Logical Content and Empirical Significance

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Introduction

Logical Positivism, could not be said to be au courant as a philosophical movement.[1] Indeed not only is the movement no longer in existence, it's projects are no longer central to philosophical investigations, even to the investigations of those who specialize in the philosophy of science. If Positivism has been making a comeback it is primarily as an object of historical inquiry, perhaps as a means to answering the question of how we got from there (our forefathers' primary philosophical interests and presuppositions) to here (our own current philosophical interests and presuppositions). The historical study of Positivism is indeed a worthwhile pursuit. However I think we still have room for a genuine inquiry into the possibility of completing at least some of the Positivists' projects. To borrow one of Carnap's most famous metaphors; besides the external project of asking what motivated the Positivists, what were their influences and basic presumptions, and what influence did they have, we can ask the internal question of how might their projects be completed. In attempting to complete some of those projects we may need recourse to methods, for instance, new types of logical constructions, that were unavailable to the Positivists. Such recourse will be legitimate as long as the methods are of a kind with those employed by the Positivists themselves.

The Logical Positivists of course had many different projects that one might consider worthy of pursuit. Amongst the most prominent of these are the construction of a verificationist account of meaning, a criterion for demarcating science from metaphysics, various accounts of confirmation, and accounts of the status and nature of logical, mathematical, and scientific truths. Often these projects, for reasons good and bad, are run together by both the Positivists and their critics. To find what is worth preserving in Positivism one sometimes needs to tease them apart.

[1] Throughout I shall use the capitalized forms such as 'Positivism' to indicate that I have in mind the logical positivists and logical empiricists of the Vienna and Berlin Schools (Schlick, Carnap, Neurath, Hahn, Frank, Hempel, Feigl, Reichenbach, Von Mises, etc.). As argued below these Positivists are not essentially committed to the kind of phenomenalistic positivism favored by earlier positivists such as Mach and Avenarius.

In this paper I will investigate the possibility of completing a Positivist style account of demarcation. One reason for pursuing this project is that standard criticisms of Positivism do not have the bite against the demarcation project that they are often assumed to have. To argue this will be the burden of the first part of this paper. The other reason is that new research in logic has provided machinery not available to the Positivists; machinery that shows promise for solving some of the technical problems faced by Positivists' account of demarcation. To argue this will be the burden of the second part of this paper. However before proceeding we need to consider a limitation to our investigation.

The central thrust of the demarcation project was to find a means of separating science as that which is empirically significant from metaphysics as that which is devoid of empirical significance. Yet initially the demarcation project was not typically cast simply in terms of separating the *empirically significant* from the *empirically non-significant*. Indeed typically the project was cast in terms of separating the *meaningful* from the *meaningless* [Cf. Carnap (1932)] or the *cognitively significant* from the *cognitively non-significant* [Cf. Hempel (1965)]. The use of strongly pejorative terms such as 'meaningless' and 'cognitively non-significant' reflects the polemic intent of the Positivists. Metaphysics was not simply to be labeled as lacking empirical content, it was to be dismissed as lacking in content altogether, as an empty and frivolous pursuit. Given this end metaphysics needed not simply to be separated from empirical science but also from the so-called formal sciences, in particular mathematics and logic. Yet mathematics and logic could not, according to the Positivists themselves, be registered in the camp of the meaningful under the banner of the empirically significant. Thus the Positivists invoked the category of the analytic in order to allow mathematics and logic to be placed alongside the empirical sciences in the camp of the meaningful or cognitively significant. Of course, the distinction between analytic truth and synthetic truths eventually became a source of enduring controversy. However fundamentally this was not the real source of the attack on the demarcation project. The project came to be seen as not viable because its central notion of a criterion separating the empirical significant from the empirically non-significant came to be seen as untenable. In the following pages in talking of the demarcation project the chief concern

will be the notion of empirical significance. Of course, certain attempts to explain the notion of empirical significance made recourse to the notion of analyticity. Thus in Carnap (1936-7) Carnap invokes the notion of analytically true bilateral reduction sentences, and in Carnap (1952) analytically true meaning postulates, in order to forge a link between sentences containing theoretical terms and sentences containing observational terms. However in this paper we will be concerned with first examining and then defending the kind of holistic account of empirical significance advocated by Ayer and the early Carnap. Such holistic accounts need make no use of any allegedly analytically based links between theoretical and observational terms. Therefore we shall now set aside the problems of the analytic-synthetic distinction.

Our inquiry then concerns the demarcation criterion narrowly construed as a means of demarcating the empirically significant from the empirically non-significant rather than the meaningful from the meaningless or the cognitively significant from the cognitively non-significant. Indeed Carnap himself came to adopt this more moderate language.[2] Furthermore, as Feigl has pointed out, the point of the demarcation criterion was not just to rule out metaphysical speculations about, for instance, Hegel's Absolute or Heidegger's Nothing; it was also to be wielded against certain pseudo-empirical propositions. Such propositions included Reichenbach's favorite example that everything is doubling in size every ten minutes. Feigl [(1943), p. 13] gives the example of Lorentz's final version of the ether theory which contained various canceling hypotheses to explain why the ether hypothesis was not in fact experimentally testable and which Einstein dismissed on account of this very lack of empirical significance.

There are of course many reasons for the abandonment of the effort to find a demarcation criterion. Here I will briefly outline what I take to be the major criticisms of Positivism, as they bear on the question of the demarcation criterion.

[2] See, for instance, Carnap (1956).

1.1 The Problem of Past Failures

One of the most basic causes, if not genuinely justifying reasons, for abandoning the quest for a criterion of demarcation is the perceived failure of the efforts of the Positivists themselves. When the likes of Carnap, Neurath, Schlick, Hempel and Ayer failed after years of concerted effort to find a clear grounds for demarcating metaphysics from science even philosophers sympathetic to Positivism came to wonder if the project itself was feasible. Of course this does not demonstrate that the construction of an adequate criterion is not possible but it lends some credence to the claim that there may be some principled reason behind those failures.

The best candidates for principled reasons for the failure to find an adequate demarcation criterion come from the challenges from holism, the Kuhnian challenge, the challenge from the failure of formal accounts of confirmation and the challenge from the failure of verificationist accounts of meaning.

1.2 The Challenge from Holism and the Failure of Reductionism

The most generally acknowledged reason for abandoning the search for a demarcation criterion is the perceived triumph of holism.[3] According to the received folk wisdom it is holism that destroyed the reductionism that was at the heart of Positivism.[4] In a nutshell the argument is essentially this;

1. If an adequate demarcation criterion is possible then empirically significant hypotheses
   can be distinguished from empirically non-significant hypotheses by the fact that only the former have empirical consequences.

2. If holism is true then no single hypothesis has empirical consequences (on its own).

[3] Misak (1995), p. 38, similarly cites holism as being perceived by contemporary philosophers as the basis for scuttling verificationism, and, as noted below, there has always been a regrettable tendency to conflate the demarcation criterion with verificationism.

[4] I do not accept that reductionism was indeed at the heart of Positivism though I will concede that Carnap and others in the early Vienna Circle days did have some serious flirtations with reductionism.

Therefore

3. If holism is true there is no substantive (i.e. non-empty) distinction between single hypotheses that have empirical consequences and those that do not.

Therefore

4. If holism is true then an adequate demarcation criterion is not possible.

Before addressing this argument directly we should consider where the Positivists themselves actually stood on the question of holism. Interestingly, the Positivists, taking a note from Duhem, at times sounded holistic themes. Thus Carnap in his classic of Positivism *The Logical Syntax of Language* writes,

> [I]t is, in general, impossible to test even a single hypothetical sentence. In the case of a single sentence of this kind, there are in general no suitable L-consequences of the form of protocol-sentences; hence for the deduction of sentences having the form of protocol-sentences the remaining hypotheses must also be used. Thus *the test applies, at bottom, not to a single hypothesis but to the whole system of physics as a system of hypotheses* (Duhem, Poincare). [Carnap (1937), p. 318 - Carnap's italics].

A similar acknowledgment of the holism is contained in Ayer's classic *Language, Truth and Logic*,

> When one speaks of hypotheses being verified in experience, it is important to bear in mind that it is never just a single hypothesis which an observation confirms or discredits, but always a system of hypotheses. [Ayer (1936) p. 125]

That Ayer and Carnap so explicitly adhere to holism in works in which the demarcation problem plays center stage should lead us to question the claim that it is holism that gives a sufficient reason for rejecting the search for a demarcation criterion. Of course it may be argued that while Carnap and Ayer paid lip-service to holism they did not seriously take it into consideration in attempting to construct a demarcation criterion. This reply is rendered ineffective by the fact that their actual attempts to construct a demarcation criterion often explicitly incorporated the lessons of holism. For instance, Ayer, in framing his criteria of verifiability, famously, says that a statement is verifiable if "some observation-statement can be deduced from it *in conjunction with certain other premises*, without being deducible from those premises alone." [Ayer (1936) p. 15 -

Italics mine.] This formulation echoes that of Carnap's *Philosophy and Logical Syntax* where he claims that "A proposition P that is not directly verifiable can only be verified by direct verification of propositions deduced from P with other already verified propositions". [Carnap (1935), p.11]. This type of proposal, of course, met with various convincing objections and perhaps it is the case that all such attempts to incorporate the lessons of holism make for an unworkable criterion. In that case the problem would not be, as popularly represented, that the Positivists notion of a demarcation criterion was predicated on a refusal to acknowledge holism. Rather the criticism would be that any attempt to incorporate holism in a demarcation criterion is doomed to failure. However the claim that there is no adequate version of the demarcation criterion which allows for holism has not been demonstrated. In a sense, once we recognize that the Positivists were willing to construct their criterion of demarcation within a holistic frame-work, the only effective argument from holism would be that somehow holism precluded the construction of an adequate demarcation criterion. But no one has shown why this should be so. What we do know is that various attempts, particularly those by Ayer and Carnap, to construct such a demarcation criterion have failed. But this simply brings us back to the argument from past failures.

At best the argument from holism strikes a knockout blow against that form of reductive verificationism which sought to analyze all meaningful statements in terms of their individual implications for experience. In particular, the form of reductionism favored by Carnap in his 1928 book *Der Logische Aufbau der Welt* and in his 1932 article "The Elimination of Metaphysics Through Logical Analysis of Language" is prima facie incompatible with holism. But Carnap himself by 1934 had abandoned that kind of reductive analysis yet still did not despair of constructing a criterion of demarcation.[5]

[5] In general, and as Friedman (1991) argues, too much has been made of the Positivist commitment to a phenomenalistic brand of reductionism. Indeed Friedman (1991) even argues that the centrality of phenomenalist reductionism to Carnap's Aufbau project has been exaggerated. In fact, while the Positivists only displayed a moderately short lived commitment to the claim that all claims could be reduced to claims about experience, they tended to show a much more long term commitment to a kind of explanatory reductionism most notably displayed

Now if one claims that a holistic demarcation criterion is possible then one must take direct issue with the argument from holism. Where then is the fault in the argument from holism? Given the above, it is clear that the problem lies in the transition from the first conclusion 3. which deals with single hypotheses to the final conclusion 4. which claims that holism precludes any viable demarcation criterion. At most the argument shows that if holism is true a demarcation criterion framed in terms of single hypotheses having empirical consequences is not viable. This leaves open the possibility of a holistically framed demarcation criterion. The second premise of the argument asserts the lack of empirical consequences of *single* hypotheses yet in the final conclusion 4. that is taken to imply that holism does not allow a substantial distinction between hypotheses, whether single or taken in the context of broader theories, that have empirical consequences and those that do not. What can be validly inferred from the premises is the conclusion 3. that if holism is true there can be no viable distinction between single hypotheses that have empirical consequences and those single hypotheses that do not. More precisely the distinction would be empty since all single hypotheses would fall on that same side of that distinction, namely, they would all be in the class of propositions without their own empirical consequences.[6] This still leaves room for a demarcation criteria that seeks to divide hypotheses according to their having or not having empirical consequences within the context of broader background theories.

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in their various versions of the unity of science thesis. This commitment to explanatory reductionism has no direct bearing on the demarcation question.

[6] In keeping with tradition I take some latitude here. Thus I talk of "hypotheses" rather than simply of propositions or statements suggesting that this excludes observational claims (whether these be taken to be claims about experience or observable physical objects) which presumably do have their own empirical consequences. Moreover in keeping with the fairly deplorable standards that go with the holism discussion I omit consideration of the possibility of long conjunctive hypotheses which include a mix of observation statements and hypotheses and which presumably are capable of having their own observational consequences. I do this because I am here not seeking a clarification, defense or rebuttal of holism. Rather my strategy is to argue that holism does not itself preclude the possibility of a demarcation criterion.

1.3 The Kuhnian Challenge

What exactly counts as the Khunian challenge is extremely difficult to say. Kuhn's claims about shifts in paradigm do not seem directly relevant to the question of demarcation. Perhaps the nearest Kuhn comes to being relevant to the demarcation problem is in his claims that there are no decisive refutations of theories and in his attack on the theory-observation dichotomy. The claim that there are no decisive refutations, whatever its merits, bears on Popper's falsificationist account of demarcation and not on the versions of the demarcation criterion favored by the Positivists. As for the attack on the theory-observation dichotomy the general thrust of that attack is to claim that observation reports are themselves theory laden. But in principle this is something the Positivists may and often did easily grant. What is needed for their purposes is a division between theoretical claims and observational claims. Such a division need not suppose that in making a (justified) observational claim one is not replying on certain theoretical assumptions. Nor need one even make the assumption that the terms of the observation claim do not partially get their meaning through links with theoretical terms. That is to say that Positivism need not be committed to the rejection of either epistemic or semantic holism. From the earliest days many of the Positivists, in particular, Neurath and Carnap, even claimed that the division between theoretical terms and observational terms was to some degree a matter of convention or decision.[7] What they sought to do was, given that distinction, seek a way of finding which claims had observable (that is, empirical) content and those which did not. Indeed the idea that a demarcation criterion will always be relative to a conventionally chosen observational base, so that relative to one base a given claim may be empirically significant and relative to an

[7] Even in Carnap's 1936-7 piece "Testability and Meaning" he admits "there is no sharp line between observable and non-observable predicates" [Carnap (1936-7) p. 455]. Indeed in that essay he gives a rather sociological account of observationality which to some degree pre-figures the kind of account given in Quine's "Epistemology Naturalized" [See, for example Quine (1969) p. 86-87].

alternative base it is not empirically significant seems to be wholly within the spirit favored by the later Carnap and Neurath.[8]

There is perhaps a general overview of Khunian philosophy that may be seen as bearing on Positivism. In particular, on one reading Kuhn is calling into question the rationality of science, perhaps most specifically in the episodes of so-called paradigm shifts. That the Positivists were generally committed to the rationality of science is not in doubt. To what extent there is a genuine clash here is difficult to say. Invoking the distinction between context of discovery and context of justification it has been claimed that Kuhn's investigation are primarily of sociological concern bearing on the context of discovery rather than the context of justification. Whatever the merits of the various arguments concerning this aspect of Kuhn's philosophy it does not bear on the narrow question of a demarcation criterion which is couched purely in terms of the empirical significance of science versus metaphysics and pseudo-science.

One may wonder to what extent the Kuhnian challenge to Positivism is more a matter of the anti-Positivist yellow press than a matter of substance.[9] Before spending any more time on the Khunian challenge someone needs to show exactly where that challenge, and in particular, for our purposes, the Khunian challenge to the possibility of a demarcation criterion, lies.

1.4 The Challenge from the Failure of Formal Accounts of Confirmation

In their attempts at a criterion of demarcation the Positivists considered basically formal (in Carnap's term, "syntactical") means of effecting the desired demarcation. More precisely, they did help themselves to something we would today label as a semantic distinction; namely the partition of vocabulary into observational and theoretical terms. However, given that distinction, the Positivists sought by merely formal means to effect a demarcation between metaphysics and

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[8] Actually, the Carnap of the 1937, whose *The Logical Syntax of Language* espouses the famous Principle of Tolerance , could clearly accept such a relativization. Indeed , Oberdan (1990) convincingly makes the case that Carnap from his 1932 essay "Über Protokalsätze" recognized both the theory ladenness of observation reports and the fact that the separation of vocabulary into observational and theoretical terms is to some extent a matter of convention.

[9] For more on this see Reisch (1991).

science. At the same time the Positivists increasingly tended to identify the notion of meaningfulness with the notion of inductive confirmability. The genesis of this identification comes in the failure of reductivist approach. Given that single statements about spatio-temporal particulars could not be reduced to singular statements about sensory qualities (i.e. the failure of reductive phenomenalism) and, more importantly, that universal hypotheses could not be reduced to molecular compounds of atomic statements about spatio-temporal particulars (the failure of logical atomism), the Positivists rejected the notion that cognitive significance could be identified with the possibility of conclusive verification. This led to a less stringent notion of cognitive significance, namely the notion of incomplete verification, which itself became identified with the notion of non-demonstrative, inductive, confirmation. For instance, Carnap in his *Testability and Meaning*, though expressing some sympathy for the view that "a sentence is meaningful if and only if it is [conclusively] verifiable" [Carnap (1936-7), p. 421], claims that view is too restrictive and so proposes to "speak of the problem of [inductive] *confirmation* rather than the problem of verification" [ibid., p. 420]. It is worth noting that the search for a demarcation criterion often goes under the name of 'verificationism'. This very title suggests a conflation of the question of empirical meaningfulness (the heart of the demarcation question) and confirmation, since 'verification' and 'confirmation' are near enough synonyms. The conflation of the question of cognitive significance or meaningfulness and the question of confirmation is apparent in Carnap's seminal demarcation piece "The Elimination of Metaphysics Through Logical Analysis of Language" where he simply identifies the question of the meaning of a so-called elementary sentence S with the following two questions: "What sentences is S *deducible* from, and what sentences are deducible from S?" and "How is S to be verified? In fact, in the context of Carnap's article the conflation of these questions is perfectly acceptable. At that stage Carnap still thought that all hypotheses could be reduced to protocol sentences. In that case it trivially follows that the set of protocol sentences deducible from S would serve to conclusively verify S. The problem arises when in later work he gives up the reducibility thesis but still identifies empirical significance with verification, now glossed as

inductive confirmation, though that very identification seems plausible only through the illict support garnered from the now abandoned reducibility thesis.

The problem with the identification of empirical significance with verification is that verification, that is confirmation, is not definable in merely syntactical terms. After the Paradoxes of Induction, in particular, Goodman's grue-green paradox, few philosophers held any hopes for a merely formal account of inductive confirmation. Thus in his canonical 1964 postscript to his canonical 1945 "Studies in the Logic of Confirmation" Hempel concludes

> confirmation - whether in its qualitative or in its quantitative form - cannot be adequately defined by syntactical means alone. That has been made clear especially by Goodman. [Hempel (1965), p. 50].

So, given the identification of a criteria of empirical significance with a criteria of confirmation, the post-paradox sense of the impossibility of a merely formal theory of confirmation translated into a sense of the impossibility of a Positivist style criteria of demarcation.

The argument from the failure of formal theories of induction may be summarized as follows:

1. Any viable Positivist style demarcation criterion besides relying on a distinction between theoretical and observational vocabulary should be constructed by merely formal means.

2. Given that it is not possible to reduce all hypotheses to observational claims and hence that on the basis of observations many scientific hypotheses cannot be conclusively verified, the demarcation criteria must be framed in terms of a notion of inductive confirmation.

3. The paradoxes of induction demonstrate that no merely formal account of confirmation is viable.

Therefore

4. The paradoxes of induction show that no viable Positivist style demarcation criteria is possible.

This argument is valid. Indeed failure of syntactical accounts is to a large extent the genuine core problem of Logical Positivism, especially as it was developed by Carnap. This is true both of

Carnap's accounts of the nature of the formal sciences and his account of the nature of confirmation. However it is not in fact true of the Positivist account of demarcation. If this is so then one of the premises of the above argument needs to be rejected. The problematic premise, one at times endorsed by the Positivists themselves, is the second premise. Giving up the attempt to reduce all hypotheses to claims about experience does not oblige one to identify empirical significance with the notion of inductive confirmation. For instance, one might identify empirical significance with the mere having of empirical consequences. So even granting that confirmation cannot be defined formally does not oblige one to conclude that empirical significance cannot be defined by nothing but the division between theoretic and observational vocabulary and purely formal means.

Here, I believe, lies the fundamental, though by no means fatal, flaw of the Positivists' search for a demarcation criterion. In identifying empirical significance with inductive confirmability the Positivists preclude the possibility of fulfilling their goal of establishing a formal criterion of demarcation. One needs to tease apart the question of confirmation and empirical significance. The later notion should be cashed out as Ayer and Carnap originally suggested in terms of having empirical consequences within a wider background theory. Given a separation of theoretical and observational vocabulary, this notion can be given a merely formal specification (see section 2 below).

Interestingly, the tendency to move from the question of empirical significance, conceived as a function of having empirical consequences, to the question of confirmation is evidenced as late as Carnap's 1956 piece "The Methodological Character of Theoretical Concepts". There he first sets himself the tasks of explicating "the concept of empirical meaningfulness of theoretical terms" [Carnap (1956), p. 421] in order to go on and explicate the empirical meaningfulness of theoretical statements. His basic conclusion is that a theoretical sentence has empirical significance if it, in conjunction with certain other claims, postulates, and correspondence rules, has observational consequences not entailed by the conjunction of the claims, postulates, and correspondence rules alone. Fascinatingly, having reached that conclusion, he then in a section entitled "The Adequacy of the Criterion of Significance" starts writing of "the requirement of

confirmability" [ibid., p. 52-3]. There is absolutely no register of the possibility that the question of confirmation and the question of having empirical consequences (empirical significance) might be separated.[10]

Having teased apart the question of a demarcation condition from the question of verification and confirmation we can now briefly consider one final popular objection to Positivism in order to note that it does not in fact bear on the question of the possibility of a demarcation criterion.

1.5 The Perceived Failure of Verificationist Accounts of Meaning

The Positivists famously advocated an account of meaning according to which "[t]he meaning of a proposition is the method of its verification" [Schlick (1936), p. 148].[11] At different times this claim was allied with a more or less reductionist account of verification. For various reasons which we need not enter into here, and despite Michael Dummet's revivalist movement, verificationism as a theory of meaning remains unpopular. No doubt the Positivists often ran together the question of a demarcation criterion and the question of what is an appropriate account of meaning. As noted above the early reductionism that took a sentence's meaning to be captured by its experiential consequences naturally led to an account of demarcation in terms of verification by experiential claims. However if one takes the general insight of the Positivist vis-a-vis the question of demarcation to be that genuine scientific unlike metaphysical and pseudo-scientific claims are linked in certain logical ways with observational claims one need not be threatened by the failure of verificationist theories of meaning. Once one has abandoned reductionism one is free to pursue in a wholly Positivist spirit the claim that what

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[10] Presumably one cause of this failure to separate questions of empirical significance from questions of confirmation is a tacit assumption of some kind of hypothetico-deductive account of confirmation according to which a claim is confirmed by its (true/accepted) empirical consequences. However this complex matter cannot be fully addressed here.

[11] Wittgenstein's Tractatus is usually taken to be the origin of this claim by the Positivists themselves, for instance see Waismann (1967) and Schlick (1936). In fact Wittgenstein's Tractarian claims, such as 4.024, "To understand a proposition (Satz) means to know what is the case if it is true", are open to alternative non-verificationist interpretations. Certainly the Positivists' interpretation that to know the truth of a proposition means knowing if certain *experiential* conditions apply takes us far from anything explicitly said by Wittgenstein.

separates science from metaphysics is that only the former has observational consequences without claiming that the meaning of scientific claims is wholly captured by their observational consequences.

In general Logical Positivism has suffered under criticism that it assumes a naive, phenomenalistic, typically reductionistic empiricism. While this may have been true of various Positivists at various times it simply fails to capture the core of the Logical Positivists' enterprise. Logical Positivism is best seen as an attempt at a post-Kantian account of the nature of scientific truth, where scientific truth covers both formal and empirical sciences. One of the chief points of difference with Kant is that in accounting for geometric, mathematical and scientific knowledge they rejected Kant's category of the a priori synthetic.[12] This was largely a response to the development of non-Euclidean geometry and the triumph of the Mach-Einstein model of relative motion over the Newtonian model of absolute motion. In any case the upshot of this was that the category of the analytic was used to give an account of the truths of the formal sciences. In particular, the machinery of logical syntax was invoked, especially by Carnap, to give a formal account of the analyticity of mathematical, geometric and logical truths. The rejection of the category of a priori synthetic also left the Positivists with the task of explaining certain types of empirical truths. Again the Positivists turned to formal means seeking to define empirical truths in terms of their formal, syntactical, relations to observational claims. It is because of this emphasis on formal, primarily syntactical, constructions, that the Positivists of the Vienna School are rightly called Logical Positivists. The failure of Logical Positivism is the failure of this formal syntactical approach. Godel's incompleteness proof scuttled the attempt at a formal syntactical account of mathematical truth. The Paradoxes of Induction showed that a complete theory of confirmation would have to go beyond the mere combination of the observational-theory dichotomy and the resources of logical syntax. However what has not been

[12] Another chief point of difference with Kant is that the positivists rejected the notion of transcendental philosophy so they allowed no special kind of philosophical knowledge above scientific knowledge. Philosophy for the positivists is not a body of truths but an activity of conceptual clarification.

shown is that this failure of the syntactical approach also infects the Positivist account of demarcation. In as much as the question of demarcation was a central concern of the Positivists we may conclude that Positivism still has legs.

2. Empirical Significance, Content and Natural Axiomatizations

The fundamental technical problem facing a holistic account of empirical significance is that of specifying exactly what counts as parts of the whole. For instance, suppose we express a theory by specifying a set of axioms with the theory itself being the closure of those axioms under the consequence relation. Then consider the theory T expressed by the axiom set with the following two members,

A1: Nn. A2: Bs

where 'Nn' stands for 'The Nothings nothings' and 'Bs' stands for Sydney has a harbor bridge'. It is tempting to say that A1 does not add to the empirical significance of T since the axiom set {A1, A2} less the axiom A1 has the same empirical consequences as {A1, A2}. But consider now the alternative formulation of T

A1*: Nn A2*: Nn $\supset$ Bs.

If we delete A1* from the axiom set {A1*, A2*} we do not preserve all the empirical consequences of {A1*, A2*}. So it seems A1* is empirically significant within {A1*, A2*}. Now note, since {A1*, A2*} and {A1, A2} have the same set of deductive consequences they are in fact merely different axiomatizations, formulations, of the same theory, namely T.[13] It is tempting here to say that while both {A1*, A2*} and {A1, A2} are axiomatizations of T only {A1, A2} counts as a natural axiomatization of T. Given this notion of natural axiomatization we could then demand that in seeking whether a given sentence is a significant part of a theory we first look at its role within a naturally axiomatized version of the theory. The problem here is

[13] It was basically this type of formal problem that was at the heart of Berlin's and later Church's criticisms of Ayer's various formulations of his so-called verifiability principle. Cf. Berlin (1938) and Church (1949).

that until recently no one has been able to formulate an appropriate account of a natural axiomatization.

Before formulating an account of natural axiomatizations we need to reconsider the Positivists' notion of the content of a theory. The Positivists, in particular Carnap, took the content of a particular sentence or set of sentences to be the class of logical consequences of the sentence or set in question (see, for instance, Carnap (1935), p.56). On this reading both A2 and A2* count as part of the content of theory T. Similarly , on the Positivists view, the sentences

T1: Op v Bs

and

T2: Bs $\supset$ Nn,

where 'Op' stands for 'Paris has an opera house', count as part of the content of T. But note that if T1 counts as part of T then on the evidence that Paris has an opera house part of the content of T has been conclusively confirmed. Worse yet, on the evidence that Sydney does not have a harbor bridge part of T, namely T2, has been conclusively confirmed! The point here is that we should not count every consequence of a theory as part of its content.

Elsewhere I have developed the following account of content

α is part of the content of ß =df (i) both a α and ß are contingent, (ii) α is a consequence of ß, and for some α', α' is logically equivalent to α and there is no ψ such that ψ is stronger than α', ψ is a consequence of ß and every atomic wff that occurs in ψ occurs in α'. [See Gemes (1994) and Gemes (1997)].[14]

ß here is a variable over both single sentences (wffs) and sets of sentences and α is a variable over single sentences. We say ψ is stronger than α if and only if ψ logically entails α but α does not logically entail ψ. On this account, for instance, 'Op v Bs' does not count as part of the content of any theory that has 'Bs' itself as a consequence since 'Bs' is stronger than 'Op v Bs' yet

[14] An atomic wff α occurs in a wff β iff α literally is part of β or α is the instantiation of some open wff that is literally part of β or α is entailed by some such set of atomic wffs. Thus, for instance., 'Fa' occurs in '(x)Fx' and 'a=c' occurs in 'a=b & b=c'. The reference to logically

'Bs' only contains atomic wffs occurring in 'Op v Bs'. By the same token none of A2*, T1 or T2 count as part of the content of T, while both A1 and A2 count as content parts of T.

Natural axiomatizations of a theory should include only axioms that are content part of the relevant theory. More precisely

> T' is a natural axiomatization of theory T iff (i) T' is a finite set of wffs such that T' is logically equivalent to T, (ii) every member of T' is a content part of T' and (iii) no content part of any member of T' is entailed by the set of the remaining members of T'. (See Gemes 1993, p.483)

On this account {A1, A2} counts as a natural axiomatization of T while {A1*, A2*} does not.

This paves the way for the following account of empirical significance:

> Axiom A of a given axiomatization of theory T is an empirically significant content part of T iff for any natural axiomatization N(T) of T there is no subset S of N(T) such that S is empirically equivalent to T and A is not a content part of S.

In effect this account amounts to saying that an axiom of a given axiom set is an empirically significant part of the theory axiomatized by that set only if there is no means of deriving from a natural axiomatization of the theory all the empirical consequences of the theory without recourse to the content of the axiom in question . On this account axiom A1* of the axiom set {A1*, A2*} is not an empirically significant content part of the theory T axiomatized by {A1*, A2*} since {A1, A2} is a natural axiomatization of T such that some subset of {A1, A2}, namely {A2}, is empirically equivalent to T and A1* is not a content part of {A2}. Similarly axiom A1 of the axiom set {A1, A2} is not an empirically significant part of T since, again {A1, A2} is a natural axiomatization of T such that some subset of {A1, A2}, namely {A2}, is empirically equivalent to T and A1 is not a content part of {A2}. On the other hand, A2 is an empirically significant axiom of {A1, A2} since for any axiomatization N(T) of T and any subset S of N(T) if A2 is not a content part of S then S is clearly not empirically equivalent to T.[15]

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equivalent a' is to ensure that the relation of being a content part is closed under logical equivalence.

[15]Consider the axiom set whose sole member is the conjunctive axiom A1'. Nn&Bs. On the above account that axiom is not an empirically significant content part of T since it can be

Given our new notion of content we can thus define a notion of empirical significance which does the work of demarcating the empirically significant parts of a theory from the empirically non-significant parts of a theory in the spirit that animated the early proposals of Carnap and Ayer. In as much as we see the question of demarcation as one of the central concerns of the Positivists this amounts to at least a partial vindication of Positivism.

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reaxiomatized as {A1, A2} whose subset {A2} is empirically equivalent to T and {A2} does not contain A1' as a content part. Here one can simply accept this conclusion noting that our definition is really a definition of being wholly empirically significant. Alternatively one can rejig the definition to be definitive of when an axiom has an empirically significant content part. This would result in a definition that allows that A1' has an empirically significant content part but would still not allow that A1* has an empirically significant content part. However space considerations to not permit the full airing of these important issues which were brought to my attention by Graham Priest.

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