The Vienna Circle
Moritz Schlick, Otto Neurath and Rudolf Carnap
Friedrich Stadler

The Vienna Circle (as the so-called Schlick Circle came to be known) consisted of a group of about three dozen thinkers coming from the natural and social sciences, logic and mathematics, which met regularly in Vienna between the two world wars to discuss philosophy and its relation to the sciences. The work of this group constitutes one of the most important and most influential philosophical contributions of the twentieth century, in particular in the development of analytic philosophy and history and philosophy of science (Stadler 2001, 2003a; Richardson and Uebel 2007).

Prior to the First World War, the predecessor of the later Vienna Circle had begun to take shape both as an organization and as a philosophy (Uebel 2000). Within a discussion circle (including Frank, Hahn and Neurath inter alia) at a coffeehouse, traditional ‘academic philosophy’ grew more scientific. This so-called First Vienna Circle met regularly as of 1907 to discuss the synthesis of empiricism and symbolic logic as modelled after Mach, Boltzmann and the French conventionalists Pierre Duhem and Henri Poincaré (see Chapter 2).

This early phase in the development of logical empiricism can also be interpreted as an anti-Cartesian turn in epistemology and philosophy of science, which undermined both the synthetic a priori and the secure foundations of knowledge. In the middle of the permanent crisis of philosophy between reform and revolution in society and science, the further development of this ‘scientific philosophy’ had, in any case, been initiated.

The Vienna Circle was first publicly announced in 1929 with the publication of what came to be called its manifesto, Wissenschaftliche Weltauuffassung. Der Wiener Kreis (The Scientific Conception of the World: The Vienna Circle), edited by the Verein Ernst Mach (Ernst Mach Society) and authored by Rudolf Carnap, Hans Hahn and Otto Neurath (Carnap et al. 1929). This
group was essentially a modernist movement, at the centre of which was the so-called Schlick Circle, a discussion group organized in 1924 and Moritz Schlick. Rudolf Carnap, Herbert Feigl, Philipp Frank, Kurt Gödel, Hans Hahn, Otto Neurath, Felix Kaufmann, Viktor Kraft, Karl Menger, Friedrich Waismann and Edgar Zilsel belonged to its inner circle. Their meetings were also attended by Olga Taussky-Todd, Olga Hahn-Neurath, Rose Rand, Gustav Bergmann and Richard von Mises, and on several occasions by visitors such as Hans Reichenbach, Alfred J. Ayer, Ernest Nagel, Willard Van Orman Quine and Alfred Tarski. Members of the periphery, most of them as participants and occasional guests, were Egon Brunswik, Karl Bühler, Josef Frank, Else Frenkel-Brunswik, Heinrich Gomperz, Carl Gustav Hempel, Eino Kaila, Hans Kelsen, Charles Morris, Arne Naess, Karl Popper, Frank P. Ramsey, Kurt Reidemeister and the alleged ‘genius’, Ludwig Wittgenstein, who was not attending the Schlick Circle but met only Schlick and Waismann regularly and had a special influence on some members of the group. In addition, the mathematician Karl Menger organized in the years 1926–36 an international ‘Mathematical Colloquium’, which was attended by Kurt Gödel, John von Neumann and Alfred Tarski, among many others (Menger 1994).

This international and interdisciplinary discussion circle was pluralistic and committed to the ideals of the Enlightenment. It was unified by the aim of making philosophy scientific with the help of modern logic on the basis of experimental and everyday experience. The general aims of the movement were expressed in its publications, such as the two book series – Schriften zur Wissenschaftlichen Weltauffassung (Publications on the Scientific Conception of the World), 1929–37, eleven volumes; and Einheitswissenschaft (Unified Science), 1933–8, seven volumes – the journal Erkenntnis, 1930–40 (the 1939 volume was called Journal for Unified Science); and the International Encyclopedia of Unified Science, 1938–70 (edited by Neurath, Carnap and Morris, 1971).

Given this story of scholarly success, the fate of the Vienna Circle was tragic. The Verein Ernst Mach was suspended in 1934 by Austro-Fascism for political reasons; Schlick was murdered in 1936 by a fanatic student, and around this time, many members of the circle were forced to leave Austria for racial and political reasons. Thus, soon after Schlick's death, the circle disintegrated. As a result of the emigration of so many of its members and adherents, however, the circle's ideas became more and more widely known, especially in northern Europe, Britain and North America, where they contributed hugely to the emergence of modern philosophy of science (Timms and Hughes 2003; Hardcastle and Richardson 2003; Manninen and Stadler 2010). In Germany and Austria, however, the break that was caused by the forced emigration of the Vienna Circle's members was felt on the
philosophical and mathematical scene for a long time (Heidelberger and Stadler 2003; Stadler 2010b).

Historically, Mach's philosophy provided the foundation for the development of the positions adopted within the Vienna Circle. The expression 'logic of science' (Carnap's 'Wissenschaftslogik'; 1934a), known since the mid-1930s as 'philosophy of science', was later used to describe these positions. This implied a general scientific conception of philosophy as well as an attempt to provide a philosophy for all sciences (including the humanities). In addition, within the Vienna Circle, philosophy was regarded both as a form of linguistic analysis and as a discipline drawing on the foundations of the natural and social sciences.

At the same time there were divergences of philosophical approaches within the Vienna Circle. Schlick and others defended a methodological dualism of philosophy and science, and a group that included Carnap and Neurath sought to integrate philosophy altogether within a scientific conception of the world or encyclopaedic unity of the sciences. In Schlick's view, the classical philosophical positions of empiricism and rationalism were integrated with the help of modern logic and mathematics, but a distinction between philosophy and science still remained. Neurath's more radical physicalism or 'encyclopedism' of logical empiricism aimed at overcoming philosophy itself within his collective project of an international encyclopaedia of the unity of science (Neurath 1946a). This divergence in philosophical approaches left room for debates within the circle on such topics as the merits of phenomenalist and physicalist languages, coherence and correspondence theories of truth, logical syntax and semantics, verification and confirmation and ideal and natural languages. At the same time there was a certain consensus on the merits of logical analysis of language, a fallibilist epistemology, a scientific attitude to the world and the unity of scientific explanation and knowledge in general.

The rivalry between Schlick's 'consistent empiricism' and Neurath's physicalist (later empiricist) unified science is a complex matter. Certain views were held by both, such as the view of philosophy as a critique of language in accordance with Wittgenstein's philosophy of the Tractatus (1922). However, while the principles of verification, logical atomism and the picture theory of language are constitutive features of the entire movement, by themselves they do not characterize the Vienna Circle. Theoretical elements like logicism, verifiability, methodological phenomenalism and physicalism, a fallibilist theory of knowledge, conventionalism and realism, together with an empiricist encyclopedism, were cornerstones of the internal pluralistic development of logical empiricism from the 1930s onwards. This development also reflected the influence of Neurath's historico-pragmatic
point of view within the circle. In particular, the objection towards any
dualism of 'language' and 'world' (as Wirklichkeitsphilosophie), with the
attendant denial of any absolute 'foundation of knowledge' (Schlick 1934), is
representative of this non-reductive naturalism and methodological holism
in the spirit of Pierre Duhem's and Henri Poincaré's philosophy of science.
This form of relativism and naturalism already anticipated the historical
turn after the Second World War in the philosophy of science (cf. Kuhn
1962), which contributed to overcoming the linguistic turn and the so-called
received view of philosophy of science.

Nevertheless, the rejection of synthetic a priori judgements remained an
important element of the Vienna Circle. According to Russell and Whitehead
in the Principia Mathematica, symbolic logic and mathematics were regarded
as purely analytic and a priori (independent of any experience). Analytic
truths of these kinds were contrasted with contingent statements of the
natural sciences and ordinary everyday experience, as synthetic a posteriori
judgements. But there was no further class of synthetic a priori judgements;
instead there was thought to be an important class of 'meaningless' sentences,
sentences without any cognitive content. The elements of this class were seen
as 'metaphysical', in the sense that they are not part of knowledge at all even
though they may express some realm of common-sense experience (for a

This position of the classical Vienna Circle is most prominently represented
by Carnap's 'Elimination of Metaphysics Through Logical Analysis of
Language' (1931), which developed a programme for a unified rational
reconstruction of science. But the question as to whether an empirical basis
could serve as the foundation for all knowledge received strongly divergent
answers from coherence theorists about truth influenced by Neurath and
correspondence theorists influenced by Schlick (Hempel 1993). Also, the
apparently strict distinction between analytic and synthetic sentences was
questioned (Menger 1979, 1–60). The ideal of one language of science, logic
and mathematics was radically weakened within the Vienna Circle itself
with Menger's and Carnap's principle of tolerance long before Quine (1953)
put forward his critique, 'Two Dogmas of Empiricism'. Thus, contrary to
popular belief, a heterogeneous pluralism of views was in fact characteristic
of the Vienna Circle; for example, regarding ethics (Schlick, Menger, Kraft),
the alternatives of realism versus positivism (Schlick, Carnap, Feigl, Kraft,
Kaufmann), verificationism versus falsificationism (both positions criticized
by Neurath, especially against Popper's Logic of Scientific Discovery) and, last
but not least, matters of ideological and political preference – for example,
conservative liberalism versus leftist socialism. In the later period of the
Vienna Circle the contested verification principle was gradually abandoned
and replaced by some form of a probabilistic confirmation methodology based on the principle of ‘connectibility’ (von Mises 1951).

The unity of science movement, with its six International Congresses for the Unity of Science (1935–41) and the ambitious publication project *International Encyclopedia of Unified Science* (1938–70), had a broader cultural meaning and goal, most notably the attempt to improve the human condition and to promote social reform and the intellectual struggle against irrationalism and totalitarian *Weltanschauungen*. It was a manifestation of a late-Enlightenment conception of science with a socially inspired anti-metaphysics. Between the two world wars metaphysics was seen as a correlative feature of German idealism as well as of (Austro-)Fascist ‘universalism’, as represented by the economist Othmar Spann.

The practical impulse behind this therapeutic destruction of metaphysical systems, then, was the desire for a scientific attitude based on human experience, directed against the zeitgeist of totalitarianism and cultural pessimism (as criticized already by Neurath in 1921 and 1931). Therefore, traditional philosophy, first of all, had to be reduced to a critical analysis of language, because most proponents of logical empiricism thought that an exact and sober usage of the scientific language is a precondition for all problem-oriented philosophizing – and moreover a sort of moral obligation.

Social criticism and collective work in philosophy of science formed a programmatic unity striving for a sweeping improvement of the human condition. Whereas in the natural sciences considerable progress had already been made, the situation in the social and cultural sciences, influenced by the ongoing *Methodenstreit* since the turn of the century (Kaufmann 1936), was not so transparent. Although some members of the Vienna Circle, like Kaufmann, Neurath and Zilsel, contributed essentially to this neglected field, their publications have been largely ignored in the historiography on the circle for a long time. In this respect it is worth mentioning that, after the disintegration of the Vienna Circle, its former members still occasionally made reference to the ‘scientific conception of the world’ when speaking about general ideological questions. For example, Carnap spoke about ‘scientific humanism’ as a view shared by the majority of the logical empiricists (Carnap 1963, 81ff.).

After the dissolution of the Vienna Circle, the forced migration of most of its members and the dispersion of the logical empiricist movement from its centres in central Europe, the twin aims of a transformation of philosophy and the establishment of philosophy of science could only be envisaged once the ties to their previous cultural context and audience had been severed. But even in these difficult times the proponents of the exiled Vienna Circle organized six well-attended, prestigious international
conferences, the International Congresses for the Unity of Science: Paris (1935 and 1937), Copenhagen (1936), Cambridge, UK (1938), Cambridge, Massachusetts (1939) and Chicago (1941). One can thus say that the demise of the Vienna Circle in the German-speaking world was accompanied by the transformation of Viennese *Wissenschaftslogik* into philosophy of science in the Anglo-Saxon scientific community, converging with North American currents like (neo)pragmatism.

Despite this pluralism is it still possible to find a sort of basic agreement here – one that unites the members of the Vienna Circle, both the central figures and those on the periphery? First of all, it is a way of philosophizing based on linguistic analysis and a great amount of problem-oriented, open-ended discussion. This was experienced personally by Arne Naess, who focused several times on the Vienna Circle’s ‘thought style’ which, in (not only) his opinion, leads to an inherent ‘pluralism of tenable worldviews’ (Naess 2003). Second, the use of an unambiguous language, together with exact methods, is certainly a main legacy of the circle and those associated with it. It is only when this exact formal approach is adopted that the content and positions can be constructively criticized and refuted – a characteristic which most current modern and postmodern philosophies lack.

The explicit and hidden history of the Vienna Circle from *Wissenschaftslogik* to recent philosophies of science documents the wide range, pluralism and diversity of its heritage and message. Be it called ‘scientific philosophy’ (as initiated by Schlick), ‘scientific humanism’ (according to Carnap) or a modern encyclopedism as a ‘republic of scholars’ (following Neurath), it is a guide to an intellectual journey, which continues through the present day and probably on into the future.

**Moritz Schlick – between nature and culture**

Friedrich Albert Moritz Schlick was born on 14 April 1882, the third and youngest son of Protestant parents. He studied natural science and mathematics at universities in Heidelberg, Lausanne and Berlin. In 1904 he completed his PhD under Max Planck, who regarded him as one of his favourite students, with a thesis ‘Über die Reflexion des Lichtes in einer inhomogenen Schicht’ (‘The Reflection of Light in an Inhomogeneous Layer’) in mathematical physics. After his first book, *Lebensweisheit* (Life Wisdom), appeared in 1908, Schlick devoted his efforts for two years to studying psychology in Zurich. He completed his habilitation in 1911 at the University of Rostock with the study *The Nature of Truth According to Modern Logic*. During his ten years of academic activity in Rostock, first as
private lecturer and then as professor (1917), Schlick worked on the reform of traditional philosophy against the backdrop of the revolution in natural science. He became friends with Albert Einstein, whose theory of relativity he was one of the first to study philosophically.

In 1918 his major study *Allgemeine Erkenntnislehre* (*General Theory of Knowledge*) was published. In 1922, on Hans Hahn's initiative, Schlick was appointed to Vienna as the successor of Boltzmann and Mach, to the chair for natural philosophy (philosophy of the inductive sciences). From 1924 on, Schlick organized, at the suggestion of his students Herbert Feigl and Friedrich Waismann, a regular discussion circle, later known as the Vienna Circle, which first met privately, then in the Department of Mathematics in Vienna. In addition to extensive research and teaching activities Schlick was also active in adult education: as a member of the Ethical Society and, above all (1928–34), as chairman of the Verein Ernst Mach. In spite of numerous interventions he could not prevent its dissolution after 12 February 1934 for political reasons. From 1926 on, Schlick came in personal contact with Ludwig Wittgenstein, who influenced him in a significant way. In 1929 he refused an attractive call to Bonn (at his students' request) and then spent several months as visiting professor at Stanford, and later (1931–2) in Berkeley, California.

On 22 June 1936 Moritz Schlick was murdered on the steps of the Vienna University by a former student who acted on private and Weltanschauung motives. Schlick was at the apogee of his influential life as a scholar. The student was released before the end of his sentence by the Nazis and lived as a free citizen in Austria after 1945. This act marked the definitive demise of the Vienna Circle, whose last members were forced to emigrate after the Anschluss (1938).

Schlick accorded philosophy an important and independent function in relation to the natural and social sciences right up to his untimely passing. Independent of this, he also embodied the prototype of the liberal, cosmopolitan intellectual in the midst of a National Socialist revolution.

In the *Philosophen-Lexikon* (1950) we find an entry written by Schlick himself. It begins with the following programmatic sentence: ‘Schlick attempts to justify and construct a consistent and entirely pure empiricism’, which, unlike its early forms, is reached by applying modern mathematics and logic to reality. Schlick continues:

> From there, and with the help of an analysis of the process of knowledge, the ‘General Theory of Knowledge’ arrives first at a clear distinction between the rational and the empirical, the conceptual and the intuitive. Concepts are mere symbols that are attributed to the world in question; they appear in ‘statements’ ordered in a very particular way,
by which these are able to ‘express’ certain structures of reality. Every statement is the expression of a fact and represents knowledge insofar as it describes a new fact with the help of old signs – in other words, with a new combination of terms which have already been used in other regards. The ordering of reality, . . . is determined solely by experience, for which reason there exists only empirical knowledge. The so-called rational truths, then, purely abstract statements such as the logical-mathematical ones . . . are nothing more than rules of signs which determine the syntax of the language (L. Wittgenstein) which we use to speak about the world. They are of purely analytic-tautological character and therefore contain no knowledge; they say nothing about reality, but it is for precisely this reason that they can be applied to any given fact in the world. Thus, knowledge is essentially a reproduction of the order, of the structure of the world; the material or content belonging to this structure cannot enter it; for the expression is, after all, not the thing itself which is being expressed. Therefore, it would be senseless to attempt to express the ‘content’ itself. Herein lays the condemnation of every variety of metaphysics; for it is precisely this that metaphysics has always wanted, in having as its goal the cognizing of the actual ‘essence of being.’ (Schlick 1950, 462f.)

This short text has its origins in Schlick’s Viennese period, as indicated by his reference to Wittgenstein. But it also represents the essence of Schlick’s main work on epistemology, his General Theory of Knowledge (Schlick 1918–25), as a manifestation of the specific sort of independent thinking with the typical duality of philosophy and the sciences – by the way, in contrast to the oft-claimed congruence with the Tractatus philosophy.

Thus, Schlick (1950, 463) concludes:

Philosophy is not a science, even though it pervades all sciences. Because while these latter consist of systems of true assertions and contains knowledge, philosophy consists in the search for the meaning of the statements and creates understanding, which leads to wisdom.

The quoted passages do not allow us to recognize any priority between nature and culture, nor between theoretical and moral philosophy. This is because, according to Schlick, ethics and aesthetics can be done in congruence with the concept of his ‘consistent empiricism.’ Hence,

it makes no sense to speak of ‘absolute’ values; only the evaluative behaviors actually practiced by human beings can be the object of
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study. Based on this standpoint arises a new justification for a kind of eudaimonism, which moral principle reads more or less so: increase your happiness! (ibid.)

This quote expresses a further characteristic, which is clearly different from Wittgenstein’s philosophy of the ineffable, and the abstention from moral-philosophic issues among some members of Vienna Circle and Berlin Group. This characteristic is elaborated in Schlick’s monographs from Lebensweisheit (1908) to his Problems of Ethics (1930).

The most decisive episode was Schlick’s encounter with Albert Einstein, with whom he had been exchanging letters on a regular basis from 1915 on. Initially, Schlick was viewed by Einstein as being the philosophical interpreter of his theory of relativity. Later on, Einstein himself is seen – alongside Russell and Wittgenstein – as a model and a proponent of the Wissenschaftliche Weltauffassung (1929). Particularly with regard to the conclusion he drew in his Geometrie und Erfahrung (Geometry and Experience): ‘Insofar as the statements of mathematics refer to reality, they are not certain, and insofar as they are certain, they do not refer to reality’ (Einstein 1921, 119f.).

Schlick ended up finding himself in disagreement with his former idol after having turned to Wittgenstein’s philosophy of language from 1924 on – before he had produced one of the most important presentations of Einstein’s writings in Space and Time in Contemporary Physics (1917), which went through four printings. Their later differences – from the mid-1920s onward – had to do with central positions from realism (Schlick 1932–33) to conventionalism and to the principle of causality in the context of a philosophy which, via linguistic analysis, views the problem of reality as a genuine pseudo-problem in the sense of Rudolf Carnap (1928) and Otto Neurath. After Schlick’s Rostock period (up to 1921) and Kiel (1921), the then forty-year-old philosopher was appointed to the chair for natural philosophy (philosophy of the inductive sciences) in Vienna in the tradition of Mach and Boltzmann in 1922. The mathematician Hans Hahn, who was the teacher of Karl Menger and Kurt Gödel, was mainly responsible for this innovative step. This move also represented an attempt to give an institutional platform and provide an intellectual figure for the further development of this scientific philosophy since the first Vienna Circle (with Frank, Hahn and Neurath). In this period, Schlick also read Wittgenstein’s Tractatus in the seminars held by the mathematicians Hans Hahn and Hans Reidemeister and also addressed Russell’s philosophy of logical atomism and neutral monism (McGuinness 1985).

By 1924 all the intellectual and institutional foundations for the formation of the Schlick Circle had been laid. The writings of Frege, Russell and
Whitehead, and Wittgenstein constituted the theoretical frame of reference against the backdrop of the synthesis of Mach and Boltzmann on the one hand and Duhem and Poincaré on the other hand. This was a process that was most lucidly described by Philipp Frank, Einstein’s successor in Prague (Frank 1949).

It was in the air when in fall 1924 Schlick, at the instigation of his talented students Herbert Feigl and Friedrich Waismann, decided to introduce a regular discussion forum (‘evening circle’) at the University of Vienna. This forum remained in existence up until his death and later went down in the history of philosophy and science as the Vienna Circle (Stadler 2001, 2003a). This institutionalization of the Schlick Circle between 1924 and 1929 was characterized by the discussion and encounter with Wittgenstein’s early philosophy and finally with Rudolf Carnap’s Logical Structure of the World (1928) – which was inspired by neo-Kantianism, Gestalt theory and set theory, based on Mach and Russell.

Until the second edition of his Allgemeine Erkenntnislehre (1925), Schlick was indebted to a form of critical realism. But in the 1930s he came to embody, together with Waismann, that wing of the circle inspired but not determined by Wittgenstein. The distinct notions of philosophy and concepts of ethics and aesthetics remained characteristic features of Schlick’s philosophizing; he conceived of philosophy as a system for expressing the most general principles inherent in the sciences. Philosophy was seen as a clearing activity, involving the logical analysis of statements within the individual sciences, for the sake of both overcoming metaphysics and clarifying meaning.

We can thus schematically trace out a movement in Schlick’s work from his initial, realistic position, via the ‘linguistic turn’ with verificationism, to the more liberal, still correspondence-theoretical position he held to till the end of his life. This was also a concrete distancing from Neurath’s ‘non-philosophical’ and coherence-theoretical physicalism, from his encyclopaedia of unified science – as appears from the controversial protocol-sentence debate of the late Vienna Circle (Oberdan 2017).

If we make a jump to the final phase of the Vienna Circle, we see that in turning to value issues and cultural-philosophical themes, Schlick took recourse to his ethical beginnings, which is unsurprising. In view of the fact that the backdrop of philosophy and society in Vienna at the time was the rise of fascism and national socialism, Schlick was prompted – like the mathematician Karl Menger – to focus on the threatening intellectual situation of his time, following his Fragen der Ethik (Schlick 1930).

In the midst of an antagonistic environment the democratic and liberal Schlick arrived at his ‘consistent individualism’ as a correlate to ‘consistent empiricism’ (konsequenter Empirismus). The omnipotent state was to be
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The Vienna Circle disenchanted in favour of a league of nations to promote the happiness of all people but not in the limited corset of social Darwinism:

Accordingly, Schlick’s critique of each form of nationalism as something destructive, always as a negative element with limitations, follows. Finally, he sees the National Socialist state as contrary to each form of liberal democracy. (Schlick 1952, 44ff.)

It is thus no longer surprising reading in the posthumous book Natur und Kultur (Schlick 1952) that Schlick in the last years of his life was mainly interested in problems of cultural philosophy, along with ethics. In addition to his lectures on these issues, he also worked on a book to be called ‘Nature, Culture, Art’, which he was unable to finish due to his early death. The central issue of the fragment is the question as to the suffering from culture, in particular existential need, tribulations of love and the mind – of which but only the first part of the planned book was completed.

These late writings suggest Schlick was attempting a programmatic synthesis of nature and culture. It is a modern variant of a monistic world view which tries to place the realm of facts and values in a humanist and cosmopolitan context – in Schlick’s own words, ‘Art is a desire for nature. Culture is a bridge on both ends of which nature rests’ (Schlick A 110).

Otto Neurath – encyclopaedia and utopia

Otto Neurath (born 10 December 1882 in Vienna, died 22 December 1945 in Oxford), one of the last polymaths of the now-lost old Austrian scientific culture, is slowly but continuously being rediscovered. This process of rediscovery is taking place on an international and interdisciplinary level, although it is still a selective process and happens at varied pace and intervals. It seems not to be due merely to chance that this exercise in intellectual archaeology takes place in our era between modernism and postmodernism.

Neurath would, on principle, have rejected the title ‘universal genius’ which William Johnston awarded him (with the best of intentions) in his book The Austrian Mind (Johnston 1972). For Neurath knowledge was always a collective enterprise embedded in an all-encompassing social context. Throughout his life he never jettisoned his enlightened view of a social and cognitive totality. For him the discovery and explication of seemingly disparate connections between phenomena, both in terms of text and image and the development of lines of argument based thereon, was an essential precondition for all intellectual work. To view science as an end in
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itself was totally alien to him. He believed that knowledge – even as part of a
hardly predictable historic process – should serve life in all the areas between
the poles of everyday life and specialist research activity. On the other hand
traditional academic metaphysics, obsessed with subtleties of meaning and
oblivious to the consequences of material being, feels equally challenged by
the radical and down-to-earth ‘scientific world conception’ clothed in the
garb of the neo-Enlightenment, which Neurath promoted.

It is not easy to approach the complex and highly diverse life’s work of
Otto Neurath without, on the one hand, getting lost in details or without,
on the other hand, resorting to inadequate generalizing descriptions such
as ‘positivist’, ‘physicalist’, ‘Austro-Marxist’ and the like. How can one
obtain an overview of a man, both of theory and practice, who covered the
entire spectrum of knowledge – including architecture, economic history,
mathematics and logic, philosophy, history and theory of knowledge, visual
education and museology in about 300 publications (including around
30 monographs and books) – and who worked in at least 4 countries
(Austria, Germany, the Netherlands, England) as a social scientist and
teacher at commercial colleges, workers’ colleges, adult education schools
and universities, a man who pursued a demanding profession (as museum
director), yet also figured centrally in the Vienna Circle?

It seems that the answer to this question lies in Neurath’s principle of
thinking and acting: to proceed from incomplete and unstable elements
temporarily united in theory and its related practice and to employ,
under the constraints of uncertainty and mere probability, the criteria of
empiricism, without ever losing sight of the fragmentary starting point or
the contemplation of a historical process. This approach in itself constitutes
a criticism of the idea of a fundamental and hierarchical system and at the
same time an appeal to think in ways differing from those which prevail in
society and the sciences, an appeal to risk a concrete utopia and to contribute
to the promotion of the common good by means of cooperative planning
for freedom and happiness. After the First World War, Neurath envisaged
an international ‘republic of scholars’, much in the tradition of the French
canopiedists. Yet despite his optimism, he realized that the growth of Fascism
and National Socialism threatened to end all these young democracies, and
he was not naive enough to believe that the proper proportion of rationalism
and empiricism alone could reverse the ‘demise of reason’. In his unpublished
response to Max Horkheimer’s ‘Der neueste Angriff auf die Metaphysik’
(1937; ‘The Most Recent Attack on Metaphysics’), Neurath, anticipating
the main arguments against the dialectic of Enlightenment, referred to the
limitations of social criticism which result from the fragility of knowledge
including sociology and its history (Neurath 1937, 2): ‘What is not at all
noticed at one time attracts the attention of other times and then can become
the centre of important considerations [...] for basically nothing is secure –
everything is in flux.’ Moreover ‘we know no other authority beyond science
which sits in judgement over science and studies its foundations’; that is, there
also is not available some form of transcendental reason. A central affinity
to the standpoint of Wittgenstein’s middle and late periods is unmistakable:
philosophy is viewed as a language game, a game from which we cannot
escape but about which we can certainly speak intelligently.

The basis for the remarkable rediscovery of Otto Neurath was laid some
decades ago; in the English-speaking world the research began (motivated not
least by Willard Van Orman Quine’s repeated reference to the ship metaphor
as an image of knowledge) with the edition of two selected volumes of
Neurath’s writings (1973 and 1983), whereas in the German-speaking world,
besides one volume of selected works and a monograph, with the volumes
of an edition of his writings – first those on philosophy and methodology
(1981), then those on visual education (1991) and now those on his life and
work and on economics (1996).

In Austria an exhibition on his life and work, together with a centenary
symposium on Neurath (in conjunction with that on Moritz Schlick), held in
1982, augmented the new interest by the public and scholars. Topics which
attracted this rediscovery ranged from his educational work to his economic
theories, his links to the architecture of the Bauhaus and the Viennese
Werkbundsiedlung and to constructivist art (Haller 1982; Stadler 1982). A
second main focus of interest moved towards the critical exploration of
Neurath’s theoretical potential and led to a reconstruction of the ‘forgotten’
Vienna Circle (Uebel 1991, 1992, 2007). As a result of all these activities,
we can now state that the depiction by others and even self-descriptions of
‘logical positivism’ after 1945 – especially of Neurath’s role – were derived
from appalling inadequacies and prejudices. For many innovations of current
history and philosophy of science were, in fact, anticipated in Neurath’s
oeuvre. The rediscovery of Neurath is therefore not merely a phenomenon
of academic nostalgia, but itself constitutes research into the conditions and
possibilities of changing a paradigm in the philosophy of science (cf. Cat
2019; Cat/Tuboly 2019; Nemeth and Stadler 1996; Sandner 2014).

But the process of reassessment did not occur only within the narrow
confines of philosophy and the theory of knowledge – the most abstract
structural context of Neurath’s various subjects which, on first glance,
seem all too disparate in ranging from the Encyclopedia of Unified Science
to the picture language and his museology and visual education. From the
start, Neurath himself had underlined the essential unity of his patterns of
thought and of action. Not only are holism in philosophy of science (Duhem-
Neurath-Quine principle) and naturalism extending to the 'orchestration of the science by the encyclopedism of logical empiricism' (Neurath 1945–6) and their precise formulation pursued as systematically as his interest in visual education and the Viennese method of visual statistics and the Isotype (abbreviation for 'International System of Typographical and Pictorial Education'). Loose but deliberate analogies can be found in Neurath's original writings, as can attempts to apply his theoretical concepts to education, social reform and the politics of knowledge. The following areas must be seen from this point of view: economy in kind, war economics, planning theory, as well as his involvement in the Bavarian revolution, the Viennese housing movement and town planning projects in England, not to mention his visual education projects and the founding of the Social and Economic Museum in Vienna and of the International Foundation for Visual Education in Holland (The Hague). Thus Neurath also emphasized several times, in a reference to Leibniz and Comenius, that the future encyclopaedia did not aim merely at a standardization of the language of science but also at a standardization of the visual representation (he projected twenty-six volumes of text and a ten-volume 'visual thesaurus'). This combination of text with visual language had already been realized in part in his publications Fernunterricht (1931–3) and his successful book Modern Man in the Making (1939). Towards the end of his life Neurath referred to the 'mosaic of the sciences'. In the spirit of this formulation we can arrive at an understanding of his life's work by means of a kind of collage, employing the regulative idea of the unity of science and society – a term that is most appropriately used as the subtitle to the latest volume of selections from his work. (Neurath and Nemeth 1994). Neurath's phrase 'mosaic of sciences' also contains (long before C. P. Snow's well-known critique) an implied criticism of distinct (second and third) scientific cultures.

The biography of Otto Neurath is marked by the historical caesuras of 1918–19, 1934 and 1938–40, which brought major interruptions to his work. The fact that he nevertheless carried on between destruction and reconstruction under the most trying circumstances can offer encouragement and indicate that, even in a hostile environment, the humanization of knowledge can make a modest contribution to the democratization of society (Nemeth and Stadler 1996).

First, there is Neurath's vision of a joint reconstruction of the enterprise of sciences, which, poetically formulated, reappears in different variations throughout his work.

We are like sailors who on the open sea must reconstruct their ship but are never able to start afresh from the bottom. Where a beam is taken...
away a new one must at once be put there, and for this the rest of the ship is used as support. In this way, by using the old beams and driftwood the ship can be shaped entirely anew, but only by gradual reconstruction. (Neurath 1921, 199)

Then there is the ethos with which Neurath pursued this reconstruction. In the middle of the revolutionary post-war phase, Neurath delivered an analysis of the zeitgeist which, particularly in our present times of change, gives us reason to reflect:

How often has the word ‘utopian’ been said with a tone of soft disdain or commiserating recognition! However stood on the ground of what happens to be the present and only knows it, sat in judgement over he who tried to glance behind the curtain of the stage of fate, who went to pains to prepare the game of the future. Now the curtain is being raised, clumsily the actors emerge from behind the scenes. Unknown figures meet unknown figures and unknown things. Some try to feign ease, others look at the prompt boxes and listen gratefully to the utterances coming from there. Rathenau, Atlanticus, Popper-Lynkeus and others are suddenly no longer simply ‘utopians,’ but social engineers who were ahead of their times. From all corners we now hear catchwords and demands which we find in Fourier, Cabet, Bellamy, even in Thomas Morus or Plato. The utopia today are the only attempts at total constructions of social engineering at our disposal. Whoever does not want to meet completely unarmed the innumerable stimuli and endeavours breaking over us today, should read the utopia which until now has been dealt with only marginally by economics. (Neurath 1919, 137f.)

Finally, there is the consistency and continuity of his thought. In his intellectual testament, where Neurath states:

I always promoted monism as a means of empiricist communication and I promoted pluralism as an attitude in making hypotheses. I have contended with thinkers of all kinds who tried to declare one system as marked out before others and therefore I tried to convey the insight that we need a kind of ‘decision’ wherever we have to make a ‘choice’, even when we are trying a scientific theory. [. . .] One may evolve more than one theory of light starting from the same basis, as one may plan more than one holiday tour from the same starting point. (Neurath 1946a, 526f.)
Rudolf Carnap – from logic of science to philosophy of science

Rudolf Carnap was born on 18 May 1891 in Ronsdorf (in northwest Germany). He attended the humanist gymnasium in Barmen (today a part of the city of Wuppertal) and studied philosophy, mathematics and physics in Jena and Freiburg under Gottlob Frege, among others, from 1910 to 1914. The young Carnap participated actively in the German youth movement and served during the First World War as soldier and physicist (1914–17), an experience which made him a pacifist and socialist intellectual. In 1921 he finished his dissertation on the topic of space (Der Raum) under the Neo-Kantian philosopher Bruno Bauch. Subsequently, Carnap continued his studies in Jena, with Hans Reichenbach among others, until 1926, before he was invited by Moritz Schlick to come to Vienna from 1925 on, where he became one of the most important members of the Vienna Circle and in logical empiricism till his emigration to the United States, where he continued his later academic career in Chicago and Los Angeles.

In 1926 he accomplished his habilitation with The Logical Structure of the World (published in 1928), which enabled him to become a private lecturer for theoretical philosophy at the Department of Philosophy of the University of Vienna (1926–30). In the following two years he was promoted to an associate professorship in Vienna and afterwards appointed associate professor for natural philosophy at the Faculty of Natural Science at the German University in Prague (1931–5). He was named full professor in 1936 while on leave as visiting professor at Harvard University. For scholarly and political reasons, Carnap, through the mediation of his friends Charles Morris and Willard Van Orman Quine, in 1936 emigrated permanently to the United States, where he assumed American citizenship in 1941. He was professor of philosophy at the University of Chicago (1936–52), then visiting professor at the Institute for Advanced Study in Princeton (1952–4). From 1954 to his retirement he was the successor of Hans Reichenbach at the University of California, Los Angeles, where he died on 14 September 1970 (on Carnap’s life and work, see Carus 2007 and Friedman and Creath 2007).

The emergence of the discipline known today as philosophy of science can be seen as converging with the process of the increasingly scientific status of philosophy, the so-called rise of scientific philosophy (Reichenbach 1951), in the interwar years. Already in the programmatic text of the Vienna Circle – Wissenschaftliche Weltanschauung – Der Wiener Kreis (1929) – the autonomous regal discipline of philosophy had given way to an anti-metaphysical, physicalist, unified science. This idea was systematically elaborated in the
1930s, most notably in Rudolf Carnap’s writings. In the manifesto, reference had been primarily made to his *Logical Structure of the World* (1928) – as a constitutive system based on experience with logical analysis. A few years later the position he took in his *Logical Syntax* (1934) found acceptance. The task of *Wissenschaftslogik* is seen as lying in the study of science as a whole or in its disciplines:

The concepts, propositions, proofs, theories appearing in the various realms of science are analyzed – less from the perspective of the historical development of science or of the sociological and psychological conditions of its functioning, but more from a logical perspective. This field of work for which no generic term has been able to gain acceptance, could be called theory of science or to be more precise logic of science. Science is understood as referring to the totality of accepted propositions. This does not just include the statements made by scholars but also those of everyday life. There is no clear boundary line drawn between these two areas. (Carnap 1934b, 5)

Here the distancing from traditional philosophy becomes highly salient, even if the role and function of a scientific *philosophy*, as linguistic analysis in Wittgenstein’s sense, is not called into question. This new discipline is not so interested in propositions on the external world as the realm of the empirical disciplines – ‘thing language’, as in ‘science itself as an orderly structure of propositions’, known as object language (ibid., 6) – accordingly, in the ‘sense’ of the propositions and the ‘meaning’ of concepts from a logical point of view. The realm of these concepts is limited either to the analytic propositions of logic/mathematics or to the empirical propositions of the sciences. This culminates in the view ‘that the propositions of the logic of science are propositions of the logical syntax of language. Thus these propositions lie within the boundaries drawn by Hume, for logical syntax is . . . nothing other than mathematics of language’ (ibid.).

Carnap had combined the elaboration of this programme of unified science in his *Logical Syntax of Language* (1934b) with its dissemination. As part of the internationalization of the Vienna Circle under way since 1929, two small books appeared almost at the same time in England: *The Unity of Science* (1934c) and *Philosophy and Logical Syntax* (1935) in the series Psyche Miniatures published by Kegan Paul. The former was an edition of the German article on physical language (Carnap 1931b), reworked by the author and translated by Max Black. The latter united three lectures that Carnap had given at the University of London in October of 1934: ‘The Rejection of Metaphysics’, ‘Logical Syntax of Language’, ‘Syntax as the Method
of Philosophy’. These attempts to popularize logic of science in the Anglo-Saxon world were continued with the translation of *Logical Syntax*, which appeared in 1937 in an expanded edition from the same English publisher (Carnap 1937).

It is known that, already in his *Logical Syntax*, Carnap had been influenced by Polish and American logicians and philosophers of science (notably Tarski, Quine and Morris) to further develop the possible field of logic of science. In addition to the syntactic dimension, he cited the semantic and pragmatic dimensions as future fields of work. In this sense he described the logic of science in his preface to the second edition as the ‘analysis and theory of the language of science’:

According to the present view, this theory comprises, in addition to logical syntax, mainly two further fields, i.e., semantics and pragmatics. Whereas syntax is purely formal, i.e., only studies the structure of linguistic expression, semantics studies the semantic relationship between expressions and objects or concepts; . . . [p]ragmatics also studies the psychological and sociological relations between persons using the language and the expressions. (Carnap 1937, vii)

With this new conceptualization of the logic of science, which already took place before the transfer of these ideas to the United States, we have also outlined the logical space for the philosophy of science as well as the terminological structure for the unity of science movement (1934c). Of course, logical empiricism before 1938 had no codified understanding of ‘logic of science’ in relation to philosophy. Here, however, only those paradigmatic elements have been indicated which turn out to be relevant later in the Anglo-American realm. In this context, I cannot dwell on the controversial protocol-statement debate within the Vienna Circle in which various positions on the basic issue of knowledge were unearthed. This eventually led to a heated discussion on fundamental questions in the epistemology of that time (Uebel 1992; 2007).

The movement of philosophical ideas between the old continent and the United States is meanwhile well documented (Giere and Richardson 1996; Hardcastle and Richardson 2003).

The historian of science Gerald Holton, who played a seminal role in the 1940s in the Unity of Science Institute and as an assistant to Philipp Frank, has given a very apt reconstruction of these cognitive parallels and this transfer of knowledge in his ‘From the Vienna Circle to Harvard Square: The Americanization of a European World Conception’ (1993). This history of ideas, which also includes Quine, describes a growing internationalization
The Vienna Circle

best illustrated by the International Congresses and the *Encyclopedia of Unified Science* and the Unity of Science Institute founded by Frank. Holton characterizes the favourable conditions for logical empiricism in the United States from 1940 to 1969 metaphorically as an ‘ecological niche’ in the New World and depicted these developments as an osmotic success story.

Proceeding from the early 1940s as the beginning of the specific American philosophy of science, it is possible to reconstruct the intellectual conditions of the convergent development of central European and American philosophy of science (Stadler 2004, 227ff.).

In a contemporary *Dictionary of Philosophy* (Runes 1944), we find the relevant discussions of that time presented in various short entries. Here it becomes clear that the central contributions on the philosophy of science were written by Rudolf Carnap, Carl G. Hempel and Heinrich Gomperz. The *Dictionary* presents philosophy of science as

that philosophic discipline which is the systematic study of the nature of science, especially of its methods, its concepts and presuppositions, and its place in the general scheme of intellectual disciplines. No very precise definition of the term is possible since the discipline shades imperceptibly into science, on the one hand, and into philosophy in general, on the other. A working division of its subject matter into three fields is helpful in specifying its problems, though the three fields should not be too sharply differentiated or separated. (Carnap 1944, 284)

Accordingly, the three fields addressed here are the following:

1. A critical study of the method or methods of the sciences, of the nature of scientific symbols, and of the logical structure of scientific symbolic terms. . . . 2. The attempted clarification of the basic concepts, presuppositions and postulates of the sciences, and the revelation of the empirical, rational, or pragmatic grounds upon which they are presumed to rest. . . . 3. A highly composite and diverse study which attempts to ascertain the limits of the special sciences, to disclose their interrelations one with another, and to examine their implications so far as these contribute to a theory either of the universe as a whole or of some aspect of it. (Benjamin 1944, 284f.)

In a preceding section, Carnap had already subsumed today’s science studies under ‘science of science’ as ‘the analysis and description of science from various points of view, including logic, methodology, sociology, and history of science’ (ibid.). In this connection he referred to his entries ‘Scientific
Empiricism’ and the ‘Unity of Science’ as ‘a wider movement, comprising besides Logical Empiricism other groups and individuals with related views in various countries’ (ibid., 286).

The unity of science was also identified with internationalization, and ‘scientific empiricism’ was introduced as a transformation of logical empiricism. With this self-understanding, the institutionalization and further differentiation of philosophy of science took place – a development which had been anticipated by two decades of intellectual exchange between Europe and America.

The contact with Morris gradually enabled Carnap to emigrate to the United States. After a stay in London in 1934, Carnap travelled to the United States for the first time in December 1935 – this move was also motivated by the increasingly unbearable political atmosphere in Prague. Already the year before he had met Willard Van Orman Quine (Harvard) in Vienna and Prague, which was followed by an intense dialogue and continuous contact following his emigration to Chicago in 1936.

At the University of Chicago, Carnap and Morris held a regular colloquium, known as the Chicago Circle, on methodological and interdisciplinary issues, even if the knowledge of modern logic was somewhat limited there. With this development, Carnap broke with the original conception of the logic of science (Wissenschaftslogik) understood as a logical syntax of language. Influenced by the work of Alfred Tarski, who immigrated from Warsaw in 1939, Carnap had undergone a ‘semantic turn’ in the United States by the time his *Introduction to Semantics* (1942) appeared. And the discussion of Quine’s ‘Two Dogmas of Empiricism’ (1951) drew from the beginning on Carnap’s sensitivity to the question of the analytic/synthetic or theoretical/empirical dualism.

Carnap writes about this new circle in exile:

In Chicago Charles Morris was closest to my philosophical position. He tried to combine ideas of pragmatism and logical empiricism. Through him I gained a better understanding of the Pragmatic philosophy, especially of Mead and Dewey. For several years in Chicago we had a colloquium, founded by Morris, in which we discussed questions of methodology from scientists from various fields of science and tried to achieve a better understanding among representatives of different disciplines and greater clarity on the essential characteristics of the scientific method. We had many stimulating lectures; but, on the whole, the productivity of the discussions was somewhat limited by the fact that most of the participants . . . were not sufficiently acquainted with logical and methodological techniques. (Carnap 1963, 34f.)
Karl Menger also participated in that circle. Referring to these meetings the editors of Karl Menger's *Reminiscences* add the following remarks:

The one tangible accomplishment of the Chicago Circle was to get some of its participants to write, and the University of Chicago Press to publish, the first monographs in the series called the International Encyclopedia of Unified Science. Apart from this the Circle suffered from an early series of blows from which, although it continued to meet in a desultory fashion until the 70's, it never fully recovered. The first of these was the departure of the noted linguist Leonard Bloomfield from the University of Chicago to become Sterling Professor at Yale. . . . The next major and practically fatal blow . . . was the war, which in the United States began in 1941, and which disrupted academic life in general. (Menger 1994, xiii–xiv)

The last two Congresses for the Unity of Science in Harvard and Chicago functioned as a forum for the transfer of knowledge and the transformation of philosophy of science into the international unity of science movement: 'Quine wrote simply: “Basically this was the Vienna Circle, with accretions, in international exile.” One might say that Mach's spirit had found a resting place in the New World at long last, and that the advance of the Vienna Circle had arrived at Harvard Square' (Holton 1993, 62).

In summary, it is clear that a basis for dialogue between Vienna and Chicago in philosophy of science had been created on various levels already prior to the outbreak of the Second World War and the preceding cultural exodus from Austria. A path had been paved for the actual transfer of knowledge in the context of (direct and indirect) contacts, journals and congresses: the International Congresses for the Unity of Science (1935–41).

From 1938 on, publications on these activities were edited by Neurath, Carnap and Morris as part of the *International Encyclopedia of Unified Science* (IEUS), a modernist project that extended into the 1960s but was to remain uncompleted. At the same time, the journal *Erkenntnis*, edited by Carnap and Reichenbach, became international with the eighth (and last) volume as *Journal of Unified Science*, after it had come under pressure by the Nazi regime in 1933 (Spohn 1991). In 1938, the first volume of IEUS, with contributions by Neurath, Niels Bohr, John Dewey, Bertrand Russell and Carnap, marked the beginning of the uncompleted project, with 19 instead of 260 projected monographs published with the University of Chicago Press (reprint of all 19 monographs in Neurath, Carnap and Morris 1971).

Even though the editors had very different ideas about the unification of the sciences, the project was continued after the war, although the death of
Neurath (1945) and the onset of the Cold War resulted in the deterioration of the whole enterprise of ‘late Enlightenment’. The last path-breaking contribution by Thomas Kuhn, *The Structure of Scientific Revolutions* (1962), can be seen as reflecting a change in the philosophy of science, characterized as a pragmatic or sociological turn embedding philosophy of science in the historical context. It is really remarkable that Carnap expressed his appreciation of Kuhn’s article in two letters (12 April 1960 and 28 April 1962) as part of the *Encyclopedia* – a fact, which was obscured by subsequent historiography for many reasons to be discussed in a different context (Reisch 2004).

Given the prehistory, it is no surprise that the Advisory Committee of IEUS documents a strong UK/US–Austrian bias. Accordingly, it becomes difficult to speak of an input-output or loss-gain transfer caused by the forced ‘cultural exodus from Austria’ from 1938 (Stadler and Weibel 1995). We are dealing more with a multilateral dynamic of science as transfer, transformation from central Europe to Great Britain and America, which can be described as a parallel process of disintegration and internationalization. Current research on Carnap confirms the significance and topicality of his road from ‘logic of science’ to ‘philosophy of science’. (Carus 2019; Creath 2012; Damböck 2016, FWF projects 30377 and 31716).

**Conclusion**

(Post-)modern philosophy of science has been strongly influenced by the direct and indirect contributions of logical empiricism (the Vienna Circle around Moritz Schlick and the Berlin Group around Hans Reichenbach) including its critics (Ludwig Wittgenstein, Karl Popper).

From the beginning of the twentieth century, we can reconstruct a long-term transfer, transformation and interaction of central European philosophy of science to the Anglo-Saxon world, from *Wissenschaftslogik* (Carnap) to philosophy of science and back to the (analytic) *Wissenschaftstheorie*. This significant development, brought on by the forced emigration of logical empiricists in the Nazi era, manifests the destruction of a creative network of philosophy of science, as well as the intense interaction of scientific philosophy and philosophy of science in central Europe (including the forgotten ‘French connection’ that existed with Pierre Duhem and Henri Poincaré) with the scientific community in Great Britain and North America (from the 1930s to the 1960s) – as represented by neo-pragmatism and operationalism, which centred around Percy W. Bridgman, Willard Van Orman Quine and Charles Morris, as well as linguistic and scientific philosophy (Bertrand Russell, Susan Stebbing, Frank P. Ramsey, Max Black). A critical reconstruction of today’s
history of philosophy of science, including exile studies and history of science, highlights this transatlantic movement and theory dynamics culminating in the long neglected re-transfer of analytic philosophy (of science) back to its roots with the ‘third’ Vienna Circle (around Viktor Kraft, with Arthur Pap, Paul Feyerabend and Wolfgang Stegmüller). Following the ‘linguistic turn’, the pragmatic and historical turns in recent philosophy of science (with Quine and Kuhn) constitute an essential part of these developments in the period from hot to cold war.

Study questions

(1) Summarize some of the main features of Vienna Circle.
(2) In spite of a common outlook on several main points, there are notable differences among Schlick, Carnap and Neurath. Describe some of these.
(3) What has survived from the Vienna Circle approach to science?

Further reading


Note

This article draws significantly on my entries on the Vienna Circle and Moritz Schlick in the Routledge Encyclopedia of Philosophy and in The Philosophy of Science: An Encyclopedia (edited by Sahotra Sarkar and Jessica Pfeiffer; London: Routledge, 2006), as well as on my contributions on Otto Neurath in the volume Otto Neurath – Encyclopedia and Utopia (edited by Elisabeth Nemeth and Friedrich Stadler; Dordrecht, Boston and London: Kluwer, 1996) and on my ‘History of the Philosophy of Science’ in Handbook of the Philosophy of Science: General Philosophy of Science – Focal Issues (edited by Theo Kuipers;

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