**The Legacy of Logical Empiricism**

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*For the most part it is not a good sign if scholars are too eagerly occupied with the foundation and history of their discipline instead of producing new statements concerning the subjects treated by them.* –Otto Neurath[[1]](#footnote-1)

The predominate legacy of Logical Empiricism for contemporary philosophy of science is a passivity inherited from Kant. Philosophers are commentators, not contributors. The other legacy is an undertone, addressing problems in the sciences that were, or should have been, vivid in the times of the Logical Empiricists but which the latter passed by or fumbled, and advancing new enterprises for science. Roughly, and not quite fairly, the first is the inheritance from Rudolf Carnap, the second from Hans Reichenbach.

1. **Visions for Philosophy**

Passing through the 2019 meeting of the International Congress on Logic, Philosophy of Science, Scientific Method and Technology, I wondered what the Logical Empricists[[2]](#footnote-2) would have thought of the professional philosophy of science now pursued by thousands but stimulated almost a century before by two little coffee house groups, one in Vienna, one in Berlin. My guess is that they would have been perplexed. The literal point of philosophy according to Carnap had vanished—only a general attitude remained; the enterprise of scientific philosophy according to Reichenbach was scarcely to be seen.

The Logical Empiricist movement had two central, conflicting ideas of what philosophy should be. One, represented by Rudolf Carnap, was this:

*Philosophy is to be replaced by the logic of science*—that is to say, by the logical analysis of the concepts and sentences of the sciences, *for the logic of science is nothing other than the logical syntax of the language of science.[[3]](#footnote-3)*

Philosophy was to be logical reconstruction, where “logic” meant something like proof theory. That cramped vision was realized in Carl Hempel’s theories of confirmation and explanation, and by Carnap’s own theory of probability.

Hans Reichenbach had a different idea, which he announced in 1930 in an editorial in the first issue of Erkenntnis.

Philosophy should produce *results*, not manifestos.

Perhaps taking Reichenbach’s pronouncement as a rejection of his own efforts, Moritz Schlick reportedly resigned from editorship of the journal in response to Reichenbach’s manifesto against manifestos.

The results Reichenbach had in mind were undoubtedly various, but his own work suggests a vision given much later by Michael Friedman, the doyen of historical studies of Kant and the Logical Empiricists:

Science, if it is to continue to progress through revolutions…needs a source of new ideas, alternative programs, and expanded possibilities that is not itself scientific in some sense—that does not, as do the sciences themselves, operate within a generally agreed upon framework of taken for granted rules. For what is needed…is precisely the creation and stimulation of new frameworks or paradigms, together with what we might call meta-frameworks or meta-paradigms—new conceptions of what a coherent rational understanding of nature might amount to—capable of motivating and sustaining the revolutionary transition to a new first-level or scientific paradigm. Philosophy, throughout its close association with the sciences, has functioned in precisely this way…[[4]](#footnote-4)

More or less in accord with this conception of the role of philosophy, Reichenbach proposed a method for the discovery of “unobserved things,” and a construction of the direction of time from the macroscopic statistics of causal relations, and an entirely empirical theory of the truth conditions for counterfactuals. None of these efforts succeeded, although two of them presaged revolutionary developments that took four more decades to emerge.

Reichenbach and Carnap began their careers in a shared neo-Kantian spirit, but they ended poles apart. For Carnap, philosophy of science was to be “reconstruction,” logical representation of what others, real scientists, said and did. For Reichenbach, philosophy of science was to be a productive enterprise, contributing to the sciences, whether in the grand way Friedman envisioned, or less grandly by filling big conceptual holes in the science of the day. In Reichenbach’s vision, as appropriately trained outsiders, scientific philosophers might make significant, perhaps even revolutionary, contributions to science by untangling urgent problems, unsowing confusions, articulating generalizations, inaugurating new methods, refuting dogmas—indeed, just what many philosophers attempted from the 17th through the 19th centuries. In that vision, Reichenbach stood in the great tradition of modern philosophy, from Descartes to Pierce. To do so, he had to overcome the limits to the conception of philosophy he inherited from his neo-Kantian education. Carnap never overcame his.

Carnap would have seen in the gathering of philosophers in Prague in the summer of 2019 that his program of logical syntax had vanished. The shunning of Carnap’s syntax extended to statistics and to algorithms, to all things formal not bound to some domain. Reichenbach would have found almost no results, nothing to realize his vision of philosophy. In Prague and elsewhere, both visions were replaced with a kind of banal and sometimes fatuous journalism in which philosophers wrote expository essays with methodological commentaries, often signaling their intellectual virtue with insights supposedly from scientific esoterica that could as well have been obtained from high school chemistry. In Prague, hundreds of philosophers nodded their heads in solemn agreement with the revelation (in *two* lectures) that specialized sciences adopt and integrate ideas and methods from other sciences. But had they looked outside this setting, here and there Carnap and Reichenbach could have found philosophical efforts more to their taste scattered amidst the dreck.

1. **The Neo-Kantian Background**

Carnap, Russell and Reichenbach all began their careers attempting to salvage something from the wreck 19th century mathematics and early 20 century science produced for Kant’s doctrines. Not long after Kant had declared the a priori certainty of physical Euclidean geometry, Gauss attempted to measure the deviation of the internal angles of triangles from 180 degrees. After non-Euclidean geometries came proofs that hyperbolic geometry is consistent if Euclidean geometry is. Well before the theories of relativity, there was work to do saving Kant, and work to do reconsidering which, if any, of Kant's arguments were sound. (I have never found a concerted analysis by any of the Logical Empiricists of the defects in any of Kant’s *arguments,* for example the transcendental deduction of the categories of the understanding, or the antinomies of reason. Perhaps I should read more.)

Reichenbach and Carnap and Russell all wrote doctoral theses devoted to saving aspects of Kant’s epistemology from mathematical and scientific developments in the late 19th century. Russell and Carnap focused on the geometry of physical space. Russell's thesis offered an a priori demonstration of the "axiom of free mobility"--what we call constant curvature; Carnap argued that the topology of space is known a priori. Reichenbach's aim was to make the theory of probability synthetic a priori, or at least a necessary condition for empirical knowledge. While all of these were detailed proposals, Russell’s and Reichenbach’s were not particularly original. Helmholtz had given arguments for constant curvature, and Reichenbach’s thesis was straight out of Poincare’ but with a Kantian twist. Judging from Kant’s remarks on “monadology” in the *Metaphysical Foundations of Natural Science*, the nascent Logical Empiricists would have had more to do saving Kantianism if Kant had lived long enough to learn of Dalton’s atomic theory.

Russell and Carnap each had close connections with Frege and his work, Russell by correspondence, Carnap by tutelage. After their doctoral work, both of them proposed to use higher order logic to provide a logical construction of the “manifold of experience” from their respective conceptions of the “material of sensation”—Russell’s sense data and Carnap’s recollections of similarity between elementary experiences. Reichenbach attempted to provide a priori foundations for the theory of relativity, vaguely in the spirit of what Kant attempted for Newtonian science in his Metaphysical Foundations. In the ensuing years, they, especially Carnap and Reichenbach, moved from construction to supposed conventions of scientific language, correspondence rules and coordinating definitions, respectively. The a priori of mind became the analytic of language. By the time of the formation of *Erkenntnis*, Reichenbach, after essentially updating Helmholtz’ account of geometry in light of general relativity, had by the 1930s begun to move beyond the boundaries of Kant’s model of philosophy.

1. **Logical Empiricism and Physics**

Friedman gave no example from the Logical Empiricists of the contributions he envisioned. That was not from oversight. Physics, principally the theories of relativity, influenced the Logical Empiricists and their progenitors—notably Schlick--but they gave nothing back, nothing, at least, of scientific value. At the time, the most explicit acknowledgement of a philosophical influence on physics was Hermann Weyl's nod to Husserl in *Space, Time, Matter.* Although educated in mathematics and physics, the Logical Empiricists left no trace on the substance of the science, on its mathematical and conceptual reformulations, or on its methodology. Even Percy Bridgeman’s “Operationalism” seems to have been uninfluenced by philosophers of the day. And because most of them were uninterested in almost everything scientific except mathematics and physics, the Logical Empiricists made few contributions to any other science. To the exclusion of almost all other sciences, the principal Logical Empiricists, champions of “scientific philosophy,” loved physics and physicists, from Helmholtz and Planck to Einstein. With the possible exception of Phillip Frank, who with Richard von Mises wrote an influential monograph on differential and integral equations in mathematical physics, they provided nothing in return except popularization and cheerleading. That was partly by design, partly by failure. For all of the latter-day criticisms and condemnations of the movement, it’s barriers against productive engagement with physics and with other sciences still stand, unrecognized, powerful but invisible, occasionally penetrated. Which is why eminent physicists in our day have said with statistical truth and literal falsehood that philosophy of science has nothing to offer physics.

Consider some of urgent fundamental issues in the physics of the first half of the 20th century that the Logical Empiricists might have addressed but did not, or did address, but poorly:

* *Confirmation and Theory Testing*: What was the logic of the three “classical” tests of the general theory of relativity: which parts of the theory did the respective tests bear on and why? What alternative explanations did they remove? What further tests would inform us about the theory, and why? Was there a general strategy of inference at work? Only Reichenbach brings up the subject, and his discussion is cursory and uninformed. The issue was debated in the physics journals, sometimes rather hotly. The first “philosophical”—in the sense of dispassionate and quasi formal--analysis came from Harold Jeffreys, then a schoolboy, later a distinguished statistician. Jeffreys’ ideas were taken up (without credit) by Eddington and became the basis of the modern “post-Newtonian” classification of the empirical implications of metrical theories of the gravitational field. In two essays in the 1930s, Carnap offered an account of how “theoretical” claims can be tested by observational claims, ideas which he did not pursue and which he did not apply to physical problems. Hempel provided his “purely syntactic” account of confirmation, which, aside from the problem of predicate selection pointed out by Nelson Goodman, provided no account of confirmation of hypotheses with “unobservable” quantities, and no account of errors of measurement. On Hempel’s theory, the smallest error or omission implied that the data could provide no support for a theory. Both Carnap’s and Hempel’s accounts of confirmation were light years away from the problems of physics.
* *Identifiability:* What did the Lorentz signature of the metric field indicate about determinable and indeterminable physical quantities of spacetime? Schlick drew conclusions about conventionality from the choice of inertial reference frames, but added no formal insights. Reichenbach attempted an answer that was seriously criticized by Weyl and by von Neumann. A. A. Robb did a better job.
* *Meanings of Theories.* What was the proper interpretation of what quantum theory says about the world? That debate was famously carried out between Bohr and Einstein. Reichenbach later took credit for suggesting that the world might be indeterministic, but any insight into the problem was left to mathematicians such as von Neumann. The Logical Empiricist literature about “the meaning of theoretical terms” helped not at all, nor was it intended to.
* *Theoretical Equivalence.* For a while, physics had two competing theories of quantum phenomena, Schrodinger’s and Heisenberg’s. Was one of them true and the other false? Were they synonymous? Were they merely different mathematical formulations of a common mathematical structure? Von Neumann showed the third was the case. I can find no mention of the problem among Logical Empiricist writers, and no wonder, because they trivialized such problems. Even if they were sufficiently *au courant* of the physics, the matter was for them a pseudo-problem: either the theories have the same empirical implications or they do not. If the latter, then they are not synonymous; if the former, then they are synonymous. In Reichenbach’s later formulation two theories are synonymous if they are equally confirmed by the same evidence, a proposal that helped not at all, especially since Reichenbach had no coherent account of how theories with “unobservable” claims could be confirmed. At least he recognized that he had a problem.
* *Theoretical Unification.* Could the quantum theory and relativity be unified? The physicists offered proposals, but not the philosophers. The philosophers did not explore the methods or virtues of unifying distinct theories, and until Ernest Nagel’s effort in 1949 there was no attempt a systematic account of theory unification.
* *Computability and Knowability.* Computability had always been essential to science, first in the need to estimate quantities from noisy data, which prompted the rapid conversion in the 19th century from uncertain but bounded inference to least squares estimation. Computation came to the fore in physics during World War II, notably to compute the implications of various models. The theory of computation had grown directly out of logic and was as philosophical as anything in 20th century science, but with the exception of Carnap’s discussions with Godel, and his unsuccessful attempts to understand categoricity, the Logical Empiricists had nothing to say about computation and its complexity, nor did their students until Hilary Putnam’s work in the 1960s. The development of the theory of computation in the 1930s was left entirely to mathematicians—Turing, Post, Kleene, Church. The philosophers were largely oblivious.
* *Probability and How to Use It.* With the ascension of quantum mechanics, understanding probability became essential to understanding physics—although it is fair to say that probability should have been essential since the discovery of least squares by Legendre. Popper, who did not count himself a Logical Empiricist, proposed treating probability as a fundamental physical feature, and proposed reformulations so that measure zero events could be conditioned on. Reichenbach’s doctoral thesis was on the foundations of probability, exploiting ideas due to Poincare’, but made no technical advance. His later work, mixing attempts at a frequency theory with “probability logic” was a mess, and the statistical parts of his *Theory of Probability* were likely written, or at least sketched out, by Valintin Bargmann, Einstein’s assistant at the Institute for Advanced Study and an old friend of Reichenbach’s. Carnap’s logical theory of probability was utterly inapplicable, and his attempt to characterize entropy was so antipathetic to physics that von Neumann urged him not to publish it. Only Frank Ramsey made an original scientific contribution of value—but not to physics—and it was left up to a statistician, De Finnetti, to develop Ramsey’s idea.
* *Quantum Logic*. Reichenbach’s attempt at a logic for quantum phenomena was inept, unoriginal, and eclipsed by Birkhoff and von Neuman’s earlier work.

Each of these examples was a foundational issue of physics or an instance of one, and some of them are examples of generic problems in philosophy of science. Others, mathematicians, logicians, and physicists, contributed to our understanding of these problems, but the Logical Empiricists did not. When they tried, as did Reichenbach, their work was inferior to contemporary efforts by others on the same topics, or, as with Carnap’s theory of probability, scientifically useless.

The Logical Empiricists had minor scientific influences outside of physics. Hempel, who had taken a doctorate with Reichenbach but attached himself to Carnap's views and projects, collaborated with Paul Oppenheim, who made original contributions to linguistics (as did Reichenbach). One of Carnap's graduate students, Herbert Simon, fathered artificial intelligence, and Bruce Buchanan, Hempel's graduate student's graduate student, embedded Nicod's and Hempel's accounts of confirmation in the first practical machine learning program.

1. **Why?**

A more through search might find crumbs in the Logical Empiricists’ bag of influences on physics, but it is pretty much empty. So the question is why? I suggest four causes:

1. The Kantian conception of the role of philosophy;
2. The influence of Einstein;
3. The model of Frege’s and Hilbert’s theories of proof;
4. Limited mathematical competence.

Quine famously construed the Logical Empiricist program as two dogmas, a distinction between analytic and synthetic propositions and the ”reducibility” of scientific concepts to those about the observable. Earlier, Russell gave an even more trenchant summary and criticism, which seems to have gone unnoticed. These summaries were only nutshells. A fuller, more accurate account of what was going on with Logical Empiricism seems first to have been given by Bella K. Milmed.[[5]](#footnote-5) But she, along with Russell and Quine, left out half the story.

There are two interwoven threads in the modern philosophical tradition, often sported by the same people. On the one side, from Descartes, Leibniz, Locke, Berkeley and Hume, the concern was with a speculative--Hume called it "experimental"--cognitive psychology, and with how one could know the workings of everyday thought and experience, some of which involved what nowadays we would perhaps call the analysis of concepts. Hume’s account of the idea of causation is the most famous example. On the other side, there was methodology, general principles, sometimes speculative, sometimes quasi algorithmic, for fathoming nature, and engagement to improve the sciences with them. Descartes offered deduction from the "natural light of reason" and claimed to put it to work in his geometry, physics, and elsewhere. Leibniz proposed a Universal Calculus for scientific discovery, never realized. Bacon expounded a method that presaged modern causal analysis and used it to provide a correct theory of heat. Whewell championed "consilience," and while he discovered nothing I know of, he at least named some scientific kinds, anion and cation. Mill provided a more or less systematic handbook of methodology, central parts of it borrowed from Bacon. Boole developed an algebra of logic intended as ancillary to the discovery of causes. Price offered Bayesian reasoning as an antidote to Hume's skepticism and as a method for the sciences. Helmholtz mixed philosophy and mathematics in a critique of Kantian ideas about space. Pierce introduced randomization in experimental design.

Logical Empiricism thus inherited a divided conception of the relation of philosophy and the sciences. On the first side, represented most vividly by Carnap, philosophy is a meta-logical enterprise remote from contributions to any science or to methodology. On the second side, represented by Reichenbach, ideas about scientific language were combined with articulating methodology and put to work in more concrete scientific efforts in physics, statistics and elsewhere. Nominal allies, Carnap and Reichenbach represented two radically different versions of the job of philosophers, one as passive observers of the language of science, the other as active contributors. Carnap’s disposition, if not his syntactic anthem, carried the day.

* 1. **Kant**

Kant was the most proximate and most important philosophical influence on the Logical Empiricists. Kant's first *Critique* announced its problem to be how synthetic a priori knowledge is possible. That was a teaser. The work can be more broadly viewed as addressing a problem of inference in the face of apparent radical underdetermination: how are we, from the buzzing and booming of sensation, the “matter of experience," to know an external world of things and processes and relationships ordered in time, located in places and occurring with causal regularity? On a psychological reading of Kant, which I endorse (since I don't really understand the alternatives), the pocket answer is that one's mind creates the "cognizable" "manifold of experience"—the things and processes and relationships ordered in time and located in places and related by causal connections. That construction embodies general constraints that cannot be contradicted by experience because of how experience itself is constructed--synthetic a priori truths that include Euclidean geometry, the elements of Newtonian physics, the universality of causal connections, and in one edition of the *Critique of Pure Reason*, the framework of phlogiston theory.

Kant's engagement with Newtonian physics was real and serious but not technical or mathematical, and except for rather opaque references to the argument of Book III of Newton’s *Principia*, uninterested in how physical theories can be tested. Indeed, on Kant's view, the central assumptions of Newtonian mechanics and celestial mechanics could not be tested, because necessarily no conceivable experience could contradict them. Kant, who made minor but genuine contributions to science, had no evident interest in the details of scientific method; his engagement with Newtonian dynamics focused on proposing a priori foundations, and arguing that those foundations are the cynosure of the relations of mind and experience. Kant pointed philosophy of science away from creating new paradigms to stir the sciences and towards “reconstruction” and “justification.”

The 19th and early 20th century wreaked havoc with Kant's framework. Not long after Kant had declared the a priori certainty of physical Euclidean geometry, Gauss attempted to measure the deviation of the internal angles of triangles from 180 degrees. After non-Euclidean geometries came proofs that hyperbolic geometry is consistent if Euclidean geometry is. Well before the theories of relativity, there was work to do saving Kant, and work to do reconsidering which, if any, of Kant's arguments were sound. (I have never found a concerted analysis by any of the Logical Empiricists of the defects in any of Kant’s *arguments,* for example the transcendental deduction of the categories of the understanding, or the antinomies of reason. Perhaps I should read more.)

Kant’s most important influence was not in prompting the backing and filling of Carnap’s, Reichenbach’s and Rusell’s doctoral theses . It was in framing the very enterprise of philosophy of science. Among the Logical Empiricists, “reconstruction” replaced the innovation Friedman later envisioned and that philosophy had traditionally tried to provide. Kantian quasi-psychology was replaced by an account of how conventions of language did the same job for science. The Logical Empiricists transformed Kant’s fixed a priori into a more flexible linguistic mode, with “coordinating definitions,” and “correspondence rules” somehow connecting words and things but beyond empirical testing. They were a priori because the language of scientific practice made them so. They could be abandoned but not refuted. They were the “pragmatic” a priori. Having thus identified the conventional or stipulative or analytic, the remainder of science was revealed by Nature, empirically. A principal philosophical task became doing this sorting for one or another piece of science, separating the “analytic” from the “synthetic.” Reichenbach’s writing about relativity is of this kind, and Carnap’s alleged masterpiece, *The Logical Syntax of Language*, articulated the program in a straightjacket: philosophy is properly about logical syntax.

* 1. **Einstein**

Whatever bit of methodological thread Kant left to the Logical Empiricists was cut shorter by Einstein. By the later part of the 19th century, a tenable opinion was that physics was basically done, settled. John Tyndall, the eminent physicist and popularist, lectured that physics was fully formed; all that remained was the discovery and formulation of further forces beyond gravity and electromagnetism fitting into the Newton scheme, if any exist. In that setting, the Theory of Relativity was an epistemological shock. Neo-Kantians, Cassirer and Schlick, were all over it. Schlick leaned on it for his epistemology and wrote a “philosophical” exposition, which Einstein praised. But most importantly, what it meant for the Logical Empiricists and their allies was that no matter how much evidence might accrue for a theory, the theory could still be false. The collapse of Newtonian theory brought back the skeptical lesson Hume took from *The* *Meno*. The moral most of the Logical Empiricists drew was that science could not be an enterprise whose business is to discover general truths about the world, because that is impossible. Instead, Popper claimed science is an enterprise for tormentors of Sisyphus—ever offering new rocks of theory to carry and making sure that each rock of theory always fell, smashed to pebbles. Hempel, who claimed the notion of truth is useless to science, offered ersatz goals: explanation and confirmation. The unknowability of the *ding an sich* was promoted to the unknowability of generalizations about the empirical world. Which is why to the surprise of many who misunderstood what they were about, Carnap and Hempel found a kindred spirit in Thomas Kuhn.

Einstein was almost an oracle for the Logical Empiricists. Einstein, the determinist, held that science is a “free creation.” Science could only spring from human genius. There could be no recipe, no algorithm, for scientific discovery. The Logical Empiricists signed on, mostly by ignoring the very possibility, even as regression and factor analysis were advancing as algorithmic methods in psychology and elsewhere. With a fine instance of an enduring philosophical argument--*I cannot imagine how to do X, therefore doing X is impossible*--Hempel explicitly denounced the possibility of algorithmic contributions to scientific discovery. Science, he argued, requires the introduction of new theoretical quantities that are not explicitly definable from observed quantities, and no algorithm could ever do that. Only Reichenbach, with his Principle of the Common Cause, demurred.

* 1. **Frege and Hilbert**

Frege provided a model of logical achievement. He provided an explicit mathematical theory intended to capture the very idea of a demonstrative proof, a theory that seemed adequate for understanding much of mathematical practice. Carnap studied with him and Russell famously corresponded. His efforts were remedied and improved by Hilbert, with whom Hempel studied. Godel, the most astonishing of Hans Hahn’s students, attended Vienna Circle meetings. Having dismissed the very idea of science as a search for special kinds of truths, the Logical Empiricists attempted to do for their surrogates--explanation and confirmation--what Frege and Hilbert had done for proof. Formal theories of explanation and confirmation were cast as first-order logical relations, indeed as special kinds of first-order proof or provability. Neither Frege nor Hilbert had attempted to give mathematical accounts of notions such as “mathematically interesting” or “mathematical explanation.” They were wise enough to know that some notions are too diffuse and subjective for useful logical formalization. The Logical Empiricists were not.

Logic was a clumsy tool for real physics, which required more specialized mathematics. Methodological problems that were pertinent to science fit within formal logic only with a complexity that made them intractable. Hilbert, a great mathematical physicist, gave an axiomatic theory of Euclidean geometry that could be formalized in second order logic, but he did not do his gravitational field theory or his theory of the electron in first-order logic, or any order logic. The Logical Empiricists missed the message. So, for example, the Logical Empiricists proposed accounts of “empirical meaning” intended to separate empirically meaningful predicates and sentences from everything else, but said nothing about the nearly isomorphic problems in physics that came later to be known as “gauge symmetries,” already present in the scalar potential of Maxwell’s electrodynamics, or the like problems for linear models that came in economics to be known as “identification problems.”

**3.4 Competence**

Few human beings have the mathematical capacities of von Neumann or Godel or Hilbert. But less gifted minds, well-trained and serious and imaginative, can and do make important contributions. Of the Logical Empiricists, Carnap was perhaps the most mathematically able, but his efforts were entirely—albeit often ingeniously, as with his theories of probability and modality—confined to developing reconstructions within a logical formalism. Reichenbach was the Logical Empiricist who most engaged physics, and who best attempted to contribute to its conceptual problems. In his early years he was sufficiently competent with field theories to produce a technical argument that they could all be “geometrized,” an argument with which Einstein seems to have agreed. But outside of that setting, he lacked the mathematical knowledge and skills to carry out some of his bold and imaginative ideas. Although he wrote extensively about probability, I very much doubt he could have defined or calculated a correlation coefficient. He did not understand the relevant properties of independence and conditional independence. In consequence, his attempt at a macroscopic causal/statistical characterization of the direction of time was a nest of confusions. Away from relativity, Reichenbach was a mathematical wood-pusher.

1. **The Inheritance**

Philosophy’s most important legacy from the Logical Empiricists is the rejection of Friedman’s manifesto: furthering the search for truth, providing new methods, new insights into the structure of going theories, jolting the sciences with a new track, is none of the business of philosophy of science. Philosophy of science lost to psychology any claim to fathom the mind, and abandoned methodology to statistics. The result is that, with occasional excellent counter-examples, philosophy of science often became fan fiction, or (as with Schlick, who in some ways was the paradigm) exposition with “philosophical” commentary.

The pursuit of Friedman’s vision in both theoretical and practical terms has been taken up only by a handful of philosophers. There are novel “revolutionary” initiatives, for example studies of signaling and formal studies of the limits of learnability, some with surprising results for methodological dogmas, and the development of automated search for causal relations, even causal relations among unobserved causes, Hempel notwithstanding. There are mathematical insights into properties of physical theories, (merely) for example: Arthur Fine’s demonstration that there is no unified probability distribution for quantum theory; David Malament’s demonstration that simultaneity is uniquely definable in Minkowski space-time; Glymour’s characterization of “indistinguishable” space-times, David Maxwell’s recent work on inertial frames or reference in Newtonian theory; and most impressively to my mind, Oliver Shultze’s demonstration that principles of formal learning theory (plus data and background, of course) determine the introduction of novel fundamental particles and their quantum numbers. But any intelligent physicist eavesdropping (as I write) on the lectures in the International Congress for Logic, Methodology and Philosophy of Science, the largest of its kind, would mostly hear fatuity. They would perhaps think that education in philosophy of science has become a form of child abuse. The Logical Empiricists are not entirely to blame, but they are to blame.

There are ironies. Early in their careers, Russell and Carnap sketched proposals for constructing from primitive data what Kant might have called the manifold of experience. Both Russell and Carnap proposed applying higher order logic to representations of the data of experience—sense data in Russell’s case, similarities of elementary experiences in Carnap’s—to construct applicable concepts of ordinary properties, things, events, and processes. Only Carnap attempted actual constructions, and he did not get very far or very well. Recently, Frederick Eberhardt, a philosopher at the California Institute of Technology, and his collaborators developed an algorithm for generating causally relevant, novel, higher-order variables from time series of data, such as pixels on a screen or firings of an array of retinal nerves. They applied their algorithm to data on sea surface temperatures and pressures and out came the ENSO phenomenon. Eberhardt presented these results at a recent meeting to celebrate and discuss Reichenbach’s work. Unsatisfied with the example, a philosopher demanded to know whether variables the algorithm would generate are the real variables in the world. I directed him to Carnap, *Pseudo Problems in Philosophy*.

1. “Ways of the Scientific World Conception,” *Philosophical Papers*, 1913-1946, Reidel, 1983. [↑](#footnote-ref-1)
2. Who were the Logical Empiricists? I count the “philosophical” members of the Vienna and Berlin circles, their collaborators, and some of their most distinguished students, Hempel and Feigl notably, as well as their English popularist, A. J. Ayer. In addition there were philosophers—Russell and Ramsey in England, Popper in Austria, C. I. Lewis and Nagel in America—who shared some of the Logical Empiricist program but had their differences. There is no sharp line I can make between Logical Positivism and Logical Empiricism. Perhaps the best demarcation is allegiance, or not, to the verifiability of meaning, although vestiges of the doctrine long endured. [↑](#footnote-ref-2)
3. From the Forward to *The Logical Syntax of Language.* [↑](#footnote-ref-3)
4. *The Dynamics of Reason*. Since his more frequent statements of the role of philosophy of science are neo-Kantian, Friedman may very well regret the passage. [↑](#footnote-ref-4)
5. *Kant and Current Philosophical Issues*. Milmed’s insightful book was damned with faint praise by Charles Parsons. Her account is similar to the more detailed view later offered by Friedman. [↑](#footnote-ref-5)