Logical positivism

Logical positivism and **logical empiricism**, which together formed **neopositivism**, was a movement in Western philosophy that sought to legitimize philosophical discourse by placing it on a basis shared with empirical sciences' best examples, such as Einstein's general theory of relativity. Its central thesis was **verificationism**, a theory of knowledge which asserted that only statements verifiable through empirical observation are *cognitively meaningful*. Efforts to convert philosophy to this new *scientific philosophy* were intended to prevent confusion rooted in unclear language and unverifiable claims.[1] The Berlin Circle and the Vienna Circle—groups of philosophers, scientists, and mathematicians in Berlin and in Vienna—propounded logical positivism starting in the late 1920s.

1 Influences

Logical positivists culled from Ludwig Wittgenstein's early philosophy of language the verifiability principle or criterion of meaningfulness. As in Ernst Mach's phenomenalism, whereby the mind can know only actual or potential sensory experience, verificationists took all sciences' basic content to be only sensory experience. And some influence came from Percy Bridgman's musings that others proclaimed as operationalism, whereby a physical theory is understood by what laboratory procedures scientists perform to test its predictions. In verificationism, only the *verifiable* was scientific, and thus meaningful (or *cognitively meaningful*), whereas the unverifiable, being unscientific, was meaningless "pseudostatements" (just *emotively meaningful*). Unscientific discourse, as in ethics and metaphysics, would be unfit for discourse by philosophers, newly tasked to organize knowledge, not develop new knowledge.

2 Definitions

Logical positivism is sometimes stereotyped as forbidding talk of unobservables, such as microscopic entities or such notions as causality and general principles, but that is an exaggeration. Rather, most neopositvists viewed talk of unobservables as metaphorical or elliptical: direct observations phrased abstractly or indirectly. So *theoretical terms* would garner meaning from *observational terms* via *correspondence rules*, and thereby *theoretical laws* would be reduced to *empirical laws*. Via Bertrand Russell's logicism, reducing mathematics to logic, physics' mathematical formulas would be converted to symbolic logic. And via Russell's logical atomism, ordinary language would break into discrete units of meaning. Rational reconstruction, then, would convert ordinary statements into standardized equivalents, all networked and united by a logical syntax. A scientific theory would be stated with its method of verification, whereby a logical calculus or empirical operation could verify its falsity or truth.

3 Development

In the late 1930s, logical positivists fled Germany and Austria for Britain and United States. By then, many had replaced Mach's phenomenalism with Otto Neurath's physicalism, whereby science's content is not actual or potential sensations, but instead is entities publicly observable. And Rudolf Carnap, who had sparked logical positivism in the Vienna Circle, had sought to replace *verification* with simply *confirmation*. With World War II's close in 1945, logical positivism became milder, *logical empiricism*, led largely by Carl Hempel, in America, who expounded the covering law model of scientific explanation. Logical positivism became a major underpinning of analytic philosophy,[2] and dominated Anglosphere philosophy, including philosophy of science, while influencing sciences, but especially social sciences, into the 1960s. Yet the movement failed to resolve its central problems,[3][4][5] and its doctrines were increasingly criticized, most trenchantly by W. V. O. Quine, Norwood Hanson, Karl Popper, Thomas Kuhn, and Carl Hempel.

4 Roots

4.1 Language

Tractatus Logico-Philosophicus, by the young Ludwig Wittgenstein, introduced the view of philosophy as "critique of language", offering the possibility of a theoretically principled distinction of intelligible versus nonsensical discourse. *Tractatus* adhered to a correspondence theory of truth (versus a coherence theory of truth). Wittgenstein's influence also shows in some versions of the verifiability principle.[6][7] In tractarian doctrine, truths of logic are tautologies, a view widely accepted by logical positivists who were also influenced by Wittgen-

stein's interpretation of probability although, according to Neurath, some logical positivists found *Tractatus* to contain much metaphysics.[8]

4.2 Logicism

Gottlob Frege began the program of reducing mathematics to logic, continued it with Bertrand Russell, but lost interest in this logicism, and Russell continued it with Alfred North Whitehead in their monumental *Principia Mathematica*, inspiring some of the more mathematical logical posivists, such as Hans Hahn and Rudolf Carnap.[9] (Carnap's early anti-metaphysical works employed Russell's theory of types.)[10] Carnap envisioned a universal language that could reconstruct mathematics and thereby encode physics.[9] Yet Kurt Gödel's incompleteness theorem showed this impossible except in trivial cases, and Alfred Tarski's undefinability theorem shattered all hopes of reducing mathematics to logic.[9] Thus, a universal language failed to stem from Carnap's 1934 work *Logische Syntax der Sprache* (*Logical Syntax of Language*).[9] Still, some logical positivists, including Carl Hempel, continued support of logicism.[9]

4.3 Empiricism

In Germany, Hegelian metaphysics was a dominant movement, and Hegelian successors such as F H Bradley explained reality by postulating metaphysical entities lacking empirical basis, drawing reaction in the form of positivism.[11] Starting in the late 19th century, there was "back to Kant" movement. Ernst Mach's positivism and phenomenalism were a major influence.

5 Origins

5.1 Vienna

The Vienna Circle, gathering around University of Vienna and Café Central, was led principally by Moritz Schlick. Schlick had held a neo-Kantian position, but later converted, via Carnap's 1928 book *Der logische Aufbau der Welt*—that is, *The Logical Structure of the World*—which became Vienna Circle's "bible", *Aufbau*. A 1929 pamphlet written by Otto Neurath, Hans Hahn, and Rudolf Carnap summarized the Vienna Circle's positions. Another member of Vienna Circle to later prove very influential was Carl Hempel. A friendly but tenacious critic of the Circle was Karl Popper, whom Neurath nicknamed the "Official Opposition".

Carnap and other Vienna Circle members, including Hahn and Neurath, saw need for a weaker criterion of meaningfulness than verifiability.[12] A radical "left" wing—led by Neurath and Carnap—began the program of "liberalization of empiricism", and they also emphasized fallibilism and pragmatics, which latter Carnap even suggested as empiricism's basis.[12] A conservative "right" wing—led by Schlick and Waismann—rejected both the liberalization of empiricism and the epistemological nonfoundationalism of a move from phenomenalism to physicalism.[12] As Neurath and somewhat Carnap posed science toward social reform, the split in Vienna Circle also reflected political views.[12]

5.2 Berlin

The Berlin Circle was led principally by Hans Reichenbach.

5.3 Rivals

Both Moritz Schlick and Rudolf Carnap had been influenced by and sought to define logical positivism versus the neo-Kantianism of Ernst Cassirer—the then leading figure of Marburg school, so called—and against Edmund Husserl's phenomenology. Logical positivists especially opposed Martin Heidegger's obscure metaphysics, the epitome of what logical positivism rejected. In the early 1930s, Carnap debated Heidegger over "metaphysical pseudosentences".[13] Despite its revolutionary aims, logical positivism was but one view among many vying within Europe, and logical positivists initially spoke their language.[13]

5.4 Export

As the movement's first emissary to the New World, Moritz Schlick visited Stanford University in 1929, yet otherwise remained in Vienna and was murdered at the University, reportedly by a deranged student, in 1936.[13] That year, a British attendee at some Vienna Circle meetings since 1933, A J Ayer saw his *Language, Truth and Logic*, written in English, import logical positivism to the Anglosphere. By then, Nazi political party's 1933 rise to power in Germany had triggered flight of intellectuals.[13] In exile in England, Otto Neurath died in 1945.[13] Rudolf Carnap, Hans Reichenbach, and Carl Hempel—Carnap's protégé who had studied in Berlin with Reichenbach—settled permanently in America.[13] Upon Germany's annexation of Austria in 1939, remaining logical positivists, many of whom were also Jewish, were targeted and continued flight. Logical positivism thus became dominant in the Anglosphere.

6 Principles

6.1 Analytic/synthetic gap

Concerning reality, the necessary is a state true in all possible worlds—mere logical validity—whereas the contingent hinges on the way the particular world is. Concerning knowledge, the *a priori* is knowable before or without, whereas the *a posteriori* is knowable only after or through, relevant experience. Concerning statements, the *analytic* is true via terms' arrangement and meanings, thus a tautology—true by logical necessity but uninformative about the world—whereas the *synthetic* adds reference to a state of facts, a contingency.

In 1739, Hume cast a fork aggressively dividing "relations of ideas" from "matters of fact and real existence", such that all truths are of one type or the other.[14][15] By Hume's fork, truths by relations among ideas (abstract) all align on one side (analytic, necessary, *a priori*), whereas truths by states of actualities (concrete) always align on the other side (synthetic, contingent, *a posteriori*).[14] At any treatises containing neither, Hume orders, "Commit it then to the flames, for it can contain nothing but sophistry and illusion".[14]

Thus awakened from "dogmatic slumber", Kant quested to answer Hume's challenge—but by explaining how metaphysics is possible. Eventually, in his 1781 work, Kant crossed the tines of Hume's fork to identify another range of truths by necessity—synthetic *a priori*, statements claiming states of facts but known true before experience—by arriving at transcendental idealism, attributing the mind a constructive role in phenomena by arranging sense data into the very experience *space*, *time*, and *substance*. Thus, Kant saved Newton's law of universal gravitation from Hume's problem of induction by finding uniformity of nature to be *a priori* knowledge. Logical positivists rejected Kant's synthethic *a priori*, and staked Hume's fork, whereby a statement is either analytic and *a priori* (thus necessary and verifiable logically) or synthetic and *a posteriori* (thus contingent and verifiable empirically).[14]

6.2 Observation/theory gap

Early, most logical positivists proposed that all knowledge is based on logical inference from simple "protocol sentences" grounded in observable facts. In the 1936 and 1937 papers "Testability and meaning", individual terms replace sentences as the units of meaning.[12] Further, theoretical terms no longer need to acquire meaning by explicit definition from observational terms: the connection may be indirect, through a system of implicit definitions.[12] (Carnap also provides an important, pioneering discussion of disposition predicates.)[12]

6.3 Cognitive meaningfulness

6.3.1 Verification

The logical positivists' initial stance was that a statement is "cognitively meaningful" only if some finite procedure conclusively determines its truth.[16] By this verifiability principle, only statements verifiable either by their analyticity or by empiricism were *cognitively meaningful*. Metaphysics, ontology, as well as much of ethics failed this criterion, and so were found *cognitively meaningless*. Moritz Schlick, however, did not view ethical or aesthetic statements as cognitively meaningless.[17] *Cognitive meaningfulness* was variously defined: having a truth value; corresponding to a possible state of affairs; naming a proposition; intelligible or understandable as are scientific statements.[18]

Ethics and aesthetics were subjective preferences, while theology and other metaphysics contained "pseudostatements", neither true nor false. This meaningfulness was cognitive, although other types of meaningfulness—for instance, emotive, expressive, or figurative—occurred in metaphysical discourse, dismissed from further review. Thus, logical positivism indirectly asserted Hume's law, the principle that *is* statements cannot justify *ought* statements, but are separated by an unbridgeable gap. A J Ayer's 1936 book asserted an extreme variant—the boo/hooray doctrine—whereby all evaluative judgments are but emotional reactions.

6.3.2 Confirmation

In an important pair of papers in 1936 and 1937, "Testability and meaning", Carnap replaced *verification* with *confirmation*, on the view that although universal laws cannot be verified they can be confirmed.[12] Later, Carnap employed abundant logical and mathematical methods in researching inductive logic while seeking to provide and account of probability as "degree of confirmation", but was never able to formulate a model.[19] In Carnap's inductive logic, every universal law's degree of confirmation is always zero.[19] In any event, the precise formulation of what came to be called the "criterion of cognitive significance" took three decades (Hempel 1950, Carnap 1956, Carnap 1961).[12]

Carl Hempel became a major critic within the logical positivism movement.[20] Hempel elucidated the paradox of confirmation.

6.3.3 Weak verification

The second edition of A J Ayer's book arrived in 1946, and discerned *strong* versus *weak* forms of verification. Ayer concluded, "A proposition is said to be verifiable, in the strong sense of the term, if, and only if, its truth could be conclusively established by experience", but is verifiable in the weak sense "if it is possible for experience to render it probable".[21] And yet, "no proposition, other

than a tautology, can possibly be anything more than a probable hypothesis".[21] Thus, all are open to weak verification.

7 Philosophy of science

Upon the global defeat of Nazism, and the removal from philosophy of rivals for radical reform—Marburg neo-Kantianism, Husserlian phenomenology, Heidegger's "existential hermeneutics"—and while hosted in the climate of American pragmatism and commonsense empiricism, the neopositivists shed much of their earlier, revolutionary zeal.[1] No longer crusading to revise traditional philosophy into a new *scientific philosophy*, they became respectable members of a new philosophy subdiscipline, *philosophy of science*.[1] Receiving support from Ernest Nagel, logical empiricists were especially influential in the social sciences.[22]

7.1 Explanation

Comtean positivism had viewed science as *description*, whereas the logical positivists posed science as *explanation*, perhaps to better realize the envisioned unity of science by covering not only fundamental science—that is, fundamental physics—but the special sciences, too, for instance biology, anthropology, psychology, sociology, and economics.[23] The most widely accepted concept of scientific explanation, held even by neopositivist critic Karl Popper, was the deductive-nomological model (DN model).[24] Yet DN model received its greatest explication by Carl Hempel, first in his 1942 article "The function of general laws in history", and more explicitly with Paul Oppenheim in their 1948 article "Studies in the logic of explanation".[24]

In DN model, the stated phenomenon to be explained is the *explanandum*—which can be an event, law, or theory—whereas premises stated to explain it are the *explanans*.[25] Explanans must be true or highly confirmed, contain at least one law, and entail the explanandum.[25] Thus, given initial conditions C_1, C_2 . . . Cn plus general laws L_1, L_2 . . . Ln, event E is a deductive consequence and scientifically explained.[25] In DN model, a law is an unrestricted generalization by conditional proposition—*If A, then B*—and has empirical content testable.[26] (Differing from a merely true regularity—for instance, *George always carries only $1 bills in his wallet*—a law suggests what *must* be true,[27] and is consequent of a scientific theory's axiomatic structure.[28])

By the Humean empiricist view that humans observe sequence of events, not cause and effect—as causality and causal mechanisms are unobservable—DN model neglects causality beyond mere constant conjunction, first event *A* and then always event *B*.[23] Hempel's explication of DN model held natural laws—empirically confirmed regularities—as satisfactory and, if formulated realistically, approximating causal explanation.[25] In later articles, Hempel defended DN model and proposed a probabilistic explanation, inductive-statistical model (IS model).[25] DN model and IS model together form *covering law model*,[25] as named by a critic, William Dray.[29] (Derivation of statistical laws from other statistical laws goes to deductive-statistical model (DS model).)[30] Georg Henrik von Wright, another critic, named it *subsumption theory*,[31] fitting the ambition of theory reduction.

7.2 Unity of science

Logical positivists were generally committed to "Unified Science", and sought a common language or, in Neurath's phrase, a "universal slang" whereby which all scientific propositions could be expressed.[32] The adequacy of proposals or fragments of proposals for such a language was often asserted on the basis of various "reductions" or "explications" of the terms of one special science to the terms of another, putatively more fundamental. Sometimes these reductions consisted of set-theoretic manipulations of a few logically primitive concepts (as in Carnap's *Logical Structure of the World* (1928)). Sometimes, these reductions consisted of allegedly analytic or *a priori* deductive relationships (as in Carnap's "Testability and meaning"). A number of publications over a period of thirty years would attempt to elucidate this concept.

7.3 Theory reduction

As in Comptean positivism's envisioned unity of science, neopositivists aimed to network all special sciences through the covering law model of scientific explanation. And ultimately, by supplying boundary conditions and supplying bridge laws within the covering law model, all the special sciences' laws would reduce to fundamental physics, the fundamental science.

8 Critics

After the Second World War's close in 1945, key tenets of logical positivism, including its atomistic philosophy of science, the verifiability principle, and the fact/value gap, drew escalated criticism. It was clear that empirical claims cannot be verified to be universally true.[12] Thus, as initially stated, the verifiability criterion made universal statements meaningless, and even made statements beyond empiricism for technological but not conceptual reasons meaningless, which would pose significant problems for science.[20][33][34] These problems were recognized within the movement, which hosted attempted solutions—Carnap's move to *confirmation*, Ayer's acceptance of *weak verification*—but the program

drew sustained criticism from a number of directions by the 1950s. Even philosophers disagreeing among themselves on which direction general epistemology ought to take, as well as on philosophy of science, agreed that the logical empiricist program was untenable, and it became viewed as self-contradictory.[35] The verifiability criterion of meaning was itself unverified.[35] Notable critics were Nelson Goodman, Willard Van Orman Quine, Norwood Hanson, Karl Popper, Thomas Kuhn, J L Austin, Peter Strawson, Hilary Putnam, and Richard Rorty.

8.1 Quine

Although quite empiricist, American logician Willard Van Orman Quine published the 1951 paper *Two Dogmas of Empiricism*,[36] which challenged conventional empiricist presumptions. Quine attacked the analytic/synthetic division, which the verificationist program had been hinged upon in order to entail, by consequence of Hume's fork, both necessity and apriocity. Quine's ontological relativity explained that every term in any statement has its meaning contingent on a vast network of knowledge and belief, the speaker's conception of the entire world. Quine later proposed naturalized epistemology.

8.2 Hanson

In 1958, Norwood Hanson's *Patterns of Discovery* undermined the division of observation versus theory,[37] as one can predict, collect, prioritize, and assess data only via some horizon of expectation set by a theory. Thus, any dataset—the direct observations, the scientific facts—is laden with theory.

8.3 Popper

An early, tenacious critic was Karl Popper whose 1934 book *Logik der Forschung*, arriving in English in 1959 as *The Logic of Scientific Discovery*, directly answered verificationism. Popper heeded the problem of induction as rendering empirical verification logically impossible.[38] And the deductive fallacy of affirming the consequent reveals any phenomenon's capacity to host over one logically possible explanation. Accepting scientific method as hypotheticodeduction, whose inference form is denying the consequent, Popper finds scientific method unable to proceed without falsifiable predictions. Popper thus identifies falsifiability to demarcate not *meaningful* from *meaningless* but simply *scientific* from *unscientific*—a label not in itself unfavorable.

Popper finds virtue in metaphysics, required to develop new scientific theories. And an unfalsifiable—thus unscientific, perhaps metaphysical—concept in one era can later, through evolving knowledge or technology, become falsifiable, thus scientific. Popper also found science's quest for truth to rest on values. Popper disparages the *pseudoscientific*, which occurs when an unscientific theory is proclaimed true and coupled with seemingly scientific method by "testing" the unfalsifiable theory—whose predictions are confirmed by necessity—or when a scientific theory's falsifiable predictions are strongly falsified but the theory is persistently protected by "immunizing stratagems", such as the appendage of *ad hoc* clauses saving the theory or the recourse to increasingly speculative hypotheses shielding the theory.

Popper's *scientific* epistemology is falsificationism, which finds that no number, degree, and variety of empirical successes can either verify or confirm scientific theory. Falsificationism finds science's aim as *corroboration* of scientific theory, which strives for scientific realism but accepts the maximal status of strongly corroborated verisimilitude ("truthlikeness"). Explicitly denying the positivist view that all knowledge is scientific, Popper developed the *general* epistemology critical rationalism, which finds human knowledge to evolve by *conjectures and refutations*. Popper thus acknowledged the value of the positivist movement, driving evolution of human understanding, but claimed that he had "killed positivism".

8.4 Kuhn

With his landmark, *The Structure of Scientific Revolutions*, Thomas Kuhn critically destabilized the verificationist program, which was presumed to call for foundationalism. (Actually, even in the 1930s, Otto Neurath had argued for nonfoundationalism via coherentism by likening science to a boat (Neurath's boat) that scientists must rebuild at sea.[39]) Although Kuhn's thesis itself was attacked even by opponents of neopositivism, in the 1970 postscript to *Structure*, Kuhn asserted, at least, that there was no algorithm to science—and, on that, even most of Kuhn's critics agreed.

Powerful and persuasive, Kuhn's book, unlike the vocabulary and symbols of logic's formal language, was written in natural language open to the layperson.[40] Ironically, Kuhn's book was first published in a volume of *Encyclopedia of Unified Science*—a project begun by logical positivists—and some sense unified science, indeed, but by bringing it into the realm of historical and social assessment, rather than fitting it to the model of physics.[40] Kuhn's ideas were rapidly adopted by scholars in disciplines well outside natural sciences,[40] and, as logical empiricists were extremely influential in the social sciences,[22] ushered academia into postpositivism or postempiricism.[40]

8.5 Putnam

The "received view" operates on the *correspondence rule* that states, “The observational terms are taken as referring to specified phenomena or phenomenal properties, and the only interpretation given to the theoretical terms is their explicit definition provided by the correspondence rules”.[11] According to Hilary Putnam, a former student of Reichenbach and of Carnap, the dichotomy of observational terms versus theoretical terms introduced a problem within scientific discussion that was nonexistent until this dichotomy was stated by logical positivists.[41] Putnam’s four objections:

1. Something is referred to as “observational” if it is observable directly with our senses. Then an observation term cannot be applied to something unobservable. If this is the case, there are no observation terms.

2. With Carnap’s classification, some unobservable terms are not even theoretical and belong to neither observation terms nor theoretical terms. Some theoretical terms refer primarily to observation terms.

3. Reports of observation terms frequently contain theoretical terms.

4. A scientific theory may not contain any theoretical terms (an example of this is Darwin’s original theory of evolution).

Putnam also alleged that positivism was actually a form of metaphysical idealism by its rejecting scientific theory’s ability to garner knowledge about nature’s unobservable aspects. With his “no miracles” argument, posed in 1974, Putnam asserted scientific realism, the stance that science achieves true—or approximately true—knowledge of the world as it exists independently of humans’ sensory experience. In this, Putnam opposed not only the positivism but other instrumentalism—whereby scientific theory as but a human tool to predict human observations—filling the void left by positivism’s decline.

9 Retrospect

By the late 1960s, logical positivism had clearly run its course.[42] Interviewed in the late 1970s, A J Ayer supposed that “the most important” defect “was that nearly all of it was false”.[43][44] Although logical positivism tends to be recalled as a pillar of scientism,[45] Carl Hempel was key in establishing the philosophy subdiscipline philosophy of science[13] where Thomas Kuhn and Karl Popper brought in the era postpositivism.[40] John Passmore found logical positivism to be “dead, or as dead as a philosophical movement ever becomes”.[43]

Logical positivism’s fall reopened debate over the metaphysical merit of scientific theory, whether it can offer knowledge of the world beyond human experience (scientific realism) versus whether it is but a human tool to predict human experience (instrumentalism).[46][47] Meanwhile, it became popular among philosophers to rehash the faults and failures of logical positivism without investigation of it.[48] Thereby, logical positivism has been generally misrepresented, sometimes severely.[49] Arguing for their own views, often framed versus logical positivism, many philosophers have reduced logical positivism to simplisms and stereotypes, especially the notion of logical positivism as a type of foundationalism.[49] In any event, the movement helped anchor analytic philosophy in the Anglosphere, and returned Britain to empiricism. Without the logical positivists, who have been tremendously influential outside philosophy, especially in psychology and social sciences, intellectual life of the 20th century would be unrecognizable.[13]

10 Footnotes

[1] Michael Friedman, *Reconsidering Logical Positivism* (New York: Cambridge University Press, 1999), p xiv.

[2] See “Vienna Circle” in *Stanford Encyclopedia of Philosophy*.

[3] Smith, L.D. (1986). *Behaviorism and Logical Positivism: A Reassessment of the Alliance*. Stanford University Press. p. 314. ISBN 9780804713016. LCCN 85030366. The secondary and historical literature on logical positivism affords substantial grounds for concluding that logical positivism failed to solve many of the central problems it generated for itself. Prominent among the unsolved problems was the failure to find an acceptable statement of the verifiability (later confirmability) criterion of meaningfulness. Until a competing tradition emerged (about the late 1950’s), the problems of logical positivism continued to be attacked from within that tradition. But as the new tradition in the philosophy of science began to demonstrate its effectiveness—by dissolving and rephrasing old problems as well as by generating new ones—philosophers began to shift allegiances to the new tradition, even though that tradition has yet to receive a canonical formulation.

[4] Bunge, M.A. (1996). *Finding Philosophy in Social Science*. Yale University Press. p. 317. ISBN 9780300066067. LCCN lc96004399. To conclude, logical positivism was progressive compared with the classical positivism of Ptolemy, Hume, d'Alembert, Compte, John Stuart Mill, and Ernst Mach. It was even more so by comparison with its contemporary rivals—neo-Thomisism, neo-Kantianism, intuitionism, dialectical materialism, phenomenology, and existentialism. However, neo-positivism failed dismally to give a faithful account of science, whether natural or social. It failed because it remained anchored to sense-data and to a phenomenalist metaphysics, overrated the power of induction and underrated that of hypothesis, and denounced realism and materialism as metaphysical nonsense. Although it has

never been practiced consistently in the advanced natural sciences and has been criticized by many philosophers, notably Popper (1959 [1935], 1963), logical positivism remains the tacit philosophy of many scientists. Regrettably, the anti-positivism fashionable in the metatheory of social science is often nothing but an excuse for sloppiness and wild speculation.

[5] "Popper, Falsifiability, and the Failure of Positivism". 7 August 2000. Archived from the original on 7 January 2014. Retrieved 30 June 2012. The upshot is that the positivists seem caught between insisting on the V.C. [Verifiability Criterion]—but for no defensible reason—or admitting that the V.C. requires a background language, etc., which opens the door to relativism, etc. In light of this dilemma, many folk—especially following Popper's "last-ditch" effort to "save" empiricism/positivism/realism with the falsifiability criterion—have agreed that positivism is a dead-end.

[6] For example, compare "Proposition 4.024" of *Tractatus*, asserting that we understand a proposition when we know the outcome if it is true, with Schlick's asserting, "To state the circumstances under which a proposition is true is the same as stating its meaning".

[7] "Positivismus und realismus", *Erkenntnis* **3**:1–31, English trans in Sarkar, Sahotra, ed, *Logical Empiricism at its Peak: Schlick, Carnap, and Neurath* (New York: Garland Publishing, 1996), p 38.

[8] For summary of the effect of Tractatus on logical positivists, see the Entwicklung der Thesen des "Wiener Kreises".

[9] Jaako Hintikka, "Logicism", in Andrew D Irvine, ed, *Philosophy of Mathematics* (Burlington MA: North Holland, 2009), pp 283–84.

[10] See Rudolf Carnap, "The elimination Of metaphysics through logical analysis of language", *Erkenntnis*, 1932;**2**, reprinted in *Logical Positivism*, Alfred Jules Ayer, ed, (New York: Free Press, 1959), pp 60–81.

[11] Frederick Suppe, "The positivist model of scientific theories", in *Scientific Inquiry*, Robert Klee, ed, (New York: Oxford University Press, 1999), pp 16-24.

[12] Sarkar, S; Pfeifer, J (2005). *The Philosophy of Science: An Encyclopedia*. **1**. Taylor & Francis. p. 83. ISBN 9780415939270.

[13] Friedman, *Reconsidering Logical Positivism* (Cambridge U P, 1999), p xii.

[14] Antony G Flew, *A Dictionary of Philosophy*, rev 2nd edn (New York: St Martin's Press, 1984), "Hume's fork", p 156.

[15] Helen B Mitchell, *Roots of Wisdom: A Tapestry of Philosophical Traditions: A Tapestry of Philosophical Traditions*, 6th edn (Boston: Wadsworth, 2011), "Hume's fork and logical positivism", pp 249-50.

[16] For a classic survey of other versions of verificationism, see Carl G Hempel, "Problems and changes in the empiricist criterion of meaning", *Revue Internationale de Philosophie*, 1950;**41**:41-63.

[17] See Moritz Schlick, "The future Of philosophy", in *The Linguistic Turn*, Richard Rorty, ed, (Chicago: University of Chicago Press, 1992), pp 43-53.

[18] Examples of these different views can be found in Scheffler's *Anatomy of Inquiry*, Ayer's *Language, Truth, and Logic*, Schlick's "Positivism and realism" (reprinted in Sarkar 1996 and Ayer 1959), and Carnap's *Philosophy and Logical Syntax*.

[19] Mauro Murzi "Rudolf Carnap (1891—1970)", *Internet Encyclopedia of Philosophy*, 12 Apr 2001.

[20] Fetzer, James (2012). Edward N. Zalta, ed. "Carl Hempel". *The Stanford Encyclopedia of Philosophy* (Summer 2012 ed.). It would fall to Hempel to become perhaps the most astute critic of that movement and to contribute to its refinement as logical empiricism... Hempel himself attained a certain degree of prominence as a critic of this movement... The analytic/synthetic distinction and the observational/theoretical distinction were tied together by the *verifiability criterion of meaningfulness*... By this standard, sentences that are non-analytic but also non-verifiable, including various theological or metaphysical assertions concerning God or The Absolute, qualify as cognitively meaningless. This was viewed as a desirable result. But, as Hempel would demonstrate, its scope was far too sweeping, since it also rendered meaningless the distinctively scientific assertions made by laws and theories... The analytic/synthetic distinction took a decided hit when the noted logician, Willard van Orman Quine, published "Two Dogmas of Empiricism" (1953), challenging its adequacy... While the analytic/synthetic distinction appears to be justifiable in modeling important properties of languages, the observational/theoretical distinction does not fare equally well. Within logical positivism, observation language was assumed to consist of names and predicates whose applicability or not can be ascertained, under suitable conditions, by means of direct observation... Karl Popper (1965, 1968), however, would carry the argument in a different direction by looking at the ontic nature of properties... Hempel (1950, 1951), meanwhile, demonstrated that the verifiability criterion could not be sustained. Since it restricts empirical knowledge to observation sentences and their deductive consequences, scientific theories are reduced to logical constructions from observables. In a series of studies about cognitive significance and empirical testability, he demonstrated that the verifiability criterion implies that existential generalizations are meaningful, but that universal generalizations are not, even though they include general laws, the principal objects of scientific discovery. Hypotheses about relative frequencies in finite sequences are meaningful, but hypotheses concerning limits in infinite sequences are not. The verifiability criterion thus imposed a standard that was too strong to accommodate the characteristic claims of science and was not justifiable... Both theoretical and dispositional predicates, which refer to non-observables, posed serious problems for the positivist position, since the verifiability criterion implies they must be reducible to observables or are empirically meaningless... The need to dismantle the verifiability criterion of meaningfulness together with the demise of the observational/theoretical distinction meant that logical posi-

tivism no longer represented a rationally defensible position. At least two of its defining tenets had been shown to be without merit. Since most philosophers believed that Quine had shown the analytic/synthetic distinction was also untenable, moreover, many concluded that the enterprise had been a total failure. Among the important benefits of Hempel's critique, however, was the production of more general and flexible criteria of cognitive significance... Hempel suggested multiple criteria for assessing the cognitive significance of different theoretical systems, where significance is not categorical but rather a matter of degree... The elegance of Hempel's study laid to rest any lingering aspirations for simple criteria of cognitive significance and signaled the demise of logical positivism as a philosophical movement. Precisely what remained, however, was in doubt. Presumably, anyone who rejected one or more of the three principles defining positivism—the analytic/synthetic distinction, the observational/theoretical distinction, and the verifiability criterion of significance—was not a logical positivist. The precise outlines of its philosophical successor, which would be known as "logical empiricism", were not entirely evident. Perhaps this study came the closest to defining its intellectual core. Those who accepted Hempel's four criteria and viewed cognitive significance as a matter of degree were members, at least in spirit. But some new problems were beginning to surface with respect to Hempel's covering-law explication of explanation and old problems remained from his studies of induction, the most remarkable of which was known as "the paradox of confirmation".

[21] Ayer, *Language, Truth and Logic*, 1946, p 50–51.

[22] Novick, *That Noble Dream* (Cambridge U P, 1988), p 546.

[23] James Woodward, "Scientific explanation"—sec 1 "Background and introduction", in Zalta EN, ed,*The Stanford Encyclopedia of Philosophy*, Winter 2011 edn

[24] James Woodward, "Scientific explanation"—Article overview, Zalta EN, ed, *The Stanford Encyclopedia of Philosophy*, Winter 2011 edn

[25] Suppe, *Structure of Scientific Theories* (U Illinois P, 1977), pp 619–21.

[26] Eleonora Montuschi, *Objects in Social Science* (London & New York: Continuum, 2003), pp 61–62.

[27] Bechtel, *Philosophy of Science* (Lawrence Erlbaum, 1988), p 25.

[28] Bechtel, *Philosophy of Science* (Lawrence Erlbaum, 1988), pp 27–28.

[29] Georg Henrik von Wright, *Explanation and Understanding* (Ithaca NY: Cornell University Press, 1971), p 11.

[30] Stuart Glennan, p 276, in Sarkar S & Pfeifer J, eds, *The Philosophy of Science: An Encyclopedia*, Volume 1: A–M (New York: Routledge, 2006).

[31] Manfred Riedel, pp 3–4, in Manninen J & Tuomela R, eds, *Essays on Explanation and Understanding: Studies in the Foundation of Humanities and Social Sciences* (Dordrecht: D Reidel Publishing, 1976).

[32] For a review of "unity of science" to, see Gregory Frost-Arnold, "The large-scale structure of logical empiricism: Unity of science and the rejection of metaphysics".

[33] John Vicker (2011). Edward N Zalta, ed. "The problem of induction". *The Stanford Encyclopedia of Philosophy* (Fall 2011 ed.). This initial formulation of the criterion was soon seen to be too strong; it counted as meaningless not only metaphysical statements but also statements that are clearly empirically meaningful, such as that all copper conducts electricity and, indeed, any universally quantified statement of infinite scope, as well as statements that were at the time beyond the reach of experience for technical, and not conceptual, reasons, such as that there are mountains on the back side of the moon. These difficulties led to modification of the criterion: The latter to allow empirical verification if not in fact then at least in principle, the former to soften verification to empirical confirmation.

[34] Uebel, Thomas (2008). Edward N. Zalta, ed. "Vienna Circle". *The Stanford Encyclopedia of Philosophy* (Fall 2008 ed.). What Carnap later called the "liberalization of empiricism" was underway and different camps became discernible within the Circle... In the first place, this liberalization meant the accommodation of universally quantified statements and the return, as it were, to salient aspects of Carnap's 1928 conception. Everybody had noted that the Wittgensteinian verificationist criterion rendered universally quantified statements meaningless. Schlick (1931) thus followed Wittgenstein's own suggestion to treat them instead as representing rules for the formation of verifiable singular statements. (His abandonment of conclusive verifiability is indicated only in Schlick 1936a.) A second element that began to do so soon was the recognition of the problem of the irreducibility of disposition terms to observation terms... A third element was that disagreement arose as to whether the in-principle verifiability or support turned on what was merely logically possible or on what was nomologically possible, as a matter of physical law etc. A fourth element, finally, was that differences emerged as to whether the criterion of significance was to apply to all languages or whether it was to apply primarily to constructed, formal languages. Schlick retained the focus on logical possibility and natural languages throughout, but Carnap had firmly settled his focus on nomological possibility and constructed languages by the mid-thirties. Concerned with natural language, Schlick (1932, 1936a) deemed all statements meaningful for which it was logically possible to conceive of a procedure of verification; concerned with constructed languages only, Carnap (1936-37) deemed meaningful only statements for whom it was nomologically possible to conceive of a procedure of confirmation of disconfirmation. Many of these issues were openly discussed at the Paris congress in 1935. Already in 1932 Carnap had sought to sharpen his previous criterion by stipulating that those statements were meaningful that were syntactically well-formed and whose non-logical terms were reducible to terms occurring in the basic observational evidence statements of science. While Carnap's focus on the reduction of descriptive terms allows for the conclusive verification of some statements, his criterion also allowed universally quantified statements to be meaningful, pro-

vided they were syntactically and terminologically correct (1932a, §2). It was not until one of his Paris addresses, however, that Carnap officially declared the meaning criterion to be mere confirmability. Carnap's new criterion required neither verification nor falsification but only partial testability so as now to include not only universal statements but also the disposition statements of science... Though plausible initially, the device of introducing non-observational terms in this way gave rise to a number of difficulties which impugned the supposedly clear distinctions between logical and empirical matters and analytic and synthetic statements (Hempel 1951). Independently, Carnap himself (1939) soon gave up the hope that all theoretical terms of science could be related to an observational base by such reduction chains. This admission raised a serious problem for the formulation of a meaning criterion: how was one to rule out unwanted metaphysical claims while admitting as significant highly abstract scientific claims?

[35] Hilary Putnam (1985). *Philosophical Papers: Volume 3, Realism and Reason*. Philosophical Papers. Cambridge University Press. p. 184. ISBN 9780521313940. LCCN lc82012903.

[36] W V O Quine, "Two Dogmas of Empiricism", *Philosophical Review* 1951;**60**:20-43, collected in Quine, *From a Logical Point of View* (Cambridge MA: Harvard University Press, 1953).

[37] Novick, *That Noble Dream* (Cambridge U P, 1988), p 527.

[38] Popper then denies that science requires inductive inference or that it actually exists, although most philosophers believe it exists and that science requires it [Samir Okasha, *The Philosophy of Science: A Very Short Introduction* (NY: OUP, 2002), p 23].

[39] Cartwright, Nancy; Cat, Jordi; Fleck, Lola; Uebel, Thomas E. (2008). "On Neurath's Boat". *Otto Neurath: Philosophy Between Science and Politics*. Ideas in Context. **38**. Cambridge University Press. pp. 89–94. ISBN 9780521041119.

[40] Novick, *That Noble Dream* (Cambridge U P, 1988), pp 526-27.

[41] Hilary Putnam, "Problems with the observational/theoretical distinction", in *Scientific Inquiry,* Robert Klee, ed (New York, USA: Oxford University Press, 1999), pp 25-29.

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[43] Hanfling, Oswald (2003). "Logical Positivism". *Routledge History of Philosophy*. Routledge. pp. 193f.

[44] "Ayer on Logical Positivism: Section 4". 6:30.

[45] Stahl *et al*, *Webs of Reality* (Rutgers U P, 2002), p 180.

[46] Hilary Putnam, "What is realism?", in Jarrett Leplin, ed, *Scientific Realism* (Berkeley, Los Angeles, London: University of California Press, 1984), p 140.

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11 See also

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14 External links

Articles by logical positivists

- The Scientific Conception of the World: The Vienna Circle
- Carnap, Rudolf. 'The Elimination of Metaphysics Through Logical Analysis of Language'
- Carnap, Rudolf. 'Empiricism, Semantics, and Ontology.'
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