On the Character of Philosophic Problems[1] (1934)

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PHILOSOPHY IS THE LOGIC OF SCIENCE

Philosophers have ever declared that their problems lie at a different level from the problems of the empirical sciences. Perhaps one may agree with this assertion; the question is, however, where should one seek this level. The metaphysicians wish to seek their object *behind* the objects of empirical science; they wish to enquire after the essence, the ultimate cause of things. But the logical analysis of the pretended propositions of metaphysics has shown that they are not propositions at all, but empty word arrays, which on account of notional and emotional connections arouse the false appearance of being propositions. This conception that the "propositions" of metaphysics, including those of ethics, have no theoretical content, is to be sure still disputed. We shall not, however, enter here on its demonstration,

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[1] Translated by W.M. Malisoff. Attention is called to the following choices taken by the translator:—*Auffassung* has been rendered variously as interpretation, conception, position; *Folgerung* as deduction, conclusion, inference, but in conformance with the discussion, most often as entailment. *Gehalt* which may mean value, has been rendered only as *content*; *Inhalt* as meaning; but *inhaltlich* as *connotative*, rather than *strict* or *meaningful* or *intensional*, which may convey as much.

but, under its guidance, will limit ourselves to non-metaphysical and non-ethical (non-evaluating) philosophical problems.

In order to discover the correct standpoint of the philosopher, which differs from that of the empirical investigator, we must not penetrate *behind* the objects of empirical science into presumably some kind of transcendent level; on the contrary we must take a *step back* and *take science itself as the object. Philosophy is the theory of science* (wherein here and in the following "science" is always meant in the comprehensive sense of the collective system of the knowledge of any kind of entity; physical and psychic, natural and social entities.) This must be appraised more closely. One may consider science from various viewpoints; e.g. whether one can institute a psychological investigation considering the activities of observation, deduction, formulation of theories, etc., or sociological investigations concerning the economical and cultural conditions of the pursuit of science. These provinces—although most important—are not meant here. Psychology and sociology are empirical sciences; they do not belong to philosophy even though they are often pursued by the same person, and have torn loose from philosophy as independent branches of science only in our times. Philosophy deals with science only from the *logical* viewpoint. *Philosophy is the logic of science,* i.e., the logical analysis of the concepts, propositions, proofs, theories of science, as well as of those which we select in available science as common to the possible methods of constructing concepts, proofs, hypotheses, theories. [What one used to call epistemology or theory of knowledge is a mixture of applied logic and psychology (and at times even metaphysics); insofar as this theory is logic it is included in what we call logic of science; insofar, however, as it

is psychology, it does not belong to philosophy, but to empirical science.]

The interpretation that philosophy is the logic of science is not to be justified here. It has been represented previously and is represented now by various philosophic groups, amongst others also by our Vienna circle. With this thesis the question as to the character of philosophic problems is not by any means already solved. Very much comes into question right at this point. We should consequently ask here: what character, what logical nature, do the questions and answers of the logic of science have? For those who are with us in the conception that philosophy is the logic of science the question of the character of philosophic problems will be answered thereby as well.

ARE THE PROPOSITIONS OF THE LOGIC OF SCIENCE MEANINGLESS?

Our antimetaphysical position has been formulated by Hume in the classical manner:—

> "It seems to me, that the only objects of the abstract science or of demonstration are quantity and number, and that all attempts to extend this more perfect species of knowledge beyond these bounds are mere sophistry and illusion. As the component parts of quantity and number are entirely similar, their relations become intricate and involved; and nothing can be more curious, as well as useful, than to trace, by a variety of mediums their equality or inequality, through their different appearances. But as all

other ideas are clearly distinct and different from each other, we can never advance farther, by our utmost scrutiny, than to observe this diversity, and, by an obvious reflection, pronounce one thing not to be another. Or if there be any difficulty in these decisions, it proceeds entirely from the undeterminate meaning of words, which is corrected by juster definitions."—Hume, An Enquiry Concerning Human Understanding, XII, 3.

Against this the following objection, which on first appearance seems indeed destructive, has been repeatedly raised:—"If every proposition which does not belong either to mathematics or to the empirical investigation of facts, is meaningless, how does it fare then with your own propositions? You positivists and antimetaphysicians yourselves cut off the branch on which you sit." This objection indeed touches upon a decisive point. It should be of interest to every philosopher as well as metaphysician to comprehend the character of the propositions of the logic of science; but to the antimetaphysician, who identifies philosophy and the logic of science, this is the *deciding question*, upon the satisfactory answer of which the security of his standpoint depends.

Wittgenstein has represented with especial emphasis the thesis of the meaninglessness of metaphysical propositions and of the identity of philosophy and the logic of science; especially through him has the Vienna circle been developed on this point. How now does Wittgenstein dispose of the objection that his own propositions are also meaningless? He doesn't at all; he agrees with it! He is of the opinion that the non-metaphysical *philosophy* also has no propositions; it operates with words, *the meaninglessness of*

which in the end it itself must recognize:—

> "Philosophy is not a theory but an activity. A philosophical work consists essentially of elucidations. The result of philosophy is not a number of "philosophical propositions," but to make propositions clear." (p. 77)

> "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. (He must so to speak throw away the ladder, after he has climbed up on it.) He must surmount these propositions; then he sees the world rightly. Whereof one cannot speak, thereof one must be silent." (p. 189, Tractatus Logico-philosophicus)

We shall try in the following to give in place of this radically negative answer a *positive answer* to the question of the character of the propositions of the logic of science and thereby of philosophy.

CONNOTATIVE AND FORMAL CONSIDERATION

(Inhaltliche und formale Betrachtung)

To construct science means to construct a system of propositions which stand in certain fundamental coherence with one another. The logic of science is thus the logical analysis of this system, of its elements and of the methods

of tying these elements. In such an analysis we can start from but two different viewpoints; we shall call them connotative (inhaltlich) and formal.

It is usual in the logic of science to put something like the following and similar questions: What is the meaning of this or that concept? In what relation does the meaning of this concept stand with respect to that? Is the meaning of this concept more fundamental than of that? What meaning (Inhalt, Gehalt) does this proposition have? (Or: What does this proposition say?) Is the meaning of this proposition contained in the meaning of that? Does this proposition say more than that? Is what this proposition asserts, necessary or contingent or impossible? Is what these two propositions say compatible?

All these questions refer to the *meaning* of concepts and propositions. We call them therefore questions of meaning or of *connotation* (inhaltliche). In contrast to this we understand by *formal* questions and propositions such as relate only to the formal structure of the propositions, i.e. to the arrangement and kind of symbols (e.g. words) out of which a proposition is constructed, *without reference to the meaning* of the symbols and propositions. Formal (in the sense here defined) are e.g. (most of) the rules of grammar.

According to prevalent conception the connotative questions of the logic of science are much richer and fruitful than the formal; though the formal do belong to the logic of science, they are at most a small, insignificant section. But this opinion is wrong. The logic of science can progress without exception according to the formal method without thereby restricting the wealth of questioning. It is possible in case of purely formal procedure, that is from a viewpoint in which one does not reckon with the meaning, finally

to arrive to the answering of all those questions which are formulated as connotative questions. This possibility is to be shown illustratively in the following. Therewith the question of the character of *philosophy as logic of science* is answered: it is *the formal structure theory of the language of science,*—we shall call it: The logical syntax of the language of science.

LOGICAL SYNTAX OF LANGUAGE

By the "logical syntax" (or also briefly "syntax") of a language we shall understand the *system* of the *formal* (i.e. not referring to meaning) *rules* of that language, as well as to the consequences of these rules. Therein we deal first with the *formative rules* (Formregeln) which decree how from the symbols (e.g. words) of the language propositions can be built up, secondly with the *transformation rules* (Unformungsregeln), which decree how from given propositions new ones can be derived. If the rules are set up strictly formally they furnish mechanical operations with the symbols of the language. The formation and transformation of propositions resembles chess: like chess figures words are here combined and manipulated according to definite rules. But thereby we do not say that language is nothing but a game of figures; it is not denied that the words and propositions have a meaning; one merely averts methodically from meaning. One may express it also thus: *language* is treated as a *calculus*.

That the formal, calculus-like representation of the formative rules is possible is evident. What linguists call rules of syntax are indeed such formal

(or at least formally expressible) rules for the formation of propositions. We can see, however, clearly that the transformation rules, which one usually calls logical rules of deduction, have the same formal, that is, syntactical character. (And that is the reason why we call the combined system of rules syntax, in widening the terminology of linguists). Since Aristotle the efforts of logicians (more or less consciously) were directed toward formulating the deductive rules as formally as possible, i.e. possibly so that with their help the conclusion could be "calculated" mechanically from the premisses. This was attained first in a strict manner only in modern symbolic logic; the traditional logic was too much hindered by the defect of the language of words.

For a certain part of the language of science we already know a strictly formal theory, namely *Hilbert's* mathematics. It considers the symbols and formulas of mathematics without reference to meaning, in order to investigate relations of deducibility, sufficiency, consistency, etc. This mathematics is hence (in our manner of expression) the logical syntax of mathematical language. The logical syntax of the language of science meant here is an analogous extension with reference to the language of all of science.

One of the most important concepts of logic and thereby of the logic of science is that of (logical) inference (Folgerung-entailment). Can this concept be formulated purely formally? It is often stated that the relation of entailment depends on the meaning of the propositions. In a certain sense we can agree with that; for when the meaning of two propositions is known, it is thereby determined whether one is the entailment of the other or not. The decisive point, however, is: is it also possible to formulate the concept

"entailment" purely formally? If the transformation rules of language are set up purely formally, we call a proposition an inference (entailment) of other propositions if it can be constructed from those propositions by the application of the transformation rules. The question, whether a certain proposition is an inference (entailment) of certain other propositions or not, is therefore completely analogous to the question whether a certain position in chess can be played from another or not. This question is answered by chess theory, i.e. a combinatorial or mathematical investigation which is based on the chess rules; that question is thus a formal one, it is answered by a *Combinatorial Calculus or Mathematics of Language,* which rests on the transformation rules of language, that is what we have called the *syntax* of language. Briefly: "entailment" is defined as deducibility according to the transformation rules; since these rules are formal, "entailment" is also a formal, syntactical concept.

The concept "entailment" is, as *Lewis* has correctly seen, quite different from the concept of "(material) *implication.*" (Russell, Principles of Mathematics). Implication does not depend on the sense of the propositions, but only on their *truth-value*; but entailment on the contrary is note quite determined by the truth values. From this, however, one may not conclude that in the determination of entailment reference to the *meaning* is necessary; it suffices to refer to the formal structure of the propositions.

THE CONTENT OF A PROPOSITION

On the basis of the concept "entailment" one can define the following classification of propositions which is fundamental to the logic of science. A proposition is called *analytic* (or tautological) if it is an entailment of every proposition (more exactly: if it is deducible without premisses, or is the entailment of the empty class of propositions). A proposition is called *contradictory* if any proposition at all is its entailment. A proposition is called *synthetic* if it is neither analytical nor contradictory. Example: "It is raining here" is synthetic; "It is raining or it is not raining" is analytic; "It is raining and it is not raining" is contradictory. An analytic proposition is true in every possible case and therefore does not state which case is on hand. A contradictory proposition on the contrary says too much, it is not true in any possible case. A synthetic proposition is true only in certain cases, and states therefore that one of these cases is being considered,—all (true or false) statements of fact are synthetic. The concepts "analytic," "contradictory," "synthetic" can be defined in analogous manner also for classes of propositions; several propositions are said to be *incompatible* (unverträglich) with one another, if their class is contradictory.

And now we come to the principal concept of the logic of science, the concept of the (Inhalt) content of a proposition. Can this central concept of the connotative (inhaltliche) method of consideration be formulated purely formally also? We can be easily convinced that that is possible. For what, to be sure, do we want to know when we ask concerning the content or meaning of a proposition S? We wish to know what S conveys to us; what we experience through S; what we can take out of S. In other words: we ask what we can

deduce from S; more accurately: what propositions are entailments of S which are not already entailments of any proposition at all, and therefore declare nothing. We define therefore: by the *content* (Gehalt) of a proposition S we understand the class of entailments from S which are not analytic. Thereby the concept "Gehalt" is connected to the syntactical concepts defined earlier; it is then also a syntactic, a purely formal concept. From this definition it is apparent that the content of an analytic proposition is empty, since no non-analytic proposition is an entailment of it. Further, that the content of S_2 is obtained from that of S_1 when and only when S_2 is an entailment of S_1; that two propositions are of equal content when and only when each is the entailment of the other. Thus the defined concept "Content" corresponds completely to what we mean when we (in a vague manner) are accustomed to speak of the "meaning" (Inhalt) of a proposition; at any rate, insofar as by "meaning" something logical is meant. Often in the investigation of the "meaning" or "sense" of a proposition one also means: What does one think of or imagine in this proposition? This, however, is a psychological question with which we have nothing to do in a logical investigation.

CONNOTATIVE AND FORMAL MODES OF EXPRESSION

(Inhaltliche und formale Redeweise)

We have set out from the fact that a language can be considered in two different ways: in a connotative and in a formal manner. Now, however, we have established that with the aid of the formal method the questions of

the connotative approach can also be answered finally. Fundamentally really there is no difference between the two approaches, but only a difference between two modes of expression: in the investigation of a language, its concepts and propositions and the relations between them, one can employ either the connotative or the formal mode of expression. The connotative mode of expression is more customary and obvious; but one must use it with great care, it frequently begets muddles and pseudo-problems. We shall consider several examples of propositions in connotative form and their translation into formal mode of speech; in the case of several of these examples (6a-10a) only on translation do we see that we are dealing with assertions concerning the language.

	Connotative Mode of Speech		*Formal Mode of Speech*
1a.	The propositions of arithmetical language give the properties of numbers and relations between them.	1b.	The propositions of arithmetical language are constructed in such and such a manner from predicates of one or more values and number expressions as arguments.
2a.	The expression '5' and '3+2' mean the same number.	2b.3b.	The expressions '5' and '3+2' are synonymous in the arithmetical language (i.e. always interchangeable with one another).
3a.	'5' and '3+2' do not mean the same number but two equal numbers.		

On the basis of the connotative formulation *1a* there arise easily a number of metaphysical pseudo-problems concerning the nature of numbers, whether the numbers are real or ideal, whether they are extra- or intramental and the like. The danger of these pseudo-problems disappears when we use the formal mode of expression, where we speak of "number expressions" instead

of "numbers." Also the philosophic conflict between *2a* and *3a* disappears in the formal mode of expression: both theses have the same translation.

4a.	The word "luna" of the Latin language signifies the moon.	4b.	On the basis of the syntactical translation rules between the Latin and the English languages the word "moon" is coödinated with the word "luna."
5a.	The concept "red" signifies an ultimate quality; the concept "man" has a more ultimate meaning than the concept "grandson."	5b.	The word "red" is an undefined fundamental symbol of language; the word "man" stands on a lower level that the word "grandson" in the definition of family-tree concepts.
6a.	The moon is a thing; the sum of 3 and 2 is not a thing but a number.	6b.	"Moon" is the designation of a thing; "3 + 2" is not a designation of a thing but a designation of a number.
7a.	A property is not a thing.	7b.	A property-word is not a thing-word.
8a.	This particular (fact, event, condition) is logically necessary: ...logically impossible; ...logically possible.	8b.	This proposition is analytic; ...contradictory; ...not contradictory.
9a.	This particular (fact, event, condition) is physically necessary; ...physically impossible; ...physically possible.	9b.	This proposition is deducible from the class of physical laws; ...is incompatible with ...; ...is compatible....
10a.	Reality consists of facts, not of things.	10b.	Science is a system of propositions, not of names.

PHILOSOPHY IS THE SYNTAX OF THE LANGUAGE OF SCIENCE

We had started with the presupposition: Philosophy of Science is the logic of science, the logical analysis of concepts, propositions, structures of propositions of science. Since now the data of every logical analysis can be

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translated in the formal mode of expression, all the questions and theorems of philosophy consequently find their place in the formal structure theory of language, that is, in the realm which we have called the Syntax of the language of Science. Here it must, however, be noted that a philosophic theorem, formulated as a proposition of syntax, can be meant in different ways:

A. As *Assertion;* e.g.

1. In the language of science available today (or a part of it: of physics, biology, . . .) such and such holds.

2. In every language (or: in every language of such and such a nature) such and such holds.

3. There is a language for which such and such holds.

B. As *Proposal;* e.g.

1. I propose to build up the language of science (or of mathematics, of psychology, . . .) so that it acquires such and such properties.

2. I wish (along with other things) to investigate a language which possesses such and such properties.

The common confusion in philosophic discussions, not only among metaphysicians but also in the philosophy of science, is principally called forth by lack of a clear conception that the object of discussion is the language

of science; and further because one does not clearly state (and mostly does not know oneself) whether a thesis is meant as an assertion or as a proposal. Let us consider, for example, in the discussion of the logical foundations of mathematics a point of conflict between the logisticists (Frege, Russell) and the axiomatists (Peano, Hilbert); let the theses be formulated by 12a, 13a. Then we translate the theses in order to formulate them more exactly into the formal mode of expression: 12b, 13b.

| 12a. | The *numbers* are classes of classes of things. | 12b. | The number-symbols are class symbols of second rank. |
| 13a. | The numbers are unique ultimate entities. | 13b. | The number-symbols are individual-symbols (i.e. symbols of null rank, which appear only as arguments). |

If now we interpret 12b and 13b in the manner A_3, the conflict disappears: one can say that a language of arithmetic is constructible which has the property 12b; but also one as well which has the property 13b. But perhaps the theses 12b, 13b are meant as proposals in the sense B_1. In that case one is not dealing with a discussion about true or false, but with a discussion as to whether this or that mode of expression is simpler or more pertinent (for certain purposes of a scientific methodical nature). In any case the discussion is oblique and fruitless as long as the discussers do not agree as to which of the interpretation A or B is meant. The situation is similar with regard to the philosophical combat concerning the theses 14a, 15a:

| 14a. | To the ultimate given belong relations. | 14b. | To the undefined fundamental signs belong two- (or more-) valued predicates. |
| 15a. | Relations are never given ultimately but depend always on the nature of the members of the relation. | 15b. | All two- or more-valued predicates are defined on the basis of one-valued predicates. |

The discussion becomes clear only when 14b and 15b are considered as proposals; the problem then consists of putting up languages of this or that form and to compare them to one another.

In the following example we deal with the conflict of two theses 16a, 17a, which correspond more or less to positivism and to realism.

16a.	*A thing* is a complex of sensations.	16b.	Every proposition in which a thing-name occurs, is of equal content with a class of propositions in which no thing-names but sensation-names occur.
17a.	A thing is a complex of atoms.	17b.	Every proposition in which a thing-name occurs is of equal content with a proposition in which no thing names but space-time coördinates and physical functions occur.

16b, 17b can be interpreted here in the sense A_1, namely as assertions concerning the syntactical structure of our language of science. In spite of that they do not contradict one another; since a proposition concerning a thing can be transformed in more than one way with equal content. We see: in using the formal mode of expression the pseudo-problem "What is a thing?" disappears, and therewith the opposition between the positivist and the realist answer disappears.

If we represent the position that all philosophical problems are questions of the syntax of the language of science, we do not mean it to be a proposal or even a prescription for limitation to a definite, seemingly very narrow field of questions. Much more is meant: as soon as one exactly formulates some question of philosophy as logic of science, one notes that it is a question of the logical analysis of the language of science; and further investigation then

teaches that each such question allows itself to be formulated as a formal question, to wit a question of the syntax of the language of science. All theorems of philosophy take on an exact, discussable form only when we formulate them as assertions or proposals of the syntax of the language of science.

THE PROBLEM OF THE FOUNDATIONS OF THE SCIENCES

In order to make clearer our position concerning the character of philosophic problems, we shall cast a brief glance on the problems which one customarily designates as the philosophic foundation problems of the individual sciences.

The philosophic *problems of the foundations of mathematics* are the questions of the syntax of mathematical language, and to be sure not as of an isolated language, but as of a part language of the language of science. This addendum is important. The logistic trend (Frege, Russell) is right in the demand that the foundation laying of mathematics must not only construct the mathematical calculus but also must make clear the meaning of mathematical concepts, since the application of mathematics to reality rests on this meaning. We restate it in formal mode of speech: mathematical concepts attain their meaning by the fact that the rules of their application in empirical science are given. If we investigate not only the syntactical rules of mathematical language merely, but also the rules which relate to the appearance of mathematical symbols in synthetic propositions, we formulate thereby the

meaning of mathematical concepts (e.g. the meaning of the symbol "2" is formulated by establishing how this symbol can appear in synthetic propositions, and according to what rules such propositions can be derived from propositions without number expressions. If a rule is set up with the aid of which one can derive from the proposition "In this room there are Peter and Paul and otherwise no person" the proposition "In this room there are 2 people," the meaning of "2" is established by that rule).

The *problems of the foundations of physics* are questions of the syntax of physical language: the problem of the verification of physical laws is the question concerning the syntactic deductive coherence between the physical laws (i.e. general propositions of a certain form) and the protocol propositions (singular propositions of a certain form); the problem of induction is the question whether and which transformation rules lead from protocol propositions to laws; the problem of the finitude or infinity and other structure properties of time and space is the question concerning the syntactical transformation rules with reference to number expressions which appear in the physical propositions as time and space coordinates; the problem of causalty is the question concerning the syntactical structure of the physical laws (whether unique or probability functions) and concerning a certain property of completeness of the system of these laws (determinism-indeterminism).

The philosophical *problems of the foundation of biology* refer above all to the relation between biology and physics. Here the following two problems are to be distinguished:

1. Can the concepts of biology be defined on the basis of the concepts of physics? (If yes, the language of biology is a part language of physical

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language).

2. Can the laws of biology be derived from the laws of the physics of the inorganic? The second question forms the kernel of the vitalism-problem, if we purge this problem from the usual metaphysical admixtures.

Among the *problems of the foundations of psychology* there are analogously to the above-mentioned: 1. Can the concepts of psychology be defined on the basis of the concepts of physics? 2. Can the laws of psychology be derived from those of physics? The so-called psycho-physical problem is usually formulated as a problem of the relation of two object-realms: the realm of psychic events and the realm of physical events. But this formulation leads to a maze of pseudo-problems. In using the formal mode of expression it becomes clear that one is dealing only with the relation of both part-languages, that of psychology and that of physics, and to be sure more accurately with the manner of the syntactical derivation relations (translation rules) between the propositions of both these languages. With the formulation of the psycho-physical problem in the formal mode of expression the problem surely is not yet solved; it may still be quite difficult to find the solution. But at least the necessary condition is satisfied whereby a solution may be sought: the question at least is put clearly.

A point of principle must now be noted so that our position will be understood correctly. When we say that philosophical questions are question of the syntax of the language of science which permit expression in a formal mode of speech, we do not say thereby that the answers to these question can be found by a mere calculating about with logical formulas without recourse to experience. A proposal for the syntactical formulation of the language of

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science is, when seen as a principle, a proposal for a freely chosable convention; but what induces us to prefer certain forms of language to others is the recourse to the empirical material which scientific investigation furnishes. (It is e.g. a question of convention whether one takes as the fundamental laws of physics deterministic or statistical laws; but only by attention to the empirical material, syntactically put: to the protocol propositions, can we decide with which of these two forms we can arrive at a well correlated, relatively simple construction of a system.) From this it follows that the task of the philosophy of science can be pursued only in a close cooperation between logicians and empirical investigators.

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