DIVISION E: THE PHILOSOPHY OF SCIENCE AND ANALYTIC PHILOSOPHY:
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Problem (a): *Analytic Philosophers' View of Science: An Appraisal*

I

If it is true that every major development of knowledge produces sooner or later its tailor made system of philosophy, then the rise of analytic philosophy should be viewed as a natural consequence of the predominantly experimental and analytic attitude of twentieth-century science. As Professor Whitehead once said, new physics produces new metaphysics.

It is a simple truth that the verbal apparatus, in order to serve a useful purpose, has to follow the development of factual knowledge. The common-sense knowledge and the Weltbild of classical physics were expressed in a language which revealed itself under close scrutiny as too loose and too vague for modern science. Various attempts were made to change the situation. The overall goal was always the same: the building-up of a coherent, homogeneous system of notions reducible to the simplest possible set of fundamental propositions i.e. axioms. In general, one of two allied approaches was chosen. One, purely logical, resulted in the construction of various systems of symbolic logic. The other was chosen by mathematical scientists, who began to reduce to axioms the whole body of mathematical knowledge. In line with this, experimental scientists, such as P. W. Bridgman for instance, attempted to build a scientific language through the exclusive use of operational terms. It is against this general background that we have to view the vast and complex movement of analytic philosophy.

We shall limit this paper to the discussion of views common to Russell, Wittgenstein, the Vienna Circle and their American followers.

From the philosophical point of view analytic doctrines were the result of a revolt against transcendental idealism. However the situation was complicated by the inability or unwillingness of analytic philosophers to make a clean break from idealism. The revolt, so loudly proclaimed, did not go far enough to protect the new philosophy from dependence on idealism. One of the cornerstones of analytic philosophy, for instance, became the Kantian distinction between analytic and synthetic judgments. The result was a system or rather a program for a system of neo-positivism. Outwardly it was a mixture of empiricism, nominalism and materialism; it was based however, on subjective idealism.

This heterogeneous creation was to be used for the analysis and explanation of scientific knowledge. Out of it an adequate philosophy of science had to develop. Applied to reality at large, it was supposed to produce a coherent scientific world picture.

The empirical criterion of objectivity and of the value of knowledge led to the introduction of verifiability as the criterion of meaning. In its original, most drastic form, this criterion stated that a sentence can be true only when it is meaningful. It is meaningful if, and only if it is

verifiable. Verifiability is in turn identified with perception, perception with sense knowledge. This meant that the only truly meaningful propositions were atomic statements about singular material objects or events. We must admit that Ockham himself could not have done a better job.

The ostracizing effects of the criterion as so formulated proved untenable and forced the analytic philosophers to dull the razor's edge more than once. However many of its far reaching effects remained as inseparable parts of the system. Roughly speaking, these effects fall into three groups: a) those pertaining to the general characteristics of this philosophy, b) epistemological consequences, and c) a metaphysical thesis. Since the criterion of meaning is in effect the pivot of the analytic philosophies under consideration we propose to concentrate in the rest of this paper on the study of the epistemological consequences. We shall also briefly mention the two other kinds of effects.

II

With sense perception as the source of meaning the Analysts were willing to accept only matter-of-fact scientific propositions. This led to an extremely technical and "scientific" form of writing. But much more serious was the resolute exclusion of value judgment and of the very notion of value. Consistent with the criterion of meaning, it gave in effect an utterly dehumanized, antihumanistic philosophy, fit for robots rather than for men.

If we now turn to the epistemological consequences of the said criterion, the most notable result is a nominalistic theory of concepts. Two important aspects of this theory have to be underlined: a) the comprehension of concepts is reduced to their extension, b) the relation between concepts and the things signified by them is purely extrinsic. As a result, all modes and levels of knowledge are reduced to one, namely the empirical knowledge of singular facts. A natural consequence is the bold thesis that there exists a horizontal unity of science. Interesting and convenient though it was, this thesis proved untenable and had to be abandoned.

Although the reduction of meaning to verification and of perception to sensation was done in the name of realism, with the desire of finding a concrete basis for factual knowledge, it was actually a well camouflaged epistemological pitfall. Its natural result was solipsism, especially apparent in the doctrines of Wittgenstein and, to a lesser extent, in Logical Positivism. The underlying subjectivism explains the concern of analytic philosophers with the product of our knowledge, namely language. We are not therefore astonished to hear the Vienna Circle declare that the purpose of philosophy is "to analyse notions and statements by means of logical analysis". In other words, philosophy was not to search for truth nor to discover truth. Its role was to inquire into the meaning of propositions established by science.

Strange as it may seem, this thesis results logically from the empirical criterion of meaning. Knowledge is classified into two groups: a) factual, productive knowledge which reveals something new about reality and whose contents are expressed by synthetic propositions; b) properly intel-

lectual knowledge, abstract and theoretical, which is best exemplified by mathematics. The latter is made up of analytical propositions considered as tautologies. In themselves, these tautologies are neither true nor false. They do not directly apply to reality.

If mathematics is the domain of abstract intellectual knowledge and of analytic propositions, then synthetic propositions and empirical cognition must belong to another class of science. Thus Analysts divided all sciences into two groups: mathematical and experimental.

Since empirical knowledge is declared the only source of factual knowledge, experimental science becomes the only valid source of verifiable propositions. The only way to know reality is through experimental science. But experimental sciences are many in number and differ appreciably among themselves. So it was necessary to set up an ideal of experimental science to which all empirical studies should conform and by which they would be measured. The ideal was thought to be best realized in physics, and physics was declared *The* experimental science. It is not difficult to understand why this science was preferred to any other. Physics is more homogeneous than other natural sciences, due to its almost entirely quantitative approach. It also is more formalized and less descriptive than the others, less dependent on qualitative judgments of the human observer.

Although the very choice of physics as the model of experimental science gives little ground for dispute, yet the consequences of this choice, drawn by the Analysts, are quite unacceptable. Having identified reality with its measurable, i.e. quantitative, aspect, they rejected the notion of specific differences between the subject-matters of various branches of natural science. It followed that no such differences should exist between the methods of these sciences. Consequently biology, sociology and psychology were denied a status different from that of physics.

Drastic as it was, this thesis was not new. Positivists and Marxists had developed similar doctrines in the nineteenth century. The novelty of the analytic solution lay in the resolute effort to supply a logically formalized framework for the levelling of various sciences.

Although the Analysts shared with other materialists the doctrine of the reduction of all sciences to the model of physics, yet one would be mistaken to believe that their views on science were consistently materialistic. The idealistic undercurrent becomes particularly evident in their opinions concerning the nature of the subject-matter of science. In line with the insistence on certitude and clarity of thought, the subject-matter of experimental science was distinguished from the object of sense perception. "From our standpoint," said Philip Frank, the most outstanding physicist of the Vienna Circle, "the nature which the human mind rationalizes by means of theoretical science is not at all the nature that we know through our senses".[1] The subject-matter was thus viewed in the line of the knowable, the intelligible. In this situation Carnap's early attempt to develop a logical construction or reconstruction of the world becomes under-

[1] Philip Frank, "Modern Science and Its Philosophy", p. 58.

standable. His position is best expressed by Russell's sentence serving as the motto for "Der Logische Aufbau der Welt": "The supreme maxim in scientific philosophizing is this: Whenever possible, logical constructions are to be substituted for inferred entities". In the intelligible world of the idealist, laws of thought are one within the laws of nature. The former can be legitimately substituted for the latter.

Logically enough, the choice of the subject-matter determines in turn the choice of their appropriate means of study. Thus the only legitimate way of dealing with the subject-matter is measurement. Consequently all serious knowledge is a quantitative analysis of quantitative or quantifiable phenomena. One can forsee that in this situation all the relations between data will be mathematical in their nature.

An explanation for the choice of the quantitative approach to knowledge in general is easy to find. Spatio-temporal exteriority reveals, when subjected to measurement, a wealth of details i.e. of precise information. Reason finds there the abundance of materials necessary for the formulation of exact relations. These relations are readily formalized by means of logic or of mathematics. Reason goes from one fact to another, from one relation to another, resulting from it and essentially similar to it. The process of analytic reasoning unfolds in a perfectly logical, lucid way, unobstructed by obscurities, conveniently excluded in advance from the subject-matter. It remained throughout on the same level of abstraction.

We can recognize in the above described process the *via inventionis* with its chain of reasoning extending indefinitely. That the *via inventionis* is not effectively balanced by the *via resolutionis,* is the result of the extensional theory of concepts i.e. of the nominalism inherent in analytic philosophy.

Before we engage in further discussion of the methods of reasoning proper to this school of thought, it is necessary to say a few words about the metaphysical implications of the criterion of meaning. The Analysts, deliberately attempted to exclude metaphysics. The net result of their efforts was an unavoidable set of metaphysical theses.

The mathematization of cognition makes the Aristotelian notion of nature, potency and interiority unintelligible. They are replaced by the concepts of spatial extension and exteriority. Even this simplification was not sufficient. As Carnap in his early doctrine maintained, the very notion of reality cannot be construed in a formal conceptual system. Therefore the notion of reality was declared a non-empirical i.e. "metaphysical" notion.

Having rejected the objective principle of the unity and order of things, the scientist must look elsewhere for a principle of unity. Without such a principle, science would lack all coherence and intelligibility. In other words, the unifying and ordering skeleton of science is not really taken from, or patterned after objective nature. It must be found in a different domain altogether, namely logic.

Those who may feel surprised by this recourse to logic, must remember that man in his intellectual quest always searches for the necessary, the

perfect, the unchanging, or as Jean Piaget says, for the "principles of conservation". A realist like Aristotle finds the supreme qualities in objective reality. In his case the desire of the intellect is satisfied by the nature of the Prime Mover in the first place, and secondly by the hierarchy of subordinated natures, inasmuch as these natures approach and resemble the Prime Mover.

Empiricists who reduce things to the sum total of perceptions or even sensations, have to look for and find the supreme qualities elsewhere than in objective reality. If objective reality, as we understand it, is excluded, as the subject and the source of these qualities, then the only other alternative is the universe of knowledge. It is within knowledge itself, in its internal, logical structure, that the scientist looks for the principle and the justification of order, clarity, stability. Hence the insistence on logic so characteristic for many of the analytic philosophers.

In order to build a coherent logical basis for science, the objective Aristotelian hierarchy of natures was replaced by a logical hierarchy of concepts. To satisfy the requirements of intelligibility, this hierarchy had to fulfil two basic conditions: a) propositions about more complex objects had to be translatable into propositions about more fundamental i.e. simpler objects; b) the whole conceptual construction had to be sufficiently complete so as to make possible within its limit the expression of all objects and problems under study. One should add an underlying precondition, namely, that the structure as a whole and all its parts be intelligible. Intelligibility in the Cartesian sense, i.e. perfect clarity, became the touchstone of the value, of the adequacy of propositions and of explanations. Even so, the last word was reserved for experimental verification. Analytic philosophers rejected in advance various problems as non-empirical, hence non-scientific. These problems were relegated to the limbo of pseudo-problems.

Returning to the epistemological analysis, we have to say a few words about the new logic. Very complete in themselves and impressive, the systems of logic developed by analytic philosophers suffered from the nominalistic notion of concepts. As a result, mainly extensional logic was developed. Its characteristics were: material implication and the syntactic concept of deriviability. This logic proved inadequate for the handling of modal, i.e. causal relations.

The limitations of extensional logic were not strongly felt within analytic doctrines because the reduction of reality to spatio-temporal exteriority led to statistical, probabilistic interpretations of scientific explanations. This attitude was fostered by developments within science itself. Causality and causal explanation in the Aristotelian sense were rejected by the Analysts as lacking objective justification. Instead the probability calculus was extensively studied, developed and formalized. It was in the field of probable reasoning that one of the most important and lasting contributions of Logical Empiricism was made.

III

This all too brief presentation of some of the views of analytic philosophers on science and its methods calls for a final appraisal.

Firstly, it has to be stressed that philosophy and the philosophy of science in particular, is reduced to a subordinate position with regard to science. The ancient distinction between science and wisdom disappears, wisdom being replaced by science. This has its roots in the rejection of the distinction between *ratio* and *intellectus*. In the nominalistic context, only *ratio* has a place and a justification.

Secondly, there is a difficulty resulting from the criterion of verifiability. As Brand Blanshard has pointed out, the criterion of verifiability confused the meaning of a proposition with what would serve to verify it. Moreover, it reduced experience to sense experience.[2] In this situation, the theory of verification runs into difficulties when it comes to verification of universal propositions. Since verification is identified with perception of singular instances, in practice we can never verify all the particular instances existing or possible. At best, we have an imperfect induction and a merely probable conclusion. This explains in turn the statistical and probabilistic approach to scientific laws. One cannot make a true universal with singulars. Thus predictability of events, one of the chief aims of science, is essentially statistical. It should be underlined that the model of science constructed by Analysts would be most appropriate for an atomic reality governed by chance i.e. for a world of Leukippus. The possibility of any development of science incompatible with the model is precluded.

Thirdly, still another difficulty results from the definition of the criterion of truth. It has to be considered in relation to the second difficulty from which it stems. The meaning of propositions depends on verification i.e. must be corroborated by facts. Thus meaning is subordinated to objective reality, it takes its content from sense data exclusively. In this respect the mind is passive with regard to the extra-mental world. On the other hand, this empiricist doctrine is combined with a strong belief in the power of logical analysis. Thus in the vein of classical idealism, an active and independent intellect is presupposed which finds within itself, reflecting upon its own operations, the adequate rules for infallible reasoning. Consequently, science is presented as a mixture of atomic data and logical rules, without an adequate explanation of their mutual relation. What is more, the distinction between analytic, abstract reasoning, and empirical, synthetic knowledge produces a chasm between sense knowledge and intellection which remains unbreached.

We have thus far indicated several weak points in the analytic approach to science. It would be wrong to believe that the contributions of the analytic philosophers to the philosophy of science have been without value. First of all, analytic philosophy has attracted attention to the specific use of language in various fields of knowledge and has undertaken to analyse, to systematize and to formalize this use. There is little doubt that great

[2] Brand Blanshard, "The Philosophy of Analysis", in *The Proceedings of the British Academy*, 1952, p. 48.

progress has been achieved in the development of logic and semantics, necessitated by the growth of science.

The nominalistic approach to language made possible a thorough analysis of its formalism. Thus we became more aware of the inferential capacities of the intellect as well as of the relative independence of the intellect with regard to its object.

There is little doubt that the most advanced interpretations of science came from the pens of analytic philosophers. Formulating their views, they have elaborated a functional conception of knowledge. In this perspective knowledge is considered as a means for prediction. Although it is quite obvious that as so viewed cognition cannot be adequately assessed, a new approach to the old problem enriches our understanding of the problem. This enrichment will remain in the ever-growing patrimony of our knowledge.

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Problem (b): *The Re-discovery of the "Topics"*

Prof. Toulmin's Inference-Warrants

The view is gaining some currency that laws of nature may be profitably considered as inference-licenses. Prof. Ryle advanced it in the metaphor of inference-tickets (R. 121).* Prof. Toulmin, on his own admission, applied Ryle's ideas to the elucidation of physical science in his *Philosophy of Science* (T. 260). Much the same idea was put forward by Schlick, who told Prof. Popper that he owed it to Wittgenstein (P. 37, n. 7). Ramsey also said much the same thing (RS. 241). More recently, Prof. Toulmin has launched what amounts to a full-scale exposition of inference-warrants in his study on the *Uses of Argument*.

This development, particularly in the form it takes in this last book, has many similarities with the analysis of the Topics in mediaeval logic. The resemblance is so close, as I hope to show, that it appears we are witnessing something of a re-discovery of the Topics. To make manifest the resemblance I shall describe first what Prof. Toulmin has to say about inference-warrants, particularly in the third essay of his book. I shall then

* These references are to books listed at the end of this paper.