A PROPOSED CRITERION OF DEMARCATION BETWEEN SCIENCE AND METAPHYSICS

(Popper's Criterion of Demarcation Does not Cut Properly)

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In this paper I would like to show that Popper's criterion of demarcation (D) is not clear with regard to its goal to distinguish between science and non-science.[1]

The 'testability' or 'falsifiability' criterion (D) is regarded by Popper as suitable basis for the characterization of empirical science.[2]

According to Popper's criterion the 'demonstrative' or formal sciences – incapable as they are of testability or falsifiability – are placed in the same camp as non-science and metaphysics. Thus 'scientific' becomes synonymous with 'empirical'. (L.Sc.D. p. 34).[3]

But since this leaves the 'demonstrative' sciences on the same side as metaphysical systems (L.Sc.D. p. 37), I would like to suggest a different criterion of demarcation, one which, I hope, will distinguish more properly between science and metaphysics.

I

Popper's criterion of demarcation is at the center of his philosophy of science and is based on his concept of science which deviates in principle from that of the inductivists and positivists. (Ph.K.P. pp. 976 ff., 981; L.Sc.D. pp. 34-5).

Popper contends that (D) as a methodological rule is bound to be vague, quite apart from the essential vagueness of the subject-matter which it demarcates. As he says, "... the transition between metaphysics and science is not a sharp one." (Ph.K.P. p. 981). I believe, however, that even if (D) must be vague in its application, it ought to be clear with respect to what it intends to demarcate, namely the difference between science and non-science. (Cf. L.Sc.D. pp. 38-9). Unfortunately (D) seems to me too 'empirical' if it is to keep the formal science on one side of the demarcation borderline, and 'empirical' science on the other.

Popper says: "My criterion of demarcation between the theories or statements of *empirical science* and those that do not belong to it (but perhaps to pseudoscience, logic, and metaphysics) is *testability*, or *falsifiability*." (Ph.K.P., p. 987).

There are some preconditions for dealing with the problem of demarcation.

To maintain the dichotomy between analytic and synthetic in regard to theoretical systems, one should have *two demarcation lines* in order to distinguish between science and metaphysics. First the distinction can be made between testable and untestable theories on empirical grounds; and second, the non-empirical theories may be derived between analytic or formal science and synthetic metaphysics.

We may infer from Popper's view an additional demarcation line with regard to the non-empirical theories : a line between demonstrative and non-demonstrative theories, based on the analytic-synthetic dichotomy to distinguish between analytic or formal sciences and synthetic metaphysics. (Cf. C4R, pp. 197-8). After accepting the 'empirical refutation' as a criterion of demarcation between science and non-science Popper had to demarcate formal science from metaphysics. He therefore postulates "that philosophical theories, or metaphysical theories, will be *irrefutable by definition.*" (Ibid.).

Thus metaphysics is characterized as irrefutable empirically and also, being a synthetic theory, unprovable logically. But if metaphysics is also irrefutable logically as Popper claims, it is altogether excluded from any possible criterism, even on being logically inconsistent. If we accept Popper's position that "logic is the organ of criticism" (O.K. p. 318, 121; C & B), and without deductive logic you undermine the method of critical discussion (O.K. p. 305), it turns out that Popper can demarcate metaphysics from science by regarding it – I believe unwillingly – not as meaningless but as irrational.

The claim of Popper that metaphysics cannot be refuted or proved, but that it is nevertheless, capable of being true or false (C & B, pp. 194-7), seems to go against our intuition about truth and falsity. Popper is right that from irrefutability we cannot infer truth and from improvability we cannot infer falsity, but despite this he decides that some forms of metaphysics are false and others are true. Since neither the logical nor the empirical procedures can constitute decision procedures for metaphysical theories, what kind of procedure could have been employed by Popper in this connection ?

In answer, I would like to take an alternative point of view concerning metaphysical theories. In my view metaphysical theories are normative systems, not descriptive ones. As normative, they cannot be considered under the category of truth and falsity. (Thus we cannot say The Ten Commandments are true-or-false). According to this view the demarcation line will divide normative from descriptive theories : normative theories are those which are not scientific in the empirical sense but are nevertheless rational. Cases of normative theories are : the proposition calculus of logic, moral, aesthetic, ideological, judicial, and pseudo-scientific theories. The problem of demarcation will be, therefore, to distinguish between scientific (empirical) and normative theories.

II

As we have already seen, Popper cannot demarcate conclusively between scientific and non-scientific theories by his criterion (D) and he needs another criterion (D') in order to complete his undertaking. This deficiency can be the result of two causes : (1) an erroneous concept of science; (2) a shortcoming in the criterion of demarcation. I believe that both are responsible for this difficulty.

The problem, as I see it, lies in understanding the formal sciences as analytic theories. This position Popper adopted uncritically from the logical positivists instead of following Kant's or some other realist's position in regard to formal science, namely, K. Gödel, E.W. Beth, J.R. Myhill, S. Körner, J. Hintikka, E. Stenius, and R.H. Thompson (as I understand them).

Such as Popper's view of formal science can be understood from the historical point of view concerning the impact of logical positivism on the philosophical atmosphere in Vienna of the twenties and the early thirties. Model theory was then in its very beginnings – with the works of Gödel, A. Tarski and others – and the full impact of these developments on the philosophy of science had not yet been felt. Yet at the time when Gödel had proved his theorem of incompleteness and thereby gave the death blow to Hilbert's formalist program, Popper had already completed his first draft of L.Sc.D. (L.d.F.), with the proposed criterion of demarcation.[4] I see the Gödelian turn as a move toward a *realistic* philosophy of formal science, in much the same way as Popper's interpretation of the Einsteinian revolution with regard to the philosophy of empirical science. (Ph.K.P., pp. 28-9).[5]

But Popper's analytic approach to formal science effected the combination of (D & D'). In this approach he took basically the same position as did Carnap, Hempel, Nagel, Bar-Hillel and others.[6] The interesting point of this position is the combination of an idealistic approach to formal science with a nominalistic approach to empirical science.

I believe that apart from the philosophy of logic and mathematics (which is 'strictly non-ontological') and the 'crude' empiricism which assumes 'direct interpretation' of formal science in empirical experience, there is another possible approach to formal science with regard to its ontology; this approach can be called *realism* and it assumes that there exist certain kinds of *abstract objects*, e.g., sets, numbers, which constitute the subject matter of logic and mathematics. This philosophical approach to formal science is in the Platonic and Kantian tradition which was developed in modern times by G. Frege, K. Gödel and others in the framework of the Model Theory.[7]

In order to formulate a new criterion of demarcation between science and non-science we need, beside the realistic concept of empirical science, a related concept for formal science. This will enable us to keep formal science in the realm of science by the criterion of demarcation without adding (D') which is

not clear in order to distinguish between formal science and metaphysics.

The realistic philosophy generally assumes that there exist two ontologically independent domains of entities : (1) the domain of concepts, propositions (thoughts), and theories and (2) the domain of objects, structures and reality. Popper states his realistic approach for empirical science in the following :

> "At that time I looked upon myself as an unorthodox Kantian, and as a realist. I conceded to idealism that our theories are actively produced by our minds rather than impressed upon us by reality, and that they transcend our 'experience'; yet I stressed that a falsification may be a head-on clash with reality. I also intepreted Kant's doctrine of the impossibility of knowing things in themselves as corresponding to the forever hypothetical character of our theories." (Ph.K.P., p. 65).

A similar approach in formal science is represented by Gödel's philosophical interpretation of his revolutionary theorem.

Without going into too many details I would like to present Gödel's realism as it appears in his "Russell's Mathematical Logic" and "What is Cantor's Continuum Problem ? ", according to my reading.[8]

Gödel assumes that there is a domain of abstract objects – classes, numbers – which are necessary metaphysical presuppositions in order that formal sciences will be reasonably understood (Cf. Barker, 1969).

> "Classes and concepts may... be conceived as real objects ... existing independently of our definitions and constructions. It seems to me that the assumption of such objects is quite as legitimate as the assumption of physical bodies and there is quite as much reason to believe in their existence. They are in the same sense necessary to obtain a satisfactory theory of mathematics as physical objects are necessary to obtain a satisfactory theory of our sense perception." (rML., p. 137).

The main point for our purpose in Gödel's 'Incompleteness Theorem' is that there is a possible sentence S formulated in the notation of a language L which is true in a domain D but neither S nor its negation –S can be deduced from a theory T formulated in L. Therefore, S is undecidable with respect to T and T is incomplete with respect to D. The underlying assumption is that there exists a structured domain D of elementary objects independent of T. To this situation Gödel refers, I believe, in the following :

> "It has turned out that (under the assumption that modern mathematics is consistent) the solution of certain arithmetic problems requires the use of assumptions essentially transcending arithmetic, i.e., the domain of the kind of elementary indisputable evidence that may be most fittingly compared with sense perception." (R.ML. pp. 127-8).

Gödel praises Russell on his 'realistic attitude' and his suggested analogy between mathematics and natural science (Cf. C.P. p. 521), which manifests

itself in Russell's early writings. Gödel writes :

> "He compares the axioms of logic and mathematics with the laws of nature and logical evidence with sense perception, so that the axioms need not necessarily be evident in themselves, but rather their justification lies (exactly as in physics) in the fact that they make it possible for these 'sense' perceptions' to be deduced." (Ibid., p. 127).

In Model Theory or Formal Semantics a domain D, a non-empty set of objects, is specified in advance or, in Kant's terms, posited. These objects and their primary properties and relations constituting the values for an interpretation of a given language L. The domain D considered as a *structural feature* of a reality (world) necessary for the determination of the truth value of a theory T formulated in L. R. H. Thompson calls this structured domain a *semantic determinant;* "Semantic determinants are things that determine valuation."[9]

I see this structured domain which is independent of L and T as identical with Gödel's 'logical evidence' mentioned above. This structured domain – a set of structures – of formal science, on its elementary objects is represented by a *background theory* (BT) which is effective and simpler than T itself. This is the way, to my understanding, that the subject-matter of formal science is given. The function of the theories Ts of formal science is to give a description of these specified structured domains.

From this analogy of structure between formal science and empirical science, which the realistic approach suggests, it is quite plausible to infer that in both of them we face the same problem of the incompleteness of our theories. In this context I understand Gödel's comment :

> Perhaps also the apparently unsurmountable difficulties which some other mathematical problems have been presenting for many years are due to the fact that the necessary axioms have not yet been found. Of course, under these circumstances mathematics may lose a good deal of its 'absolute certainty'; but under the influence of the modern criticism of the foundations, this has already happened to a large extent." (Ibid, p. 127).

Gödel developed the idea that a well-determined domain of objects can be established effectively (C.P. pp. 518-19, 520, 521, 523 n. 26), and with reference to it we elaborate our theories. Some hypotheses about this reality can be proved from a given set of axioms and some others are undecidable "from the axioms in their present form." (C.P. p. 520). Dealing with a specific problem (of Cantor's continuum conjecture) Gödel faces it in the same approach :

> "In respect to Cantor's conjecture its undedicability from the axioms as known today can only mean that these axioms do not contain a complete description of this reality. (P. 520). ... not only that the axiomatic system of set theory as known today is incomplete, but also that it can be supplemented without arbitrariness by new axioms..." (Ibid.).

The philosophical conclusion of this discussion is that any axiomatic theory

of formal science will never exhaust all the possible structures of their abstract objects. In order to theorize (Gödel : 'describe') these structures, we will have to develop new theories and replace the old ones by more comprehensive ones. K. Popper reached the same conclusion with respect to empirical science : 'Explanation is always incomplete... This is why the evolution of physics is likely to be an endless process of correction and better approximation toward an unattainable end.' (Ph.K.P. p. 104).

III

Assuming this interpretation of Gödel's philosophical approach to formal science is correct; we can see that it leads towards a new concept which differs from the formalistic, logistic, and nominalistic philosophical concepts of formal science. The important outcome here is the resemblance in structure between the concept of formal and empirical sciences. Under these assumptions I propose a new criterion of demarcation between theories of science and non-science, assuming they are all consistent theories.

(D*): Scientific theories are incomplete while non-scientific theories, (normative ones), are complete. (There are no theories beside descriptive (scientific) and normative ones).

(Usually of course we think that questions of normative theories are just the ones that we cannot decide definitely; but this is only in practice, and if this is the case, it means that we still do not have formalized normative theories but only sketches of them).

The result of my (D*) is quite different from Popper's (D & D') criterion; the normative theories are not irrefutable by definition because if they are inconsistent they are refutable. Being consistent or possibly amended to be such, normative theories are always "true" with respect to their 'structured domain'. However, this "truth" says nothing about reality but only about our normative approach to it, the way we determine the Reality. The normative theories are devoid of any explanatory power with respect to their structures of objects even though most of the time they create the illusion of having this function.

IV

It is assumed that metaphysics is a specific kind of normative theory, and this kind will concern us here. It seems that for a metaphysical theory there is no object outside its models of interpretation; the set of structures (domain) of the objects of metaphysics and the set of models for it are identical; otherwise, there will be some objects which are not determined by the metaphysical theory, which are 'outside the world'.[10]

In light of this characterization of metaphysics it can be understood as a normative theory versus the descriptive character of scientific theories. In other

words, metaphysical theories are not aimed to describe structures but to be exemplified in models. The efforts which have been made from time to time to verify metaphysical statements (or theories) in the same methods employed for scientific ones, cannot gain any success.[11]

Assuming the above picture of metaphysics the question arises why (according to our linguistic intuition) Popper is not right in claiming that metaphysical theories might be at the same time both false and irrefutable ?

From the assumption that it is impossible for two incompatible theories to be at the same time true and the postulation of their irrefutability Popper infers that irrefutability cannot entail truth (C & B, p. 195). But incompatible theories can be true at the same time with respect to different structures. In different possible worlds incompatible theories can be true at the same time without generating any contradiction.

A counter argument can be raised to the effect that all metaphysics refer to the *same world*, our factual world. (Bunge loc. cit. p. 158). (Metaphysics is 'transcendental logic' and not formal logic which should be true in all possible worlds). A solution to this predicament can be that meta physical theories are understood as sets of 'rules of procedure' which interpret and determine *'the same world'* in different shapes according to the different conceptual frameworks and ontological presuppositions of each metaphysical theory. If may argument is correct, it becomes clear why two incompatible metaphysical theories can be both 'true'; they are true in different models.[12]

The last problem of our concern here is how metaphysical theories replace each other or why we sometimes give up one metaphysics to which we used to adhere before ? A solution to this problem might be that even if consistent metaphysical theories are irrefutable, nevertheless, like with moral or ideological theories, we accept or reject them if they agree or disagree with our intuitive model of the world (or a categorical part of it). Metaphysical theories rise and fall with their models of interpretation. If nobody, for example, wants to accept Kant's model of nature, the metaphysics which is connected with this model becomes *useless* and neglected. In short, metaphysical theories appear and disappear with their models.[13]

To conclude the entire discussion : If our analysis and conjecture are correct and if the concept of science (the Popperian and Gödelian) is accepted and if the result of our discussion with regard to metaphysics coincides with a reasonable one, then, the new criterion of demarcation (D*) enables us to draw a better distinction between science and non-science or metaphysics. This can be the case if the concept of theory is maintained accurately.[14]

NOTES

(1) POPPER, K.R. (1954), *The logic of Scientific Discovery*, (L.Sc.D.), English edition, 1959, 1968; New York and Evanston, Harper Torchbooks, pp. 38-9.

(2) "Testability is therefore the same as refutability of falsifiability." In : K. R. Popper (1963, 1965), *Conjectures and Refutations*, (C & R), New York and Evanston, Harper Torchbooks, pp. 197, 256.

(3) P.A. Schilpp (ed.), (1974), *The Philosophy of Karl Popper*, (Ph.K.P.), La Salle, Open Court, The Library of Living Philosophers, Book II, Replies to my Critics, p. 987.

(4) Cf. Ph.K.P., "Intellectual Autobiography", pp. 62-69, and the historical description of : J. Fang (1970), *Hilbert*, Towards a Philosophy of Modern Mathematics II. Ch. XI : Foundational Problems. Paideia Press, p. 168 ff.

(5) Cf. S. F. Barker, "Realism as a Philosophy of Mathematics", In : J. J. Bulloff, T.C. Holycke and S.W. Hahn (eds.) (1969), *Foundations of Mathematics*, Symposium Papers Commemorating the Sixtieth Birthday of Kurt Gödel. Berlin, Heidelberg and New York, Springer Verlag.
E. W. Beth (1968) *The Foundations of Mathematics*, A Study in the Philosophy of Science, Second revised edition, Amsterdam, North Holland Publishing Company (Parts V & IX).

(6) See Y. Bar-Hillel's discussions in *Philosophy of Mathematics*, Edited by I. Lakatos, 1967, e.g., "... the most adequate philosophy of mathematics, viz. the strictly non-ontological conception of mathematics by Carnap, Kemeny and others..." (p. 136).
I must admit that in Popper's latter writings there is a change towards a realistic approach to formal science. In his O.K., 3, 6 : "Appreciation and Criticism of Brouwer's Epistemology", he writes : "Brouwer's other great achievement, from a philosophical point of view, was his antiformalism : his recognition that mathematical objects must exist before we can talk about them." (P. 134, Cf. also pp. 137-8).

(7) "As regards the formal element, we can determine our concepts in *a priori* intuition, inasmuch as we create for ourselves, in /pure/ space and time, through a homogeneous synthesis, the objects themselves – these objects being viewed simply as quanta." B751.
"We are not here concerned with analytic propositions... but with synthetic propositions, and indeed with just those synthetic propositions that can be known a priori. For I must not restrict my attention to what I am actually thinking in my concept of a triangle (this is nothing more than the mere definition); I must pass beyond it to properties which are not contained in this concept, but yet belong to it. Now this is impossible unless I determine my object in accordance with the conditions... of pure intuition." B746. I. Kant, *Critique of Pure Reason*, (C.P.R.).

(8) K. Gödel, "Russell's Mathematical Logic", (R.ML.), In : P. A. Schilpp (ed.) (1944, 1951), *The Philosophy of Bertrand Russell*, The Library of Living Philosophers; "What is Cantor's Continuum Problem ?" (C.P.), In : *The American Mathematical Monthly*, Nov. 1947, pp. 515-25.

(9) R. H. Thompson, "Philosophy and Formal Semantics", In : H. Leblanc (ed.) (1973), *Truth Syntax and Modality*, North-Holland Publ., p. 300.

(10) L. O. Kattsoff expresses a similar idea in the following : "It appears that what cannot be in reality cannot be expressed in an adequate language; and *if we have such a language* then what cannot be expressed in it could not be." *Logic and Nature of Reality*, Second edition, Martinus Nijhoff, The Hague, 1967, pp. 51-52.

(11) Cf. Kattsoff, loc. cit. Ch. 8 : The Verification of Metaphysics Statements, and :
M. Bunge (1973), *Method, Model and Matter*, Dordrecht, D. Reidel publishing Company, pp. 146, 158.

(12) We may also have a kind of *categorical gap* between Kant and Popper in regard to determinism and necessity. Kant applies his determinism to the theories of nature while Popper's indeterminism is applied to an extra-theoretical nature, the world-in-itself. (Ph. K.P., p. 104).

(13) Compare my position with M. Bunge's words on metaphysics : "Although a metaphysical theory can be neither confirmed nor refuted by empirical data, it can be either relevant to science or pointless in regard to it. The metaphysical presuppositions of scientific theory do not hang in mid-air : they are not free speculations but come and go with the theory. (loc. cit. p. 146).

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