LOGICAL POSITIVISM

George Nakhnikian

Logical positivism, the enfant terrible of twentieth-century philosophy, began around 1922 with the meetings of a group subsequently known as the "Vienna Circle." Until 1936, when its leading exponents had either died or dispersed abroad, the movement shook the philosophical world into intense partisan controversy. By now as a movement logical positivism is dead, but not like the dodo. Its early excesses have been toned down by its best surviving representatives, chief among whom is Carnap. These early excesses were the energetic outbursts of serious, intelligent, technically well-equipped men. The positivists left an indelible mark on modern analytic philosophy. Even their mortal enemies, the speculative metaphysicians, have been somewhat chastened by the positivists' powerful attacks.

The two most important figures of logical positivism are Moritz Schlick (1882-1936) and Rudolf Carnap (1891-1970). Carnap's "left wing" version of positivism became the generally recognized image of the movement. During the heyday period of 1926—1936, Carnap alone tried to work out in detail a completely consistent logical positivism. His work, though less judicious than Schlick's, was on that account much more exciting and original.

A letter of Professor Carnap's contains the following historical remarks:

> Until 1926 I worked completely on my own in a small village in Germany. I started out on my philosophical road, strongly influenced by Russell and Frege (my teacher). My aim was the application of modern logic for the analysis of scientific concepts and the clarification of philosophical problems. I was not at all thinking of a philosophical movement. My early publications are concerned with topics in the foundations of physics (as was my Ph.D. thesis on space), a textbook on symbolic logic (stressing particularly its applications). The largest part of my time in these early years, however, was devoted to writing Der Logische Aujbau der Welt[1]; the manuscript was finished when I came to Vienna in 1926.
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> Although Wittgenstein had a strong influence on the Vienna Circle, it is often overrated. . . . He influenced most deeply Schlick and Waismann, but me and Neurath a good deal less. I would say that I owe much more to Russell than to Wittgenstein.

Although Carnap put the stamp of his own positivism upon the recognized image of the movement, Schlick was its catalyst. In 1922, Schlick was appointed Professor of Philosophy in Vienna University. The appointment was initiated by a group of scientists, led by Hans Hahn. Schlick had been trained in physics, having written a doctoral dissertation on light under Planck. He had close personal ties with Planck, Einstein, and Hilbert. In 1917, he had published *Space and Time in Contemporary Physics* and in 1918*, General Theory of Knowledge*. It was his already established reputation as a philosopher of sci-ence that led to Schlick's appointment in Vienna. Around this physicist become professional philosopher there flocked immediately upon his arrival in Vienna a number of philosophers and mathematicians. Outstanding among the philosophers were Herbert Feigl, Victor Kraft,

and Friedrich Waismann and among the mathematicians there were Kurt Godel, Hans Hahn, and Karl Menger. Otto Neurath, who regarded himself as a social scientist, was a prominent member of this group. Carnap joined it in 1926. At about the same time a similar though less influential group was forming itself around Hans Reichenbach in Berlin. The one thing that these people in the Vienna and Berlin groups had in common was their disdain of scientifically untaught philosophers who made pontifical pronouncements about knowledge and science.

From 1922 to 1929, the Vienna group met for frequent philosophical discussion. By 1918, Wittgenstein had written the *Tractatus*, the most radical statement of logical atomism. Wittgenstein lived near Vienna for a time after the first war, and although he never personally took any part in the meetings of the Vienna group, some of its members had occasional contact with him. They studied his *Tractatus* extremely thoroughly. The *Tractatus* was a strong influence in the shaping of logical positivism. Much of Carnap's work in the period between 1926-1934 is an attempt to make the logical atomism of the *Tractatus* into a consistent positivism. In 1929, the Vienna group had become sufficiently integrated to christen itself the "Vienna Circle" and to declare itself a school with a definite program and a published manifesto, *Scientific World-View: The Vienna Circle*. Its members organized congresses, established contact with like-minded philosophers in Poland, Britain, and the United States. In 1930, Carnap and Reichenbach began jointly editing *Erfenntnis* which was the chief medium of disseminating the ideas of logical positivists. By 1936, the movement lost its initial momentum. Philosophically, the logical positivists ceased to dominate the scene. Physically, the Vienna Circle dissolved. Hahn had died in 1934, two years before Schlick was killed by a demented student. The authoritarian regimes of Dolfuss and Schuschnigg were unbearable to the rest of the Vienna Circle. Godel, Menger, Carnap, and Feigl eventually came to the United States. Waismann went to Oxford where he died in 1959.

Logical positivism is a type of empiricism. The logical positivists deliberately chose the qualifying term "logical" in order to indicate that they were doing logical analysis rather than propounding theses about ultimate reality or giving psychological accounts of the origin of our ideas and the laws of their association. According to Carnap, "The function of logical analysis is to analyze all knowledge, all assertions of science and everyday life, in order to make clear the sense of each such assertion and the connections between them." The word "positivism" relates this movement to traditional empiricism. One recurrent theme of traditional empiricism is that all theoretically significant propositions are based upon sense perception. This is intended to be a criterion of theoretical intelligibility. But the word "significant" also means worth serious consideration. Empiricism in one breath lays down its criterion of theoretical intelligibility and passes judgment on whatever fails to meet that criterion. There is, however, a class of true propositions, those of logic and mathematics, which empiricists regard as worthy of serious consideration but which they could not plausibly subject to their own criterion of theoretical intelligibility. Mill's theory that the truths of logic and mathematics are extraordinarily well-supported
inductive generalizations from sense experience did not satisfy most empiricists as an account of the sort of necessity that logical and mathematical truths appear to have.

The way out of the impasse, as far as the logical positivists were concerned, appeared to be provided by the logistic thesis of *Principia Mathematica* that mathematics is reducible to logic, and by Wittgenstein's addendum in the *Tractatus*, that logical truths are tautologies devoid of factual content. Now the logical positivists could say that all significant theoretical propositions are based upon sense perception, except the factually empty tautologies that exhaust and are exhausted by the truths of logic and mathematics.

The characteristic tenet of logical positivism is the verifiability criterion of factual

meaning. According to the verifiability criterion, the factual meaning of a sentence is the method of its verification. In other words, to understand what a factual sentence means is to know what fact would support it and what fact would fail to support it, provided that nothing is admitted to be fact except what can be observed by the senses. Verification in turn was said to be direct, as in the case of "this is a blue square" or indirect, as in the case of "gases are collections of molecules."

The central idea of the verifiability criterion is not original with logical positivism. C. S. Peirce's pragmatic conception of "intellectual meaning" and Einstein's operationalism (the term was coined by P. W. Bridgman) came earlier than positivism. Although Peirce's conception antedates Einstein's by about twenty-five years, operationalism did not take hold in physics until after Einstein had built it into the very fabric of relativity theory. Einstein did this by so defining the concept of simultaneity that whether or not two events are simultaneous could be decided by observing the results of carrying out certain operations.[2] Einstein justified his recommendation that physicists work with operational concepts on the ground that otherwise the point of scientific work, namely, to give intersubjectively decidable answers to questions about nature, would be frustrated. The positivistic criterion of factual meaning is closely related to pragmatism and operationalism, but the positivists, unlike Einstein and Peirce, used their criterion as a major weapon against metaphysics. Regarding as metaphysical all claims to knowing something about matters that in principle no sense experience could confirm or deny, the positivists argued that metaphysics has no theoretical significance because it is in principle impossible to specify what we mean when we try to talk about that which no sense experience could confirm or disconfirm, either directly or indirectly. If a purified physics weeds out nonoperational concepts, a purified philosophy excludes all of metaphysics.

The verifiability criterion is part of logical positivism's theory of meaning. The main break is between theoretical or "cognitive" meaning and "cognitive" nonsense by which the logical positivists meant "lack of cognitive meaning." Theoretical nonsense is broken down into three subclasses: (1) pure gibberish, like that uttered by children pretending speech, (2) locutions violating syntax, for example, "Nobody was on the road, and he was walking faster than I was" violates syntax by treating "nobody" as a name, and (3) "emotive" expressions. These are said to be locutions that are generally recognized means of venting emotions, feelings, and attitudes without describing them. The positivists put metaphysical sentences under emotive meaning, together with poetry, normative ethics, and religious discourse. Carnap's "Ueberwindung der Metaphysik durch logische Analyse der Sprache"[3] is a full-length essay stating the classic positivistic view of the emotive character of metaphysics.

The theoretically meaningful divides into the sentences governed by the verifiability criterion and the tautologies (and their denials). The tautologies are the only necessary truths admitted within the positivistic scheme. Following Wittgenstein, the positivists accounted for the necessity of tautologies in terms of formal structure devoid of content. For example, letting "p" and "q" stand for any statements and defining "p or q" to mean it is not the case that p and q are false simultaneously, the formula:

p or not-p

is a formal truth. This fact can be proved by mechanical calculation. It is in this sense only that formal truths are known a priori. It follows from all this that there are no factual a priori propositions.

Against Husserl's factual a priori, Schlick argued that all Husserlian propositions, for example, that all colored surfaces are extended, are disguised tautologies. They are true

in virtue of the rules governing the uses of the words "colored," "surface," "extended."[4] Against Kant's factual a priori the positivists had two lines of attack. They believed that all of mathematics, including arithmetic and geometry, is at bottom a system of tautologies without any factual content whatever. This, they thought, refutes Kant's analysis of arithmetic and geometry as factual a priori. The second line of attack, supplementing the first, was provided by Einstein's general theory of relativity. The geometry of the general theory is Riemannian, one of the innumerably possible non-Euclidean geometries. Taken as a hypothetico-deductive system without any physical interpretation of its fundamental concepts, geometry — be it Euclidean or not — is a tautological system, hence not factual. But when made a part of a physical theory and interpreted in physical terms, any geometry becomes a factual theory, but then its truth or falsehood is no longer known a priori. Einstein himself had said: "As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."

Carnap's most original and exciting work during the formative years of logical positivism may be understood as an attempt to work out a conception of philosophy consistent with the tenets of logical positivism. Carnap set out to show how philosophy still has a task, granted that it is neither metaphysics, nor natural science, nor mathematical logic. The aim was to show that philosophy is reductive analysis in the style of logical atomism, but with two differences. The logical atomists had described analysis as supplying in a "clarified" language equivalents for statements in ordinary language whose meaning and truth were known on the common-sense level. The equivalents in the "clarified" language were thought to be superior in that they pictured the facts more adequately. Indeed, when reduced to their ultimate atomistic base, they were ideal pictures of facts. Carnap and the rest of the Vienna Circle saw that this way of describing and of justifying analysis is inconsistent with their positivism. Statements talking about the relation of language to fact were thought to be unverifiable. Moreover, as they were obviously not statements belonging to formal logic, they were not "cognitively" meaningful. As the positivists conceived it, philosophy was "cognitively" meaningful, but not empirical. These conditions would be satisfied if it could be shown that philosophical sentences are about the logical (syntactical) relations and properties of linguistic expressions. Philosophy was to be identical with logic (syntax), provided that "logic" was suitably broadened to cover the syntax of the language of the factual sciences in addition to the syntax of mathematics. In this way philosophy would be more than mathematical logic while still differing from factual science. Factual science would be the investigation of nature. Philosophy would be logical investigation of the language of factual science. And one could justify philosophy by its intrinsic intellectual interest; or by its power to produce clarity so that we would be safeguarded from the sorts of blind alleys that classical physics got into because it allowed nonoperational concepts of space and time; or by showing that philosophy explains how so many traditional disputes are merely verbal; or by showing how it prevents us from being misled into metaphysical pseudotheses which cannot be corrected as easily as the merely verbal disputes.

The consistent working out of this view of philosophy within the positivistic framework requires a demonstration that the language of science can describe its own syntax. The language of science, as construed by Carnap, is the theoretically adequate language, i.e., it is the language in which everything sayable can be said. Only nonsense is excluded from among its sentences. The positivists assumed that the logical skeleton of the theoretically ideal language is the one depicted in *Principia Mathematica*. The logical skeleton, it was further assumed, was sufficient to account for the whole of pure mathematics, including pure geometry. But to get the full-fledged language of the empirical sciences, the *Principia* skeleton had to be filled out with some extralogical primitive terms and nontautological principles or rules, these being the syntactical correlates of what are ordinarily known as

physical laws. Now philosophical sentences could not fall outside the theoretically ideal language on pain of making philosophy into cognitive nonsense. Philosophical sentences were not to constitute, in other words, a class of sentences distinct from the sentences of theoretical discourse. Wittgenstein, in the *Tractatus*, had said that the sentences of philosophy are nonsensical: "My propositions are elucidatory in this way, he who understands me finally recognizes them as senseless when he has climbed out through them, on them, over them." This doctrine followed from Wittgenstein's view that the propositions of philosophical analysis cannot describe their own logical form. Philosophy is, therefore, the attempt to express the inexpressible. Russell, in his introduction to the *Tractatus*, had suggested that even if a language could not describe its own structure, there might be a hierarchy of languages such that for every language there would be one at a higher level capable of describing the logical form of the language below it.

The trouble with Russell's suggestion, from Carnap's point of view, would be that it rules out the possibility of a theoretically ideal language, the existence of which seems to have been taken for granted by logical positivists, especially Carnap. For at every level in the hierarchy, the same defect would recur. The language would not be able to talk about its own logical form, hence it would not be able to talk about everything sayable. And the defect of Wittgenstein's position was that it made philosophy into nonsense.

In order to sustain his view that philosophy, conceived as being the description of the logical syntax of the language of the factual (empirical) sciences, is a theoretical discipline, Carnap had to show that Wittgenstein was wrong. He took Wittgenstein to be saying that the ideal language cannot talk about its own syntax without contradiction. So in *Logische Syntax der Sprache* (1934),[5] he undertook to show that a language rich enough to contain elementary arithmetic can talk about its own logical form or syntax. It would be a corollary of this that the ideal theoretical language can consistently talk about its own syntax.

The form of language, Carnap said, is determined by two sorts of rules. One sort consists of formation rules, rules for forming the sentences of the language. The second sort consists of transformation rules, rules for deriving sentences from sentences. These two sorts of rules together exhaust syntax. Carnap showed that a language rich enough to contain mathematics and physics can talk about its own syntax without generating contradiction. Using a technique developed by Godel in 1931, Carnap "arithmetized" syntax[6] (for a popular exposition of arithmetization see James R. Newman and Ernest Nagel, *Goedel's Proof*, N.Y.U. Press, 1958, esp. pp. 68-84). The rules concerning the "range of possible language-forms and, consequently, of the various possible logical systems" (*The Logical Syntax of Language*, p. xiv), belong to combinatorial analysis, a part of arithmetic. The rules concerning a specific language belong to applied mathematics. (Carnap suggests that the former are to the latter what pure geometry is to physical geometry.) Thus, logical analysis yields sentences belonging to pure or to applied mathematics, and hence it may be held that philosophy is theoretically significant without being identical with factual science or with mathematical logic. It is not identical with science, for example, physics, because physics is first order talk about nature. Philosophy is second order talk about the language of physics. Philosophy is also not identical with mathematical logic because the language of physics is richer than that of pure mathematics. (This is true if mathematical logic is identified with the axiomatization and formalization of classical mathematics in purely logical terms. An example is W. V. Quine's *Mathematical Logic*, 1st ed., Harvard, 1940.)

Carnap said that logical syntax (or philosophy) could be in one of two modes of speech. The traditional philosophers, including the Greeks, were given credit for having engaged in philosophical activity at least part of the time, even though they seemed to be talking metaphysics. For example, they would say "Five is a number," making it sound as if they were talking about something outside of language. They were simply talking in the

"material mode of speech." Put in the "formal mode of speech," what they meant was that "'Five' is a numeral." This is clearly about language. Carnap was tolerant of the material mode. Only he warned against being misled by it into metaphysics. As long as the material mode was recognized for what it is, namely, an informal way of talking, but translatable into formal talk, there was no danger.

The distinction was part of Carnap's program of rounding out a consistent positivism. But the alleged equivalences were frequently howlers. For instance, Carnap translated the material mode sentence "The lecture treated of metaphysics" into the formal mode, "The lecture contained the word 'metaphysics.'"

A biography of Queen Victoria might state that she was altogether ignorant of metaphysics. The word "metaphysics" is contained in such a biography, but it is false that the book treats of metaphysics. Even if some of Carnap's translations are satisfactory, he would be begging the question if he insisted that therefore his translations into the formal mode of traditional metaphysical statements in the material mode are correct and convey precisely what the metaphysician meant to say.

Besides using it as a reason to say that what positivism was doing was continuous with the philosophical tradition, Carnap used the material-formal distinction to escape the need of admitting that, at least at the level of protocols, language and reality are related and the relation has to be mentioned in philosophical statements. In "Physics as a Universal Language" (reprinted below), Carnap writes in the material mode: "The simplest statements in the protocol-language refer to the given, and describe directly given experience or phenomena, i.e., the simplest states of which knowledge can be had." Now this is talking about the relation of language and what lies outside language. But not really. For the same thing can be said in the formal mode: "The simplest statements in the protocol-language are protocol-statements, i.e., statements needing no justification and serving as foundation for all the remaining statements of science."

But why are these particular classes of protocols the ones serving as the foundation? The usual answer would be that they seem to be the ones we cannot do without if we are to have a language adequate to talk about what we experience. Consistent to the last, Carnap gives no such "metaphysical" answer. He says the basic protocols are chosen by convention. But this is hard to believe. In his Philosophical Analysis, J. O. Urmson has written a nice epitaph to this phase of logical positivism:

> When Carnap says "Protocol statements are of the same kind as: 'joy now,' 'here, now, blue,' 'there, red,' " Carnap means, or ought to mean, that all protocol sentences are of the same syntactical type as "joy, now" and the rest. He does not mean, officially at any rate, statements which as directly report reality as does "joy, now," but statements to which the same rules for the formation of sentences and their transformation into others apply. Bearing this in mind, we ought immediately to ask two obvious questions: Why does Carnap choose sentences of this syntactical form rather than any others to fulfill this particular basic role in language? And on what principle does one decide which of these protocols of the right syntactical form to accept and which to reject? Carnap cannot give the obvious answers because statements of this syntactical form are the kind which we use to report experience; and we select those for acceptance which do as a matter of fact record experience accurately. For according to Carnap to say that a statement is of the kind which reports experience is just to say, in the material mode, that it is of this syntactical form.
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> The well-nigh incredible answers in fact given are these. It is purely a matter of convention that we select sentences of this syntactical form as the basic protocol

> statements; and we accept those protocols which are accepted by the accredited scientists and reject those which are not. Carnap says, for example, "Every concrete proposition belonging to the physicalist language-system can in suitable circumstances serve as a protocol proposition." We could go on now to ask why we accept the protocols of accredited scientists, why they are accredited, and how we know within syntax that these or those are accepted by accredited scientists. But it is clearly not worth while to pursue this theory further. Philosophy cannot just be logical syntax, nor can a language be characterized by a vocabulary understood as a list of marks on paper with formation and transformation rules. Carnap and his fellows probably did as well as can be done by this thesis. But it is impossible; they could only make it appear plausible by relying on the natural meaning of what was supposed to be merely syntax in the material mode of speech. Carnap, of course, came to see this. He now acknowledges, and writes on, a branch of philosophy which he calls semantics and which deals with this forbidden topic of the relation of words to things. But on the credit side of the Carnap of other days it must be said that he was one of the few in the period of classical logical empiricism who honestly faced the need to maintain consistently that philosophy consisted solely of tautological transformations, of analytical equivalences. But for his errors the need for some revision of the doctrine would not have been seen so quickly.[7]

By 1935, however, Carnap had modified his views on this point so that remarks like Urmson's are relevant only to a relatively short period in Carnap's philosophical development. In "Truth and Confirmation," he allows that a statement may be "compared with fact" if by this we understand the operation of "confronting" a statement with the facts confirming it. This operation he restricts to what he calls "directly testable" statements, and these he roughly characterizes in terms of conceivable circumstances (observations) in which the statement in question would be considered so strongly confirmed or disconfirmed on the basis of one or very few observations that we would either accept or reject it outright. These statements are the counterparts of what earlier the Vienna Circle called "protocol statements."

The unity of science is another tenet characteristically associated with logical positivism. The thesis has two parts. One says that all the specific sciences, for example, physics, chemistry, biology, and psychology have a common vocabulary. In "The Physical Language as the Universal Language of Science," Carnap identifies the common language as the physical language. This is the language in which "statements of the simplest form . . . attach to a specific set of co-ordinates (three space one time co-ordinates) a definite value or range of values of a coefficient of physical state." This is not identical with the language of current physics. For physics may alter (for instance, quantum theory, which is now "probabilistic" may become "deterministic"), while the physical language still remains the one containing the basic scientific vocabulary. This at least is Carnap's claim in "The Physical Language as the Universal Language of Science." The second part of the unity of science program claims that all the laws of all the sciences are presumably derivable from physical laws. But this is only a presumptive hope. Its truth or falsehood, Carnap says, can be determined only by waiting to see how the sciences in fact develop.

To illustrate the thesis of physicalism and to argue that it is in principle a plausible position, Carnap proposes a way of translating a psychological statement, for example, "Jones is in pain," into a statement about the observable states of Jones's body, including the sounds Jones makes. The notion of "translation" in question is a special one. The translating sentence need not be logically equivalent to the translated sentence. Carnap's physicalism does not require that "Jones is in pain" be logically equivalent to "Jones's

body is in state S." It is sufficient that there be a scientific law to the effect that someone is in pain if, and only if, his body is in state S. Then, from someone's being in pain together with the law, we can deduce his being in state S; and from his being in state S together with the law, we can deduce his being in pain. It is in this sense that "Jones is in pain" and "Jones's body is in state S" are translations (analyses) of one another although they are not logically equivalent statements. Carnap invokes the verifiability criterion of cognitive meaning in arguing that such translation is in principle possible. For, if a psychological statement such as "Jones is in pain" were not directly or indirectly verifiable, it would have no cognitive meaning, hence could not be a sentence belonging to (scientific) psychology.

This theory, however, leads to a serious difficulty. The verifiability criterion implies that two synthetic sentences have the same cognitive meaning if, and only if, they are both true or both false under the same circumstances. If it were a law that a person is in pain if, and only if, his body is in a state S, then the psychological statement, "Jones is in pain," would be true or false under the same circumstances as the physical statement, "Jones's body is in state S." Hence the two sentences would have the same cognitive meaning. This would be sufficient for saying that they are translations of one another even though they are not logically equivalent. However, the reader may wonder as to how we are to arrive at the needed scientific laws. On the usual view, an invariant correlation between matters of fact may be discovered by observing that (at least) two variables are functionally interdependent. For example, we observe that an object looks red in sunlight if, and only if, it emits such and such wave lengths. The possibility of discovering such a matter-of-fact correlation presupposes that we understand the color-word "red" and we understand it as not having the same meaning as the phrase "emits waves of such and such length." But in Carnap's view in "Philosophy and Logical Syntax," the cognitive meaning of "Jones is in pain" is that Jones's body is in state S. That is to say, "Jones is in pain" has no independent cognitive meaning. How, then, can we discover an invariant correlation between pain and the state S?

Since 1935, Carnap has broadened his earlier tendency to restrict philosophy to "syntax" to include semantical investigations. "Truth and Confirmation" is a harbinger of this new emphasis. In this new spirit, he published a classic monograph, "Testability and Meaning" (1936) in which he did some pioneer work in the analysis of dispositional predicates such as "soluble," "malleable," and so on. His most intensive work in recent years, however, is concerned with constructing a logic of probability and induction that he hopes will make explicit the fundamental presuppositions of scientific method and the foundations of statistics, a branch of mathematics. Carnap's theory of induction is the major alternative to Reichenbach's "frequency theory" of probability. If Carnap succeeds in carrying out his program, his contributions may bring about unsuspected innovations in scientific procedures together with a better understanding of their fundamental presuppositions.

References

1. This book is discussed in some detail in Nelson Goodman's *The Structure of Appearance*, Cambridge, Mass., Harvard University Press, 1951, pp. 114-146.

2. For a popular exposition, see *Albert Einstein, Relativity*, London, Methuen, 1920, Chap. 8; see also P. W. Bridgman, "The Logic of Modern Physics," 1927.

3. Rudolf Carnap, "Uberwindung der Metaphysik durch Logische Analyse der Sprache," *Erkenntnis* , 2 (1931) (English translation in A. J. Ayer, ed., *Logical Positivism*, New York, The Free Press of Glencoe, 1959).

4. See Schlick, “Is There a Factual a Priori?” Wilfrid Sellars (trans.), in H. Feigl and W. Sellars (eds.), *Readings in Philosophical Analysis*, New York, Appleton-Century-Crofts 1949 (first published in Wissenschaftlicher Jahresbericht der Philosophischen Gesellschaft an der Universitat zu Wien fur das Vereinsjahr, 1930-1931).

5. The English translation appeared as Rudolf Carnap, *The Logical Syntax of Language*, New York, Harcourt, Brace & World, Inc., 1937. *Rudolf Carnap, Philosophy and Logical Syntax*, London, George Routledge & Sons, 1934, reprinted here is a popular digest of some of the main themes of that book.

6. For a popular exposition of arithmetization see James R. Newman and Ernest Nagel, *Goedel's Proof*, New York, New York University Press, 1958, esp. pp. 68-84; shorter versions of this monograph are in *Scientific American*, 6 (June, 1956); and James R. Newman, *The World of Mathematics*, New York, Simon and Schuster, 1956, vol. 3, esp. pp. 1688-1691.

7. J. O. Urmson, *Philosophical Analysis*, Oxford, Oxford University Press, 1956, p. 125.

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