!", he wrote (Einstein to Metz, May 11, 1927; CPAE, Vol. 15, Doc. 849a).

Klatzkin confirmed again to Meyerson that Einstein was working on the review (Klatzkin to Einstein, May 20, 1927; CZA, A408/34). Meyerson wrote to Einstein soon thereafter and was, needless to say, enthusiastic: "Nothing, in my career as a philosopher, has made me more proud than the favorable judgment with which you have gratified me" (Meyerson to Einstein, May 28, 1927; EA, 18-279). Meyerson was aware that Einstein's endorsement would have given "a decisive contribution drawing attention to

[18]The passage appears in Metz, 1927, 179–180.

the conceptions I am defending" (Meyerson to Einstein, May 28, 1927; EA, 18-279). Meyerson recollected the dinner that they had in Paris, and he imagined that he could learn even more from Einstein's article. In particular, he was interested in understanding the difference between "the starting point of your own deductive approach and that of the Hegelian deduction" (Meyerson to Einstein, May 28, 1927; EA, 18-279).

Einstein finally sent the first drafts of the review in German in June. "I have admired your exposition very much", Einstein wrote (Einstein to Meyerson, May 28, 1927; EA, 91-254). Einstein expressed some concerns that although the review was largely positive (if not overtly laudatory), he had given too much space to criticisms. He was, however, ready to discuss possible changes. At any rate, Einstein continued, Lévy-Bruhl "wrote me that he intends to publish the review" (Einstein to Meyerson, Jun. 15, 1927; EA, 91-254). In the following, I will present the content of the German version of the review (Einstein, 1927b) that Einstein attached to this letter. As we shall see, it is slightly different from the published version. To simplify the exposition, I will attempt to separate clearly the wheat from the chaff, what Einstein appreciated in Meyerson's book or, in general, in his philosophy from what he did not.

5.1 The First Draft of the Review

Einstein opened the review by emphasizing Meyerson's unique capacity of understanding "the pathways of thought of modern physics" and penetrating the "history of philosophy and the exact sciences" (Einstein, 1927b, 1). According to Einstein, Meyerson was able to combine "[l]ogical acumen, psychological instinct, multi-faceted knowledge" (Einstein, 1927b, 1). Einstein praised the historical-critical approach of the book. The theory of knowledge, for Meyerson, was neither an "analysis of the spirit" nor a "logical speculation" (Einstein, 1927b, 1). On the contrary, it was based on the analysis of the "empirical material" (Einstein, 1927b, 1). The empirical material of philosophy of science is nothing but the history of science.[19] By looking at the history of science, Meyerson wanted to investigate the interplay between theory and experience and between deduction and induction in physics.

I think it is straightforward to identify the features of Meyerson's philosophy that Einstein found attractive:

Rationalism. Meyerson rejects and even fights "[p]ure positivism and pragmatism". Science is "a conceptual construction which cannot be extracted from experience as such". Instead of collecting facts, science attempts to "build up a logical system, based on as few premises as possible" (Einstein, 1927b, 1); from it, the natural laws can be derived as "logical consequences" and finally put to empirical test. What Einstein found particularly appealing is that Meyerson does not "censure [*tadelt*]" the "strongly deductive-constructive, highly abstract character of the theory" (Einstein, 1927b, 3). On the contrary, he "finds that this character corresponds to the tendency of the whole development of exact sciences". Because of this "deductive-constructive character," Meyerson is not afraid to "compare the theory of relativity in a very ingenious manner [*Geistreicherweise*] with Hegel's and Descartes' systems". Physics does not simply aim to catalogue facts, it wants to "comprehend [*begreifen*]" (Einstein, 1927b, 4), it does not only describe how nature is, but it wants to show that it cannot be

[19] A proper 'classification' of Meyerson's work is not an easy task, as Meyerson himself conceded. Meyerson's investigations do not fit under the category 'philosophy of science.' Meyerson does not want to understand how the 'good,' scientific knowledge is different from the 'bad,' non-scientific one (Meyerson, 1931, 14–15). Meyerson, as we have mentioned, was concerned with the 'philosophy of the scientists,' with the philosophical views that, for better or worse, *de facto* motivated their research. However, Meyerson did not regard his work as a form of 'psychology'; he found direct psychological observation untrustworthy, either in introspective or behaviorist form. Meyerson later introduced the expression *philosophie de l'intellect* (Meyerson, 1934b) to indicate that his inquiry was intended to shed light on how the mind works, but through an indirect analysis of its products, particularly scientific theories (Meyerson, 1934a).

different from what it is [20] In Einstein's view, Meyerson is a "rationalist and not empiricist".[21] However, "he also differs from critical idealism in Kant's sense". Science, of course, relies on non-empirical conceptual tools, but these are not *a priori* conditions of all possible science: "We can only ask how the system of science (in its states of development thus far) is composed, but not how it *must* be composed" (Einstein, 1927b, 2f.). Thus, the non-empirical construction tools used by physics are "(from a logical point of view) conventional; their only justification lies in the performance of the system vis-a-vis the facts, in its unified character, and in the small number of its premises" (Einstein, 1927b, 3).

Realism. According to Einstein, Meyerson has rightly pointed out that science seeks to arrange this highly abstract, speculative system so that it corresponds "to the world of real things of pre-scientific *Weltanschauung*" (Einstein, 1927b, 2). Meyerson combined the insistence on the highly deductive-constructive nature of physical thinking with the conviction that "at the basis of all natural science lies a philosophical realism" (Einstein, 1927b, 2). Physics proceeds substituting the object of common sense experience with abstract unobservable entities. These are free constructions of the human mind. Nevertheless, physics attributes to these constructions a reality independent of observation which is comparable to the objects of common sense.[22] When people unacquainted with physics observe a galvanometer in a laboratory, they see, say, a small pivoting coil of wire connected to a pointer that traverses a calibrated scale, a horseshoe magnet, a mirror, etc. However, for the physicist, the motion of the pointer indicates the presence of an electric current. The latter is indeed an abstract construction which makes sense only under the assumption of the validity of electrical theory. However, the electrical current, for the physicist, is an object just as real as the macroscopic parts of the galvanometer observed by the non-physicist. If the galvanometer is hidden behind a screen, no physicist would claim that the current has ceased to flow because one cannot see the galvanometer, just like no one would claim that the galvanometer ceased to exist when we do not look at it (Meyerson, 1908, 344f.; tr. 1930b, 369f.).

Thus, Meyerson offered to Einstein that combination of constructivist rationalism and realism (Hentschel, 1990, sec. 4.11) that he was searching for.[23] Meyerson dismissed the positivistic interpretations

[20]The comparison between the scientists' strive for a global deduction and speculative philosophical systems such as Hegel's philosophy had been introduced by Meyerson in his second monograph (Meyerson, 1921) and further restated in his relativity book. Relativists, just like previous scientists, "sought to establish [...] nothing less than a true system of universal deduction, in the sense that Cartesian physics or the natural philosophy of Hegel constitutes such a system" (Meyerson, 1925, 124; tr. 1985, 88). However, according to Meyerson, on the one hand "the relativistic deduction is more comprehensive than Descartes's, for it goes beyond the bounds the latter had set for his geometrical explanations" (Meyerson, 1925, 127; tr. 1985, 90); on the other hand, it "goes well beyond the limits of Hegel's deduction. For Hegel intends to deduce only the most general characteristics of reality" (Meyerson, 1925, 129; tr. 1985, 91).

[21]Statements like these seem to indicate that Einstein confuses what Meyerson considered the 'philosophy of the scientists' with Meyerson's own 'philosophy of science' (see fn. 19). Meyerson claims that scientists, often in contradiction with their own empiricist rhetoric, are actually rationalists and realists, but not that realism and rationalism are a feature of a 'good' philosophy of science. The fascination that Einstein felt for Meyerson's book was probably the consequence of the fact that Meyerson had offered a strikingly good description of his own "motivations for doing research" (Einstein, 1918). However, Einstein went beyond Meyerson's intention when he tried to attribute a normative meaning to this philosophical stance.

[22]According to Meyerson, scientists search for "an object whose reality is in all respects analogous to the reality of common sense objects" (Meyerson, 1925, 19; tr. 1985, 19). They are persuaded of the existence of the theoretical entities of science "by reasoning analogous to that by which common sense is persuaded of the existence of any object whatsoever, namely because this assumption accounts for a whole series of observed phenomena" (Meyerson, 1925, 21; tr. 1985, 20f.). According to Meyerson, scientists actually believe that "the entities created by science" and "destined to be substituted for those of common sense" are "necessarily [...] more detached, more independent of the subject, that is to say, more real, than the latter. This is true, for example, in the case of the atoms or electrons that are to replace the material bodies of our spontaneous perception" (Meyerson, 1925, 29f.; tr. 1985, 25).

[23]Meyerson indeed emphasizes that "[i]n relativistic physics as in physics in general, the tendency toward idealism coexists side by side with realistic convictions" (Meyerson, 1925, 144; tr. 1985, 100). "Although the Einsteinian physicist, like all physicists, is basically a realist," he wrote, "the very success of his deduction leads him to a structure that is just as basically idealistic" (Meyerson, 1925, 143; tr. 1985, 99). In Meyerson's view, science is somehow driven by the contrast "between the vigorously realistic thought of the physicist and the ultimate goal of his science, which is necessarily idealistic since it aims at an explanation of the whole, a deduction of the whole from the content of reason" (Meyerson, 1925, 251; tr. 1985, 168).

of relativity, *à la* Wolfgang Petzoldt (1921), which are simply incompatible with the theory's level of mathematical abstraction (Meyerson, 1925; tr. 1985, §44). At first sight, this seems to prove thinkers like Cassirer (1921) right, which regarded relativity theory as the expression of a pan-mathematical idealism (Meyerson, 1925; tr. 1985, §52). According to Meyerson, however, this interpretation misses a fundamental point: "this mathematical construction nevertheless leaves reality intact, and the goal of relativity theory is precisely to inform us about the nature of this reality" (Meyerson, 1925; tr. 1985, 56). After having dispelled the myth of Einstein's positivism (Meyerson, 1925; tr. 1985, §45), Meyerson, relying on the authority of numerous relativists (Eddington, Langevin, Borel, Jean Becquerel, Weyl, etc.), insists that the goal of relativity theory, in spite its misleading name, is to describe a "reality as independent of the observer" (Meyerson, 1925; tr. 1985, §48). Relativism is ultimately a theory about reality (Meyerson, 1925; tr. 1985, ch. 5).

Einstein undeniably regarded this realistic-rationalistic approach more adequate than the existing alternatives. Nevertheless, there were also aspects of Meyerson's book with which he could not agree:

Relativism. Meyerson, in Einstein's reading, regarded the theory of relativity as a *new* deductive system of physics which he labeled 'relativism'.[24] Einstein, on the contrary, wanted to emphasize the continuity between relativity theory and previous physics. Relativity theory indeed introduced a new principle. "The theory adapts to this principle the basic laws of physics—as they were known before—with as few changes as possible" (Einstein, 1927b, 3). Both relativity theories are theories of principles, and they impose constraints on the possible and existing laws of nature and change the latter if they do not satisfy these constraints. In this sense, "[n]ot the theory as a whole, but only the adaptation to the principle of relativity, is new". "One should rather speak of a 'physics adapted to the principle of relativity' as 'relativism,' than of a new system of physics" (Einstein, 1927b, 3). The relativity principle, as a second-order constraint based on empirical facts, appears safer that any of the first-level theories. Quantum theory can force us to abandon concepts like the electromagnetic field, but it will probably let the requirement imposed by relativity untouched.

Geometrism. In Meyerson's view, general relativity has realized the dream of Descartes of reducing physics to geometry.[25] However, Einstein disagreed (Lehmkuhl, 2014). "I cannot, namely, admit that the assertion that the theory of relativity traces physics back to geometry has a clear meaning" (Einstein, 1927b, 4). Einstein had made the same point in correspondence with Reichenbach roughly one year earlier (see fn. 16; cf. Giovanelli, 2016). At that time, Einstein had just read Meyerson's book, and probably Reichenbach prompted him to express his reaction to Meyerson's pan-geometrism. According to Einstein, "the designation of the theory as 'geometrical' is actually without content; one

[24]Toward the end of the book Meyerson seems to suggest that 'relativism' might even be seen as the sign that the structure reason has changed in the attempt to accommodate reality; cf. the next footnote.

[25]Meyerson indeed repeatedly insists that "the relativistic explanation, unlike those that preceded it, [is] *geometrical*. In relativism, taken to its logical conclusion, everything is geometry and only geometry, while in mechanical theories geometry is simply applied to concepts of a nongeometrical nature, such as the chemical atom, the material particle, etc" (Meyerson, 1925, 29f.; tr. 1985, 84f.). In support of his claim, Meyerson could cite (Meyerson, 1925, 125; tr. 1985, 89) Weyl's famous *dictum* that relativism has achieved "Descartes's dream of a purely geometrical physics" (Weyl, 1921c, 258). However, Einstein did not seem to have understood the motivation beyond Meyerson's insistence on the importance of geometrical explanations. In Meyerson's view, relativists simply share the same physicists' preference for spatial explanations on which he had insisted in his previous works. This preference is nothing but the consequence of the general tendency of the human mind to strive for 'identity.' The physicist, Meyerson writes, "always explains [...] in spatial terms; he is constantly dominated by the concern to reduce all diversity to a purely spatial diversity" (Meyerson, 1925, 138f.; tr. 1985, 97). However, reality resists this process of identification; relativism "cannot eliminate all diversity; therefore, while physics becomes simpler, the geometry that replaces it must become more complex" (Meyerson, 1925, 150; tr. 1985, 104). In particular, according to Meyerson, to spatialize the phenomena, relativity was forced to introduce a non-homogenous space. In this way, however, relativism renegades the very nature of spatial explanation, which was based on the indifference of space respect to its contents: "the term *space* signifies something very different from what it has designated in physics until now" (Meyerson, 1925, 365; tr. 1985, 238). In this sense, as a consequence of relativism, "scientific reason must obviously do violence to itself to some extent" (Meyerson, 1925, 366; tr. 1985, 239). Thus Meyerson reached a quite surprising conclusion: either relativism will turn out to be only a transitory phase of science, or, so to say, it has forced reason to modify itself (Meyerson, 1925; tr. 1985, §278).

could just as well say that the metrical tensor describes the 'state of the ether'" (Einstein, 1927b, 5). The real achievement of Weyl and Eddington's theory, in Einstein's view, lies not in the fact that they have incorporated the theory of this field into geometry, but that they have shown a possible way to represent gravitation and electromagnetism as two sides of the same field (Einstein, 1927b, 5)

To balance these criticisms, Einstein concluded the review with a praise. As he had already briefly pointed out during the 1922 Paris discussion (cf. above in sec. 2), Meyerson was fully correct in criticizing the parlance of the *spatialisation du temps* (Einstein, 1927b, 5), a parlance which could be found not only in philosophical expositions of relativity theory but also in some authoritative technical accounts. "Space and time are indeed fused into a unified continuum," Einstein insisted, "but this continuum is not isotropic" (Einstein, 1927b, 5). In this way, Einstein restated his respect for Meyerson's ability to set the record straight in a matter that had misled even some prominent physicists. At the same time, however, Einstein unwittingly offered a good example of his fundamental misunderstanding of the spirit of Meyerson's book.

Meyerson denounced the "exaggerations of the relativists" (Meyerson, 1925, 109; tr. 1985, 76), the fact that even textbook authors like Cunningham (1921, §62), Eddington (1920, 48, 51), etc. could not completely avoid the rhetoric of the spatialization of time. However, according to Meyerson, these 'exaggerations' were not simply mistakes that needed to be corrected. The "source of the relativistic exaggerations" lied in a "general tendency inherent in our reason" (Meyerson, 1925, 105; tr. 1985, 71), in its deep-seated desire to reduce temporal displacements to displacements in space. Things do not change by simply being displaced in space, but they do change by simply advancing in time. Thus, reason, in its perennial attempt to explain away becoming, tirelessly tries to find a way to reduce temporal change to spatial change, a change that does not change anything. However, nature seems to have other plans. The relativistic rejection of backward causation (together with Carnot's principle) was for Meyerson the manifestation of the resistance of nature to be subjected to the dictates of reason. As we shall see, Einstein seems to have completely overlooked that, what he had mostly admired in *La déduction relativiste*, Meyerson's grasp for the scientists' deep-rooted belief in the rationality of real, was inseparable from Meyerson's acknowledgment that such faith was no less illusory than a religious faith.

5.2 Meyerson's Reaction to Einstein's Review. The Randbemerkungen

Meyerson received the draft of Einstein's review a few days later: "Yesterday gave me the immense pleasure of receiving your letter and your article" (Meyerson to Einstein, Jun. 19, 1927; EA, 18-281). Meyerson confessed that until the last moment, he had somewhat doubted that Einstein would have really written the review. Meyerson knew that he was constantly solicited from all sides and for causes of much greater importance. "*Die Kalle zu schön*", he commented using a Yiddish expression: it can only go bad when 'bride is two beautiful' for the bridegroom (Meyerson to Einstein, Jun. 19, 1927; EA, 18-281). "My gratitude toward you is then even greater today for this really *great* present", Meyerson wrote (Meyerson to Einstein, Jun. 19, 1927; EA, 18-281). Not being a French native speaker, Meyerson suggested Metz as a translator. Meyerson estimated that it would have taken some time, since he found Einstein's objections significant and wanted to reply, "if only in the sense, as one would say in English, that *we agree to differ*[26]" (Meyerson to Einstein, Jun. 19, 1927; EA, 18-281).

Indeed because of Metz' difficulties with the translation (Lévi-Bruhl to Meyerson, Jul. 6, 1927; EMLF, 409s), Meyerson could get back to Einstein only toward the end of July (Meyerson to Einstein, Jul. 20, 1927; EA, 18-283). He enclosed the original manuscript of the review (Einstein, 1927b), Metz's translation into French (EA, 91-236) and some marginal remarks (*Randbemerkungen*) (Meyerson, 1927), that were meant to discuss Einstein's objections. Meyerson noticed that, concluding the review, Einstein praised the book as *one* of the most important contribution of the philosophy of relativity. "Implicitly this means that other philosophical works are, so to speak, *ex aequo* with mine in this competition" (Meyerson to Einstein, Jul.

[26]In English in the text.

20, 1927; EA, 18-283). From what Meyerson had heard from Klatzkin and Metz, "I was inclined to think you considered my work for *the* best (in the matter the theory of knowledge)" (Meyerson to Einstein, Jul. 20, 1927; EA, 18-283). Meyerson was then curious to know the identity of these competitors. Schlick was, of course, the most prominent (Einstein had complained that Meyerson did not mention Schlick's work; cf. Einstein, 1927b, 5), but he wanted to have other names.

Most of all Meyerson, provided a lengthy justification for the lengthy remarks that he had attached to the letter (Meyerson, 1927): five pages of handwritten annotations which addressed the two objections raised by Einstein. "I hope you do not mind if my explanations have lengthened somewhat: to reply [*Erwidern*] to an Einstein is not easy" (Meyerson to Einstein, Jul. 20, 1927; EA, 18-283). As many of his readers failed to understand (including probably Einstein), Meyerson did not necessarily embrace the philosophy of science he was describing; he simply attempted to uncover the often unconscious philosophical attitude of science practitioners. Thus, it was essential for Meyerson to grasp precisely where he had misunderstood the object of his investigations.

In the following, I briefly summarize the two counter-objections which Meyerson put forward in his *Randbemerkungen* (Meyerson, 1927).

Relativism. Meyerson had to admit that he used turns of phrase in which "relativity theory appears as a new deductive system when compared to previous physics" (Meyerson, 1927, 1). However, Meyerson could point out to the numerous passages in which he emphasized the opposite point, that relativity theory follows the trail blazed by "traditional physics" (Meyerson, 1927, 1). Meyerson had chosen the expression 'relativism' not to indicate a new system but because it was handy to have one category to cover Einstein's general relativity and Weyl's and Eddington's early attempts at a unified field theory (Meyerson, 1927, 1). Meyerson also clarified his remarks about the relationship between quantum theory and relativity theory. He was open to the possibility that the quantum phenomena would force us to abandon the continuity of spacetime. However, he was indeed confident that "the revolution introduced by your [Einstein's] works will never be overthrown" (Meyerson, 1927, 1).

Geometrism. The second objection raised by Einstein required a somehow lengthier explanation. Meyerson realized that Einstein did not accept his claim that "that relativity theory reduces the physically real to pure space" (Meyerson, 1927, 2). Meyerson, however, could refer to numerous remarks of Weyl and Eddington in which relativity theory was presented as the realization of the 'dream of Descartes.' In this sense, Meyerson claimed, it was his "duty as a philosopher" (Meyerson, 1927, 3) to point out that also relativists shared the unconscious inclination to privilege 'spatial explanations.' Meyerson conceded that he had not found similar passages in Einstein's writings. Einstein seemed to believe that relativity theory has made geometry 'physical' rather than the way around. Meyerson could, however, point out that, from his point of view, the alternative between 'geometrization of physics' vs. 'physicalization of geometry' was somehow irrelevant. Meyerson quoted a long passage from *De l'explication dans les sciences* (Meyerson, 1921) in which he insisted on the second aspect (Meyerson, 1921, 2:445–446). What was important for Meyerson was the deductive aspect of geometry "on which, if I understand you correctly we are in complete agreement" (Meyerson, 1927, 5).

Meyerson's remarks are unfortunately of little philosophical interest. One has the impression that, although lengthy a full of citations from his previous books, they were meant to seek conciliation rather than a serious confrontation with Einstein's review. Meyerson did not seem to see or did not want to see the elephant in the room: Einstein had understood very little of Meyerson's *épistemologie*. He glossed over many Meyerson's major points and only singled out what mirrored his own philosophical views.

5.3 Einstein's Reaction to Meyerson's Randbemerkungen

Einstein replied only at the end of August when he was back to Berlin after vacation. Concerning Meyerson's request to have some 'reading tips,' Einstein made an interesting choice: Schlick, Reichenbach,

Rudolf Carnap, and Edgar Zilsel, that is all philosophers that we would classify as 'logical empiricists.' In particular, Einstein suggested Meyerson to write directly to Schlick and to read Schlick's work. Einstein thanked Meyerson for the "abundant and profound reflections" (Einstein to Meyerson, Aug. 31, 1927; EA, 18-284). He admitted that he had "indeed not correctly characterized [his] conception of the role of relativity in relation to previous physics" (Einstein to Meyerson, Aug. 31, 1927; EA, 18-284). Concerning the geometrization-issue, Einstein, on the contrary, did not back off: "I have not changed my mind". Einstein was still convinced that the word geometrical is "meaningless" (Einstein to Meyerson, Aug. 31, 1927; EA, 18-284). Einstein's remark about geometry was much more simple and, at the same time, more radical that Meyerson had suspected. Einstein was not really concerned with the opposition between 'physicalization of geometry' vs. 'geometrization of physics.' Einstein regarded the distinction between geometrical and non-geometrical as inessential: there is no reason to call the gravitational field $g_{\mu\nu}$ a 'geometrical' field, and the electromagnetic field $\varphi_{\mu\nu}$ a 'non-geometrical' one (Lehmkuhl, 2014). At any rate, Einstein did not have any time to rewrite the review.

Because of Einstein's delay in returning the revised translation, Meyerson started to worry that Einstein was annoyed by or had even taken offense at his remarks (Meyerson to Einstein, Oct. 11, 1927; EA, 18-286). After the misunderstanding was cleared up (Einstein to Meyerson, Oct. 15, 1927; EA, 18-287), Meyerson's first impulse was to immediately forward the article to Lévy-Bruhl. However, at a second thought, he realized that it would been more advisable to introduce some modifications to the text of the review (Meyerson to Einstein, Oct. 27, 1927; EA, 18-289). Meyerson adduced as an attenuating circumstance for his request, the fact that Einstein's words were taken extremely seriously by the readers: *Le roi l'a dit*, he wrote (Meyerson to Einstein, Oct. 27, 1927; EA, 18-289). Every word choice, every nuance would have conditioned the reception of his work.

From October 24 to 29, 1927 Einstein participated at the Solvay conference, in which he made his first public remarks about the new quantum theory (Lorentz, 1928; cf. Bacciagaluppi and Valentini, 2009). Getting back from Bruxelles, Einstein wrote to Meyerson that he agreed with his proposal concerning the review (Einstein to Meyerson, Nov. 3, 1927; EA, 18-290). Meyerson promised to send the revised version back as soon as possible (Meyerson to Einstein, Nov. 6, 1927; EA, 18-292). The text was mailed to Einstein just before Christmas. "As you will see," Meyerson wrote, "the changes are not important, and I think I proceeded in the direction of the information contained in your letters, borrowing here and there directly form these letters" (Meyerson to Einstein, Dec. 19, 1927; EA, 18-293).

At a cursory reading, Meyerson simply smoothed Einstein's critique concerning the novelty of relativism,[27] presented a more balanced version of their respective opinions on the role of geometrization in physics,[28] and finally added a remark concerning the role of spatialization of time in the history of physics.[29] However, at closer inspection, Meyerson's additions to Einstein's text revealed that the issues at stake were more serious. Indeed, the "analogy" he had set forth "between relativistic physics and geometry [was] much more profound" (Einstein, 1928a, 165; tr. 1985, 255) than Einstein had realized. As we have mentioned, for Meyerson, physics was dominated by the tendency to dissolve 'diversity' into the uniformity of space. This tendency unconsciously persists in the mind of physicists despite the fact that "relativity itself [...] [has shown] that this complete reduction, which was the dream of

[27]Not in the original German: "It seems to me that, everything considered, the author completely shares this point of view, for he often insists that relativistic thought is essentially in conformity with the laws and general tendencies science had already manifested earlier" (Einstein, 1928a, 163; tr. 1985, 253).

[28]Not in the original German: "Consequently, I believe that the term 'geometrical' used in this context is entirely devoid of meaning. Furthermore, the analogy Meyerson sets forth between relativistic physics and geometry is much more profound. Examining the revolution caused by the new theories from the philosophical point of view, he sees in it the manifestation of a tendency already indicated by previous scientific progress, but even more visible here— a tendency to reduce 'diversity' to its simplest expression, that is, to dissolve it into space. Meyerson shows in the theory of relativity that this complete reduction, which was the dream of Descartes, is in reality impossible" (Einstein, 1928a, 165; tr. 1985, 255).

[29]Not in the original German: "The tendency he denounces, though often only latent in the mind of the physicist, is nonetheless real and profound, as is unequivocally shown by the extravagances of the popularizers, and even of many scientists, in their expositions of relativity" (Einstein, 1928a, 166; tr. 1985, 255).

Descartes, is, in reality, impossible" (Einstein, 1928a, 166; tr. 1985, 255). Thus, relativity theory, more than other theories reveals the limits of scientific theorizing; it shows that there is an 'irrational' which resists "despotism of the mind" (Meyerson, 1925; tr. 1985, ch. 13). Meyerson "often" insisted that relativity was the manifestation of the same need for 'global deduction' "already indicated by previous scientific progress" (Einstein, 1928a, 166; tr. 1985, 255). However, he has also expressed disconcert toward the fact that 'relativism,' to obtain this goal, abandoned the essential advantage of spatial explanations, that is the uniformity of space. In this regard, Meyerson even went as far as to claim that the mind was forced to modify itself in its attempt to dominate reality.[30]

In this way, under the appearance of adding only a few lines (which the reader would have perceived as being written by Einstein), Meyerson deftly reintroduced in the review the major themes of his *épistémologie*. At the same time, Meyerson unwittingly revealed how little Einstein had actually understood it. In Einstein's review, there was no trace of Meyerson's equivalence between explanation and identification, of the central role of spatial explanation and of the elimination of time in the history of science, of Meyerson's belief in the fundamental irrationality of reality. To a certain extent, there was no trace of Meyerson's doctrine. Einstein's review was more an exposition of his own philosophical *credo*, which indeed was akin to the 'spontaneous philosophy of the scientists' which Meyerson had aimed to describe. However, Einstein did not seem to have realized that, in Meyerson's view, this philosophy, the scientists' belief in the rationality of real, was ultimately delusory.

The Einstein–Meyerson dialog was ultimately a 'dialog of the deaf' (cf. also Balibar, 2010, 69). Unfortunately, neither parties seemed to have an interest in a proper clarification. Einstein was mainly concerned with his 'unification' agenda, whereas Meyerson did not want to lose Einstein's precious endorsement. Nevertheless, the fact that, in the plethora of philosophical publications on relativity, Einstein singled out Meyerson's book highly reveals his philosophical stance at that time. Just before Christmas, Einstein quickly gave his *imprimatur* (Einstein to Meyerson, Dec. 24, 1927; EA, 18-294). A few days later, Meyerson communicated to Einstein that he had sent the text to Lévy-Bruhl (Meyerson to Einstein, Dec. 26, 1927; EA, 18-295). The number of *Revue philosophique de la France et de l'étranger* in January was already in print; therefore, the review was planned to be published in the next number.

5.4 Einstein's Reference to Meyerson in the Public Debate

After nearly one year of to-and-fro, Einstein's review of *La déduction relativiste* was finally published in Spring 1928. "It is my conviction," Einstein concluded the review, "that Meyerson's book is one of the most valuable contributions to the theory of relativity, which has been written from the viewpoint of the theory of knowledge" (Einstein, 1928a, 166; tr. 1985, 256). Like he did in the original version of the review, Einstein complained that Meyerson did not mention Schlick's work, but he probably added the name of Reichenbach in the final draft.[31] In spite of this homage to his old philosophical comrades-in-arms, the Meyerson review represents a clear reconfiguration of Einstein's system of alliances. When Einstein became deeply involved in the unified field theory program, Meyerson—or at least Einstein's 'Meyerson'—seems to have progressively taken the role of Schlick as Einstein's 'reference philosopher.' It was with Meyerson's odd combination of speculative rationalism and common-sense realism that Einstein intended to counter "the Heisenberg-Bohr tranquilizing philosophy" (Einstein to Schrödinger, May 31, 1928; ESBW, Doc. 172). Physicists do not simply search for mathematical methods adequate to describe our observations. Physicists are possessed by the 'demon of explanation,' they are urged on by the desire to understand and not to describe.[32]

The use that Einstein wanted to make of Meyerson's reading of relativity theory became clear in the next months. At the end of May, Einstein wrote to Zannger that he had "laid a wonderful egg in

[30]Cf. fn. 25.

[31]Einstein received the galley proofs of Reichenbach's *Philosophie der Raum-Zeit-Lehre* (Reichenbach, 1928) at the end of 1927 Einstein to Reichenbach, Dec. 1, 1927; EA, 20-090 and published a review (Einstein, 1928c) short thereafter.

[32]Cf. fn. 13.

the area of general relativity" (Einstein to Zannger, May 31, 1928; EA, 40-069). During a period of rest due to a heart condition, Einstein came up with a new unified field theory, based on a flat geometry with non-vanishing torsion (Sauer, 2006). This structure allows for additional degrees of freedom that, again, could be used to accommodate the electromagnetic field. Einstein was still weak, and Planck presented the paper to the Academy on June 7 (Einstein, 1928d). The second paper was presented on June 14 (Einstein, 1928b). As Einstein wrote to Metz, a few days later: "I have discovered a new possibility in the general theory of relativity to regard gravitation and electricity from a unified point of view, a possibility that deviates widely from all attempts so far. The first communication will soon appear in the Proceeding of our Academy of Sciences" (Einstein to Metz, Jun. 18, 1928; EA, 18-262). Einstein, as usual, considered the approach very promising. Besides working with his two assistants, Jakob Grommer and Cornelius Lanczos, he discussed the technical aspects of the theory in correspondence with Herman Mütz, Roland Weitzenbök, and Élie Cartan (Sauer, 2006). Nevertheless, the skepticism was widespread. Weyl, who had always been criticized by Einstein for his speculative style of doing physics could relaunch the accusation in a paper (Weyl, 1929) in which he had uncovered the gauge symmetry of the Dirac theory of the electron (Dirac, 1928a,b). "The hour of your revenge has come", Pauli wrote to Weyl in August: "Einstein has dropped the ball of distant parallelism, which is also pure mathematics and has nothing to do with physics" (Pauli to Weyl, Aug. 26, 1929; WPWB, Doc. 235).

The theory, however, attracted enormous and irrational attention among the general public, after the *The New York Times* had published a rather sensationalist article on the topic (Miller, 1928) in early November. At about the same time, Einstein was asked to contribute to a *Festschrift* on the occasion of the 70th birthday of Aurel Stodola, a professor of mechanical engineering at the ETH (Einstein to Honegger, Nov. 2, 1928; EA, 22-261). Einstein agreed to contribute with a semi-popular review article on his new theory, *Über den gegenwärtigen Stand der Feldtheorie* (Einstein, 1929d). The manuscript was submitted on December 10 (Sauer, 2006). "After 12 years of searching with many disappointments", Einstein finally came to conviction to have found a suitable mathematical structure allowing a proper unification of electromagnetism and gravitation. For the solution of this problem, Einstein continued, "the experience does not gives—so it seems—any starting point". Thus, the only hope is to construct a theory "in a speculative way" (Einstein, 1929d, 128). The physicist had to try to deduce the theory following "a purely intellectual path", led by the deep conviction of the "formal simplicity of the structure of reality" (Einstein, 1929d, 127). Einstein warns his readers of the dangers of proceeding "along this speculative road", dangers that "those who dare to follow this path should permanently keep before their eyes" (Einstein, 1929d, 127). In a footnote, Einstein added the following remark: "Meyerson's comparison with Hegel's program [*Zielsetzung*] certainly has some justification; he illuminates clearly the danger that one here has to fear" (Einstein, 1929d, 127).

"With this stuff, one can only impress American journalists", Pauli wrote to Jordan with the usual scathing sarcasm (Pauli to Jordan, Nov. 30, 1929; WPWB, Doc. 238). Pauli was ready to take any bet that Einstein would abandon the theory within two years (Pauli to Einstein, Dec. 19, 1929; WPWB, Doc. 239; cf. also Einstein to Pauli, Dec. 24, 1929; WPWB, Doc. 240). However, the general public continued to be enthralled by the great 'discovery.' At the beginning of 1929, after the submission of the third paper (Einstein, 1929e), a reference to distant parallelism field theory appeared on the front page of the *New York Times*. "Have not you been much attacked these days because of the new theory of relativity? America is very fond of it", Schrödinger wrote to Sommerfeld (Schrödiger to Sommerfeld, Jan. 29, 1929; ESBW, Doc. 175). An English translation of the note, including all formulas, appeared on the title page of the *New York Herald Tribune* on February 1. Einstein published two popular and non-technical accounts in the *New York Times* on February 3 (Einstein, 1929b) and in the *London Time* of February 4 (Einstein, 1929c). In both articles, after describing the highly speculative nature of the theory, Einstein added: "Meyerson in his brilliant studies on the theory of knowledge [*Der geistreiche Erkenntnisstheoretiker Meyerson*] justly draws a comparison of the intellectual attitude [*geistige Einstellung*] of the relativity theoretician with that of Descartes or even of Hegel, without thereby implying the censure [*Tadel*] which

a physicist would read into this [*den das Ohr eines Physikers naturgemäss heraushoren wird*]" (Einstein, 1929a, 7f.).

French newspapers reported about Einstein's new 'discoveries' following the English-speaking press (de Broglie to Einstein, Jan. 29, 1929; EA, 8-285; Einstein to de Broglie, Feb. 2, 1929; EA, 71-703). Meyerson had good reasons to consider the fact that Einstein mentioned his name in two international newspapers as the definitive 'official' endorsement of his philosophical views. As Metz wrote to Einstein, Meyerson was touched by Einstein's appreciation of his work (Metz to Einstein, Feb. 17, 1929; EA, 18-264). "As for me, you know what I think of it," Metz wrote to Einstein, "*he deserves it*": "But he has so long been deprived of satisfactions of this kind that now he is extremely sensitive to these manifestations", especially coming from a scientist of the stature of Einstein (Metz to Einstein, Feb. 17, 1929; EA, 18-264).

In July 1929, Herbert Feigl, Schlick's doctoral student at that time, visited "the old Meyerson" (Feigel to Schlick, Jul. 21, 1929; SN) in Paris, introduced by Samuel Broadwin, an American student and Meyerson's disciple who was spending some time in Vienna (cf. below in sec. 6). In a letter to Schlick, Feigl described Meyerson as "an extreme historicist" who "does not show any understanding for the epistemological view despite the reading of yours, Carnap's, and Reichenbach's writings". "Unfortunately," he continued, "Einstein strengthened his opinion by mentioning him in a praising manner in various circumstances (just recently in a *Times* article). After all, an interesting, independent head, possessing an immense knowledge" (Feigel to Schlick, Jul. 21, 1929; SN; cf. also Metz to Meyerson, Jul. 25, 1929; EMLF, 498). However, in spite of Feigl's remark, the Vienna group would need some time to fully appreciate that Einstein's praise of Meyerson's work was the symptom of a his deep-seated philosophical views.

As Feigl wrote to Schlick in the same long letter, he had great hopes for the forthcoming first conference *Erkenntnislehre der exakten Wissenschaften* which was organized in Prague in collaboration with the *Deutsche Physiker und Mathematikertag*. On September 16, 1929 Philipp Frank, Einstein's successor in Prague and founding member of the Vienna Circle, opened the joint session. He presented the new quantum mechanics as the manifestation of a positivistic tradition, in which physics was regarded as a tool for organizing perceptions (Frank, 1930). As Frank will later recall, Arnold Sommerfeld stood up to make a remark during the discussion, claiming that he wanted to defend Einstein's point of view (Frank, 1947, 215).[33] Frank initially felt confident that Sommerfeld was going to be on his side. However, he was soon disappointed. In Sommerfeld's view, Einstein—who Sommerfeld apparently regarded as the most important living philosopher—far from being a Machian positivist, was a convinced 'realist.' In his talk, Sommerfeld conceded that, as the opening of Heisenberg's 1925 paper showed, Mach's philosophy might have "*by way of an exception* a positive influence" (Sommerfeld, 1929, 866; my emphasis). However, in general, it had been an obstacle to the development of physics. Sommerfeld continued that physics presupposes a mathematical order of nature which is independent of the of investigating the subject. As Sommerfeld admitted in a talk he held in Vienna in January, "a little bit of metaphysics" (Sommerfeld, 1930, 197) is hidden behind this assumption. However, without such a "metaphysical belief" (Sommerfeld, 1930, 198) one would not even start doing physics.

6 The positivist and the metaphysician. Einstein between Schlick and Meyerson

In November 1929, Einstein traveled to Paris, where he was awarded an honorary doctorate. On November 8 and 9 he gave two lectures on distant parallelism at the Institut Henri Poincaré (later published as Einstein, 1930a; cf. Sauer, 2006). Einstein insisted again that he arrived at the theory in a purely formal way. Only by integrating the field equations and finding solutions corresponding to particles "the comparison with experience becomes possible" (Einstein, 1930a, 24). On November 12, Einstein participated in a debate on quantum mechanics meeting of the *Société française de philosophie*, with de Broglie, Langevin, and Metz. The name of Meyerson was mentioned numerous times during

[33]The name of Sommerfeld is not mentioned by Frank here, but the physicist in question is undoubtedly Sommerfeld. See, e.g., the reconstruction of the same episode in Frank and Kuhn, 1962.

the discussion (Broglie et al., 1929). At that time, Meyerson was working on his next major work, an ambitious three-volume history of Western thought *Du cheminement de la penseé* (Meyerson, 1931), which was meant to represent the *summa* of his philosophical investigations. In addition, the book entailed Meyeron's take on quantum mechanics. As one can infer from a letter to Broadwin, Meyerson discussed the matter with Einstein while he was in Paris: "I am delighted to hear that you are going to include a treatment of the quantum theories in your coming book and that your distinguished visitor Einstein has also approved of your studies and views on that subject" (Broadwin to Meyerson, Dec. 29, 1929; CZA, A408/13).

Meyerson and Einstein continued to be in occasional correspondence concerning Meyerson's new book. In January, Meyerson wrote to Einstein that he added some information taken from a conversation that he had with him when they first met in 1922 and wanted to have Einstein's approval. It was a minor biographical detail (Meyerson, 1931, Vol. 2, 647f.), but it testifies Meyerson's extreme care in using Einstein's name (Einstein to Meyerson, Jan. 27, 1930; EA, 18-297; Einstein to Meyerson, Feb. 10, 1930; EA, 67-697). At about the same time, the expanded and improved third edition of Meyerson's first monograph (Meyerson, 1926) was translated into German (Meyerson, 1930a) by Kurt Grelling,[34] with an introduction by Léon Lichtenstein, a Polish–German mathematician with interests in theoretical physics, who had contributed to spread Meyerson's ideas in Germany (Lichtenstein, 1928). Lichtenstein knew that Einstein was interested in Meyerson's thought and sent him a copy of the translation, with the hope that he could write some lines about it. Moreover, Lichtenstein wanted Einstein to actively push for having *La déduction relativiste* (Meyerson, 1925) translated into German as well (Lichtenstein to Einstein, Mar. 26, 1930; EA, 18-299).

Einstein did attempt again (cf. above in sec. 4) to find a publisher. Hamburger, the candidate translator, must have written to Oldenbourg Verlag, claiming that Einstein was behind the project. The publisher directly wrote to Einstein in September of 1930 to inquiry whether he confirmed Hamburger's claims, that Einstein believed that the book "contains the best that has ever been written on the theory of relativity" and that he was ready to write a 'Forward' (Oldenbourg to Einstein, Sep. 8, 1930; EA, 18-300). Einstein replied that he was ready to preface the book, which he considered "a quite remarkable contribution to the philosophical discussion of the theory". As one can infer from a letter of Lichtenstein to Hamburger, there were great hopes that the publisher accepted the offer (Hamburger to Lichtenstein, Sep. 15, 1930; EA, 18-302). Meyerson was, of course, very excited as well and planned to update the part of the book concerning quantum mechanics (Meyerson to Hamburger, Sep. 15, 1930; EA, 18-302). However, in spite of Einstein's and Lichtenstein's endorsement, Oldenbourg decided not to publish the translation (Hamburger to Meyerson, Oct. 12, 1930; CZA, A408/47). Experts contacted by Oldenbourg had pointed that there were already enough literature on relativity; moreover, the final cover price would have been probably quite high (also because of the 8% royalties requested by Meyerson) and made the translation not competitive with the original French edition (Oldenbourg to Hamburger, Oct. 1, 1930; CZA, A408/47).

A month later, toward the end of October, Einstein attended his last Solvay Congress in Brussels (Langevin, 1932), which became the stage of the second Bohr–Einstein debate (Jammer, 1974, ch. 5). Details aside, Einstein's critique to quantum mechanics started to assume a familiar form. Writing soon thereafter to Myron Mathisson, a young promising Polish physicist,[35] Einstein complained that in quantum mechanics "[t]he real objects, so to say, disappear from the theory. It has been unjustly attempted to make a strength out of this fault!" (Einstein to Mathisson, Nov. 13, 1930; EA, 18-031). According to Einstein, to grasp reality, one has to proceed in a different way: "Only a construction of greater mathematical naturalness and simplicity can help, which does not come about, so to speak, by squinting [*Schielen*] at reality and mathematical patchery [*Flickerei*]". Einstein considered general relativity as a the paradigm, even if "physically is, of course, insufficient because it does not refer to the entire reality", that is to the total field (Einstein to Mathisson, Nov. 13, 1930; EA, 18-031)

[34]The correspondence between Grelling and Meyerson about the translation is preserved in CZA, A408/56.
[35]On Mathisson cf. Havas, 1989, 242f. Sauer and Trautman, 2008.

A few days later on November 15, 1930, Planck held a now celebrated lecture, *Positivismus und reale Außenwelt* (later published as Planck, 1931), in which he rephrased similar concerns into an opposition between the positivistic tendencies that were fashionable at that time and the metaphysical drive that lies at the basis of physics (Planck, 1931). Einstein, of course, couldn't agree more: "I feel that I have, to tell you again how marvelous I have found your remarks on positivism with regard to the modern phase of theoretical physics" (Einstein to Planck, Nov. 15, 1930; EA, 19-348; see Ryckman, 2017, 293–298). Einstein used the opposition between positivism and metaphysics a week later, in correspondence with Schlick. Schlick sent to Einstein the draft of a paper on causality in physics (Schlick, 1931). Einstein's letter to Schlick has often been quoted, and with good reasons, since it is one of the clearest summaries of Einstein's philosophical stance at that time:

> From a general point of view, your presentation does not correspond to my way of viewing things, inasmuch as I find your whole conception, so to speak, *too positivistic*. Indeed, physics *supplies* relations between sense experiences, but only indirectly. For me, its essence is by no means exhaustively characterized by this assertion. I put it to you bluntly: *Physics is an attempt to construct conceptually a model of the real world as well as of its law-governed structure.* To be sure, it must represent exactly the empirical relations between those sense experiences accessible to us; but only thus is it chained to the latter. I also admire the achievements of quantum theory in Schrödinger-Heisenberg-Dirac coinage, but I am sure that one will not and will not be able to work with this mode of observation for the long term. *This theory does not provide any model of the real world at all. (The elements functionally linked in it do not represent the real world, but only probabilities which relate to experiences).* In short, I cannot stand the unclear distinction between the experienced reality [*Erlebnisrealität*] and existing reality [*Seinsrealität*] [...] You will be surprised at the '*metaphysician*' Einstein. But every four- and two-legged animal is *de facto* in this sense a metaphysician (Einstein to Schlick, Nov. 28, 1930; EA, 21-603; my emphasis; part. tr. in Howard, 2014, 371.

This rightly famous passage introduces the fundamental features of Einstein's philosophical position at that time. Quantum theoreticians rely on a positivistic conception of physics as a catalog of observations. In particular, the ψ-function does claim to be a model of something in nature but is only a mathematical tool to make predictions about what can be observed. On the contrary, Einstein insisted that the goal of physics is to construct a 'model'[36] of reality as it is independent of observation. It is essential to distinguish between perception and reality. If this distinction is metaphysical, as the positivists claim, then everyone is a metaphysician.

Even if this passage is well known, in my view, the literature has failed to appreciate its 'Meyersonian' background. Einstein was indeed quite right in imagining that Schlick would have been nonplussed by the 'metaphysician Einstein.' Broadwin wrote to Meyerson that Schlick read out Einstein's letter at the usual meeting of the Vienna circle (Fruteau de Laclos, 2007). Schlick was, in fact, baffled and believed that there must have been a "<trivial> misunderstanding" (Broadwin to Meyerson, Dec. 5, 1930; CZA, A408/13). Broadwin told Meyerson that Schlick, over the years, had numerous conversations with Einstein. Schlick had "always believed that Einstein was a partisan of positivism". In the letter, however, Einstein "declared himself against the positivists and recognized that he is a 'metaphysician'". As Broadwin remarked,

[36]The failure of the new quantum mechanics of producing a 'model' is a common theme of Einstein's writings of this period. In a brief text written in December 1930, a later published in the *The Yale University Library Gazette* Einstein expressed the same complaint upon which he touches in Schlick's letter. In searching for a unified field theory, "as in the earlier theory an attempt is made to construct a model of real" (Einstein, 1930b, 3) , which explains the result of our measurements and observations through the behavior of some basic entities (fields, particles etc.). However, in Einstein's view, quantum mechanics abdicated the historical task of natural science: Quantum theory fully "renounces the possibility of constructing *a model of reality.* The variables appearing in its equations specify only probabilities, not actualities" (Einstein, 1930b, 4) . However, as he put it in a longer unpublished version of the text, Einstein was convinced "that the renunciation to model of realty would not be advantageous in the long run" (EA, 2-111.1, 7). The use of the word 'model,' as Einstein explained elsewhere, expresses the "speculative nature of science" (Einstein, 1932, 363). Physicists initially aimed to directly describe 'real things' but progressively realized that they could only construct abstract models (Einstein, 1932, 363), which can be said to be more or less useful, but not 'true.' Quantum theory went so far as to forgo even the 'the model-character' of physics (Einstein, 1932, 363).

"*of course Einstein's change of attitude coincides with your* [Meyerson's] *influence* over him [Einstein]" (Broadwin to Meyerson, Dec. 5, 1930; CZA, A408/13; my emphasis; cf. also E. Meyerson to I. Meyerson, Dec. 30, 1930).

Meyerson was not unknown in Vienna (cf. e.g. Hahn, 1930, 1933), although looked upon with some condescendence (Schlick, 1932a, 108). An American student and good friend of Feigl, Albert E. Blumberg had just written a dissertation under Schlick's guidance defending the 'metaphysical neutrality' of Viennese positivism against Meyerson's 'metaphysical rationalism' (Blumberg, 1929, 1932). Probably no one suspected that Einstein, one of the philosophical mainstays of the Vienna circle, had come to embrace precisely that Meyersonian blend of rationalism and realism[37] that they treated with eye-rolling contempt. Thus, Einstein's letter to Schlick appeared as a bolt out of the blue. Einstein incomprehensibly betrayed his early commitment to positivism in the name of the old-fashioned realism of Planck and Sommerfeld. Broadwin, Meyerson's 'fifth column' in Vienna, effectively expressed the puzzlement of the Viennese group in a letter to Meyerson written at the beginning of 1931: "The positivists show genuine amazement that nearly all the scientists of note are really their opponents. They look upon this attitude as though it were the outbreak of a mysterious and contagious infection from some outside malicious metaphysical source" (Broadwin to Meyerson, Feb. 12, 1931; CZA, A408/13).

The disconcert of the Vienna circle is confirmed by other sources. In May 1931, Bernhard Bavink, a German scientist, philosopher, and theologian, sent the last edition of his book on epistemology (Bavink, 1930) to Schlick (Bavink to Schlick, May 24, 1931; SN). In the book, Bavink defended a realist point of view against the "Vienna school" and declared himself proud to be in the company "of the greatest living German physicists", Planck, Einstein, and Sommerfeld (Bavink, 1930, 217). To support his claim, Bavink recounted the story of the Frank–Sommerfeld dispute at the Prague conference, in which Sommerfeld claimed to share Einstein's aversion for positivism (cf. above in sec. 5.4). Schlick replied that he was just having "a correspondence with Einstein on the question of realism" (Schlick to Bavink, Aug. 1, 1931; SN). Schlick believed that he would have been able to find an agreement. The Frank–Sommerfeld dispute was also based on a misunderstanding. Schlick, in fact, decided to write an "article on the question of realism which was mainly meant for the physicists" (Schlick to Carnap, Sep. 19, 1931; SN). Schlick sent the paper to Reichenbach, who was the editor of *Erkenntnis*, in October. As he explained to Reichenbach, the article was meant to be his "answer to the objections of several outstanding physicists (Planck, Sommerfeld, Einstein) against the Viennese point of view" (Schlick to Reichenbach, Oct. 31, 1931).

Schlick's paper, "Positivismus und Realismus" (Schlick, 1932b), was published in *Erkenntnis* only in the Spring of 1932. Einstein did not reply. However, Sommerfeld described to Schlick Einstein's position (and his own) in a significant way. After recollecting his debate with Frank in Prague, Sommerfeld conceded that there he had no deathblow argument against positivism: "I am not a dogmatist in the religious sense," he wrote, "but I am a dogmatist when it comes to the laws of nature. I cannot stand the

[37]In this regard, the textual evidence is overwhelming. In July 1930, in a conversation with Rabindranath Tagore, Einstein admitted that he could not prove the reality of the external world, but he described such a belief as his religious *credo*: "there is a reality independent of human beings, there is also a Truth relative to this reality" (Einstein and Tagore, 1930, 4). The one claim cannot stand without the other. This conviction lies at the basis of common sense experience: "Even in our everyday life, we feel compelled to ascribe a reality independent of man to the objects we use. We do this to connect the experiences of our senses in a reasonable way. For instance, if nobody is in this house, yet that table remains where it is" (Einstein and Tagore, 1930, 4). As Einstein put it in an article written for the celebration of Maxwell's death centenary (Blackett to Einstein, Dec. 30, 1930; EA, 1-99) and finished in April 1931, the same belief is held in scientific practice: "The belief in an external world independent of the perceiving subject is the basis of all natural science" (Einstein, 1931b, 1; tr. 1931a, 1). However, since sensation gives us information about the real only indirectly, "we can only grasp the latter by *speculative means*" (Einstein, 1931b, 1; tr. 1931a, 1; my emphasis). It is quantum mechanics that has abdicated science's responsibility of understanding the real in the name of a tranquilizing positivism. Einstein insisted on this point in an unpublished document that must have been written toward the end of 1931: "many positivists" believe that the only end of science is "to establish connections between the facts of experience, of such a kind that we can predict further occurrences from those already experience" (EA, 2110-0, 1f.). However, if one looks at science not as a finished product, but at the motivations that drive scientists' practice, one cannot remain satisfied with this description: "There lurks a stronger, more mysterious drive: one wishes to comprehend [*begreifen*], the being [*das Seiende*], the real [*das Wirkliche*]" (EA, 2110-0, 1f.), driven by the "the belief that the being [*das Seiende*] should have a completely harmonious structure" (EA, 2110-0, 4).

Machian 'principle of the messy [*schlampigen*] laws of nature,' the uncertainty relations notwithstanding. Einstein rejects it, too. He once said to me: '*all physics is metaphysics*'" (Sommerfeld to Schlick, Oct. 17, 1932; SN, my emphasis). Schlick attempted to give a charitable interpretation of this latter claim: "If, according to Einstein, all physics is already metaphysics, I believe, on the basis of earlier conversations with him, that [...] he thinks that we are already doing metaphysics when we operate with atoms, electrons, etc., which, according to our opinion, is fully permissible" (Schlick to Sommerfeld, Dec. 18, 1932; SN). Schlick was partly correct about this. However, Einstein intended to add an important caveat: atoms and electrons, in spite of being free conceptual constructions, are considered by physicists as things existing 'out there' independently of observation, just like the object of common sense experience. It was this belief that Schlick considered to be irreparably metaphysical. However, as Planck put it in his reply to his former student, this metaphysical assumption, "in my opinion, is indispensable to the progress of science" (Planck to Schlick, Dec. 10, 1932; SN).

Most participants in this debate failed to appreciate Meyerson's role in what Einstein's former assistant Lanczos described as a "metaphysical turn" (Lanczos, 1932, 115).[38] Meyerson proudly, and to a certain extent rightly, emphasized this point in a letter to the French chemist Georges Urbain, written around 1932. When, Urbain accused him of an excess of rationalism, Meyerson could again point out Einstein's support: "In this regard [*Sur ce terrain*] at least, I can boast that I have been proven right", he wrote. "One could even say (perhaps with some irony) that *Einstein evidently invented his theory only to prove the validity of my schema*" (Meyerson to Urbrain, ca. 1932, EMLF, 897; my emphasis). Meyerson could provide evidence for his claim: "Einstein himself, in presenting his new theory of the field to the readers of the *Times* of London (February 4 to 5, 1929), expressly acknowledged that I had been right to assimilate his research to that of Hegel" (Meyerson to Urbrain, ca. 1932, EMLF, 897). Moreover, Meyerson could rightly point out that "that in doing so, he went directly against the numerous attempts of German epistemologists such as Petzoldt, Cassirer, Schlick, Reichenbach, etc. who draw very different conclusions" (Meyerson to Urbrain, ca. 1932, EMLF, 897). "The only name he mentions in this order of ideas is mine (he describes my researches as *brilliant*)".[39] "It is not pure vanity," Meyerson reassured Urbain. Einstein's endorsement shows that "I have not lost track too much, that physics, on this crucial point, is in conformity with what I wanted it to be and which seemed at first so paradoxical" (Meyerson to Urbrain, ca. 1932, EMLF, 898).

Meyerson conceded to Urbain that relativity does not represent anymore the last stage of development of physics. Quantum mechanics has introduced something completely new in the history of natural sciences. As Meyerson revealed to Urbain, "following mostly discussions with Langevin, Louis de Broglie, Einstein, Lichtenstein, Metz, etc.," he had written, "a little paper (Provisional title: *Réel physique et indéterminisme*), which I may one day publish in the form of an article and where I deal with the question a little more thoroughly" (Meyerson to Urbrain, ca. 1932, EMLF, 897-898). Meyerson died toward the end of 1933. The booklet was published posthumously (Meyerson, 1933), with an introduction of Louis de Broglie (cf. de Broglie to Meyerson, Jan. 23, 1933), who later would also preface a collection of Meyerson's writings (Meyerson, 1936). In the book, Meyerson mentioned that quantum theory was not primarily a challenge to determinism, but to scientific realism (Bitbol, 2010; Mills, 2014), it was the renunciation

[38] At end of 1931, Cornelius Lanczos (Lanczos to Einstein, Oct. 20, 1931; EA, 15-243) communicated to Einstein that he had written a semi-popular presentation of distant parallelism approach for the *Ergebnisse der Exakten Wissenschaften*, a series sponsored by Berliner's journal (Lanczos, 1931). Lanczos worked on the topic during his tenure as Einstein's assistant. Lanczos exposed his own ideas, but he was confident to have found "a tone that should correspond to your conviction as well. I think that, deep down, we have something in common" (Lanczos to Einstein, Oct. 20, 1931; EA, 15-243). In the paper, Lanczos distinguished between a *positivist-subjectivist* interpretation of relativity theory and a *metaphysical-realistic* perspective. In his Einstein-biography Frank recalls that, reading a partial reprint of Lanczos' paper (Lanczos, 1932), he was "quite astonished" to find the theory of relativity characterized as the expression of a realist program "since I had been accustomed to regarding it as a realization of Mach's program" (Frank, 1947, 215). However, around 1932, he discussed the matter with Einstein who confirmed Lanczos' views: the essential point of relativity theory, he explained to Frank, is to "regard an electromagnetic or gravitational field as a physical reality in the same sense that matter had formerly been considered so" (Frank, 1947, 216).

[39] 'Brilliant' was the English translation of *Geistreich* in the *Times* article (Einstein, 1929c).

of the construction of a '*Weltbild*.' In spite of the positivist rhetoric of quantum physicists, according to Meyerson, this was "painful renunciation" (Meyerson, 1933, 39) , and not a positive achievement. "There is no real doubt," Meyerson concluded his book, "that if the slightest possibility were offered, the researchers would be eager to return to an image of a universe that is at least somewhat concrete, realizable in thought, a *Weltbild* according to the expression of M. Planck" (Meyerson, 1933, 49).

7 Conclusion

It is implausible that Einstein ever read Meyerson's booklet considering the historical circumstances in which it was published. On January 30, 1933, Hitler came to power. Einstein never returned to Germany. As far I can see, he will not mention Meyerson in his writings again. Nevertheless, Einstein's infatuation for Meyerson's work in his late Berlin years reveals the extent of his 'philosophical pilgrimage.' If Schlick had been Einstein's main philosophical interlocutor at the turn of the 1920s, Meyerson seems to have taken his place at the turn of 1930s. The reasons why Einstein was fascinated by Meyerson's thought are still clearly recognizable in Einstein's often-quoted Herbert Spencer lecture, which he delivered on June 10 in Oxford (Einstein, 1933a).

The lecture is maybe the most famous expression of that speculative-rationalistic approach to physics, that, after some resistance, he had come to embrace in the previous decade. Einstein proclaimed that we could discover the true laws of nature by seeking those with the simplest mathematical formulation (Norton, 2000). The fundamental guide of our research is the conviction that "nature is the realization of the simplest that is mathematically conceivable [*des mathematisch denkbar Einfachsten*]" (Einstein, 1933b, 5; tr. 1933a, 167; slightly modified). It is "purely mathematical construction" (Einstein, 1933b, 5; tr. 1933a, 167), which gives us the key to understanding the phenomena of nature. Experience remains the sole judge for this mathematical construction, but the truly creative principle resides in mathematics. "In a certain sense, therefore, I hold it to be true that pure thought is competent to comprehend the real, as the ancients dreamed" (Einstein, 1933b, 5; tr. 1933a, 167). These are nearly the same words that Einstein had used, e.g., in the Stodola *Festschrift* that we have mentioned above (see sec. 5.4). If there Einstein cautiously endorsed Meyerson's neo-Hegelian undertones, here he preferred a maybe less controversial reference to a neo-Platonic or neo-Pythagorean dream.

The semivector project on which Einstein was working with Walther Mayer (Einstein and Mayer, 1932, 1933a,b, 1934), like previous attempts at a unified field theory, was motivated by the search for the mathematically most natural kind of field theory. As it has been emphasized (Dongen, 2004, 2010), Einstein's insistence on the power of mathematical speculation was combined with a realistic train of thought. In the search for the most simple among the possible conceivable field structures, and the equations governing them, "lies the justification for the theorist's hope that he may comprehend reality in its depths" (Einstein, 1933b, 7; tr. 1933a, 168). Semivectors are indeed abstract mathematical tools. However, they are introduced with the hope to construct a "model [*Modell*] of reality" (Einstein to Meyer, Jun. 11, 1933; EA, 8-177) and provide an objective mathematical representation of the matter field and the elementary constituents of matter as they exist out there (cf. Dongen, 2004, 236, 245, 2010, 112, 121). On the contrary, in quantum mechanics, the ψ-function does not even claim to be an objective description of reality, a "a mathematical model [*Modell*] of atomistic objects [*Gebilde*]" (Einstein, 1933b, 7; tr. 1933a, 169). It is only a mathematical artifice that enables one to make statistical predictions about the position and state of motion of those objects, if we make the measurement. In this sense, quantum mechanics cannot be the candidate for a fundamental theory: "I still believe in the possibility of giving a model of reality [*Modells der Wirklichkeit*], a theory, that is to say, which shall represent events themselves and not merely the probability of their occurrence" (Einstein, 1933b, 7; tr. 1933a, 168).

In September 1933, Einstein left Europe and settled permanently in the United States in October 1933, taking on the position of a professor at the Institute for Advanced Study in Princeton. At around the same time, Einstein started to reflect on the implications of treating the quantum algorithm as a 'complete'

description of reality. Discussions with Nathan Rosen and Boris Podolsky ended into a celebrated 1935 paper on the incompleteness of quantum mechanics (Einstein, Podolsky, and Rosen, 1935). "Physics is a kind of metaphysics" (Einstein to Schrödinger, Jun. 19, 1935; ESBW, Doc. 55), Einstein famously wrote to Schrödinger introducing his own version of what would be known as the EPR argument (Fine, 1986; Howard, 1985). As we have seen, Einstein often used this physics-as-metaphysics parlance in the previous decade to express, somehow tongue in cheek, the paradoxical nature of physics' endeavor : "Physics describes 'reality' [*Wirklichkeit*]," Einstein wrote to Schrödinger, "But we don't know what reality is unless we describe it with physics!" (Einstein to Schrödinger, Jun. 19, 1935; ESBW, Doc. 55). Physics is, on the one hand, "a refinement of everyday thinking" (Einstein, 1936, 313; tr. 349). It implicitly presupposes the "real external world of everyday thinking" (Einstein, 1936, 313; tr. 349), as something independent of observation. Nevertheless, the fundamental components of this observer-independent reality that our physical theories postulate (electrons, fields, etc.) have a "constructive-speculative character" (Einstein, 1936, 327; tr. 362). The only guarantee of their reality is the success of the theory. It was this paradoxical blend of speculative rationalism and common sense realism that was behind Einstein's dislike for the positivist overtones of probability-based quantum mechanics and his quixotic attempt to derive the atomistic and quantum structure of reality from a classical nonlinear field theory.

Starting from 1937, Einstein placed again great hopes in the five-dimensional program (Einstein and Bergmann, 1938). In the Spring of 1937, while a professor of mathematics at Purdue, Lanczos was invited to give two lectures at Indiana University, entitled *The Philosophical Aspects of Relativity*. The lectures were published as a small booklet, with the same title the following year (Lanczos, 1938). Lanczos sent a copy of the published form of these lectures to Einstein (Lanczos to Einstein, Mar. 1, 1938; EA, 15-266). Lanczos, challenging the dominant positivism, presented general relativity as an "amazing triumph of speculative reasoning" and a manifestation of "the power or abstract reasoning" (Lanczos, 1938, 20). During the discussion following his lectures, Lanczos pointed out, many asked whether Einstein would have agreed with such characterization (Lanczos to Einstein, Mar. 1, 1938; EA, 15-266). Einstein indeed found Lanczos's booklet one of the best things that he had read about relativity (Einstein to Lanczos, Jan. 24, 1938; EA, 15-268). "The problem of gravitation," he famously confessed to Lanczos, "made me to a believing rationalist [*zu einem gläubigen Rationalisten*], that is, one who seeks the only trustworthy source of truth in mathematical simplicity" (Einstein to Lanczos, Jan. 24, 1938; EA, 15-268; cf. Ryckman, 2014). However, differently from Lanczos, Einstein did not believe that the mathematical formulation of the laws of nature should be of "*geometrical* nature": "this only a way of speaking, with which one cannot connect a clear meaning" (Einstein to Lanczos, Jan. 24, 1938; EA, 15-268). As this paper has shown, Einstein had roughly the same reaction to Meyerson's book. As in the case of Lanczos, Einstein believed to have found in Meyerson someone with the same "attitude toward physics", someone who shared the same "belief in the intelligibility of reality through something logically simple and unified" (Einstein to Lanczos, Mar. 21, 1942; EA, 15-294). As it turned out, differently from Lanczos, Meyerson did not share such belief. Meyerson was indeed convinced that, deep down, this trust in the rationality of nature was the 'motivation for doing research' (Einstein, 1918) of even the most positivists among the scientists, whether they want to admit it or not. However, in Meyerson's view, nature has unfailingly betrayed the scientist's confidence.

Acknowledgments

I started to work on this material while working as a contributing editor at the Einstein Paper Project at Caltech. I am deeply grateful to Diana Kormos-Buchwald for giving me this opportunity. The paper was completed while I was a senior fellow at the Sidney M. Edelstein Center in Jerusalem. I thank Orly Shenker, Tony Travis, and Aviv Shirtz for the kind hospitality and Yemima Ben Menahem for her insightful comments on an early draft of the paper. I extend my gratitude to Rochelle Rubinstein of the Central Zionist Archive in Jerusalem for granting me access to Meyerson's papers in spite of being in

need of cataloging. I am grateful to Frédéric Fruteau de Laclos for tips and reading suggestions about Meyerson. I have greatly benefited from Jeroen Van Dongen's careful reading of the manuscript and his numerous suggestions for improvement.

Abbreviations

CPAE Albert Einstein (1987–). *The Collected Papers of Albert Einstein.* Ed. by John Stachel et al. 15 vols. Princeton: Princeton University Press, 1987–.

CZA *Central Zionist Archives* (n.d.). Jerusalem.

EA *The Albert Einstein Archives at the Hebrew University of Jerusalem* (n.d.).

EMLF Émile Meyerson (2009). *Lettres françaises.* Ed. by Bernadette Bensaude-Vincent and Eva Telkes-Klein. Paris: Cnrs Editions, 2009.

ESBW Karl von Meyenn, ed. (2011). *Eine Entdeckung von ganz außerordentlicher Tragweite. Schrödingers Briefwechsel zur Wellenmechanik und zum Katzenparadoxon.* Berlin/Heidelberg: Springer, 2011.

SN *Schlick Nachlass* (n.d.). Noord-Hollands Archief, Haarlem.

WPWB Wolfgang Pauli (1979–). *Wissenschaftlicher Briefwechsel mit Bohr, Einstein, Heisenberg u.a.* Ed. by Karl von Meyenn. 4 vols. Berlin/Heidelberg: Springer, 1979–.

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