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WHY IS IT RATIONAL TO BELIEVE SCIENTIFIC THEORIES ARE TRUE?

1. INTRODUCTION

Alan Musgrave is one of the foremost contemporary defenders of scientific realism. He is also one of the leading exponents of Karl Popper's critical rationalist philosophy. In this paper, my main focus will be on Musgrave's realism. However, I will emphasize epistemological aspects of realism. This will lead me to address aspects of his critical rationalism as well.

Musgrave is both a scientific realist and a commonsense realist. 'Scientific realism,' he says, 'is a form of realism' (1999, p. 132). And realism is committed to the commonsense realist belief 'that there is a real world outside of us and largely independent of us' (1999, p. 132). 'There is,' Musgrave adds, 'a continuity between common sense and science' (1999, p. 132). But while science may lead to occasional revision and refinement of common sense, 'it does not show that it is root-and-branch mistaken' (1999, p. 133; cf. 1996, p. 23). The real world postulated by common sense is the reality that science seeks to explain. This world does not depend on human belief or experience. Nor is it relative to conceptual scheme, theoretical background or mode of description (1999, pp. 52, 173, 180 ff).

For Musgrave, though, realism is not just a thesis about reality. It is also a thesis about truth. Musgrave takes the aim of science to be truth. He 'subscribe[s] to the old-fashioned idea that scientific realism ... says that the aim of a scientific inquiry is to discover the truth about the matter inquired into' (1996, p. 19; cf. 1999, p. 52). Scientific theories are taken at face-value as genuine assertions about the world, the truth or falsity of which depends on the way the world really is (1996, p. 26). Musgrave understands truth in the classic correspondence sense that he takes to have been defined by Tarski. A theory or statement is true just in case the world is the

C. Cheyne & J. Worrall (eds.), Rationality and Reality: Conversations with Alan Musgrave, 109–132.

way it is said to be (1993, ch. 14; 1996, p. 24; 1999, p. 165). This is a 'non-epistemic conception of truth' (1996, p. 28; cf. 1999, p. 186). Given the emphasis on correspondence between theory and reality, Musgrave's realism diverges from the tendency among some scientific realists to adopt ontological rather than truth-orientated versions of the doctrine. Musgrave dismisses such 'entity-realism' as incoherent (1996, p. 20).[1]

Musgrave's realism has an epistemological dimension as well. For Musgrave, methodological considerations play a prominent role in the appraisal and acceptance of scientific theories. While a variety of methodological norms figures in Musgrave's writings, there is some tendency on his part to emphasize the testing and falsification of theories.[2] The attempt to falsify theories is the basis of the critical method in science. And criticism is the heart of rationality. A critical discussion may provide 'the best reason there is for believing (tentatively) that a hypothesis is true' (1999, p. 324). If a theory 'best withstands criticism then it is reasonable for scientists to believe that theory and to use it in practical applications' (1999, p. 325). Such belief must remain tentative, however. For Musgrave is a fallibilist who eschews the search for epistemic certainty in science and everyday affairs (cf. 1993, ch. 15; 1999, pp. 194 ff, 341-3).

But matters of method and rationality are separate matters from those of reality and truth. This is especially the case from the perspective of realism. In the first place, to believe that the world is a given way does not mean that the world is that way. Nor does it make the world that way. Reality is not subject to determination by human thought. This remains the case even if the belief that the world is a given way is a belief that is rationally justified. For one may rationally believe what is false. The point applies with equal force to scientific theories certified by the norms of scientific method. A theory that is certified by the norms of method is not thereby

[1] Entity realism is an ontological thesis about the reality of the unobservable ('theoretical') entities discovered by science. It contrasts with versions of scientific realism according to which the claims made about such unobservable entities by scientific theories are true or approximately true, or at least candidates for truth or falsity. Musgrave raises the following objection to entity realism: 'We are to believe in scientific entities ... without thinking true any theory about those entities .... This is incoherent. To believe in an entity, while believing nothing further about that entity, is to believe nothing. I tell you that I believe in hobgoblins (believe that the term 'hobgoblin' is a referring term). So, you reply, you think there are little people who creep into houses at night and do the housework. Oh no, say I, I do not believe that hobgoblins do that. Actually, I have no beliefs at all about what hobgoblins do or what they are like. I just believe *in* them' (1996, p. 20). Musgrave's point is that it is not possible to believe *in* the existence of some entity without having at least some beliefs *about* the entity. This is a crucial point to be made in relation to entity realism. But it does not entirely dispose of the doctrine. For, as Musgrave notes, entity realists may adopt a less extreme position according to which some low-level theoretical beliefs may be true of the theoretical entities.

[2] Since Musgrave often writes within the context of falsificationist philosophy of science, an emphasis on such issues as corroboration, independent testability, *ad hoc*ness and predictive novelty is perhaps understandable. However, within the context of scientific realism, Musgrave places special emphasis on the role of novel predictions, arguing that the success argument for scientific realism should be restricted to theories which correctly predict facts not employed in the construction of the theory (cf. Musgrave, 1999, pp. 55-7, 119, ch. 12). Other methodological criteria, such as simplicity or unity, also receive favourable mention (cf. 1999, 111-2, 247ff). Thus, despite the emphasis on falsification, Musgrave allows that the methodology of science consists of a plurality of methodological rules (cf. 1999, pp. 226-7, 250, fn 291).

shown to be true. A theory which satisfies methodological norms may yet be false. Nor need a theory that satisfies methodological norms be accepted as true. The methods of science are not the exclusive domain of realism. They may serve aims other than the realist aim of truth. Satisfaction of the norms of method might indicate empirical adequacy or pragmatic reliability, rather than truth.

An explanation is therefore required on the part of the realist of why certification by method provides warrant with respect to truth. I will refer to the need to provide such an explanation as *the problem of method and truth*. As a realist who holds that it may be rational to believe a theory which has been subjected to critical scrutiny in accordance with the norms of method, the problem of method and truth is one that Musgrave must address. That is, he must confront the question of why it is rational to believe theories certified by the methods of science to be true, or close to the truth.[3] In this paper, I will explore his response to the problem.

I will illustrate the problem of method and truth in section 2 by means of the examples of Lakatos's 'plea for a whiff of inductivism' and the internal realist conception of truth of Putnam and Ellis. In section 3, I will turn to Musgrave's approach to the problem of method and truth, where I will consider his treatment of inference to best explanation and critical rationalism. In section 4, I will explore a naturalistic approach to the problem which sets the issue within a broader metaphysical framework. Finally, in section 5, I shall offer some suggestions as to how Musgrave might put metaphysical aspects of his realist position to epistemological use.

2. THE PROBLEM OF METHOD AND TRUTH

Scientific realism enforces a sharp divide between method and truth. On the one hand, scientific method consists of a set of rules and procedures which govern experimental practice and inform the appraisal of scientific theories. A scientist whose acceptance of a theory or result complies with the rules and procedures of method is rationally justified in accepting the theory or result. On the other hand, truth consists in a relation of correspondence between a statement and extralinguistic reality. The relation of correspondence between statement and reality is a relation that may obtain whether or not one has methodologically warranted grounds for believing it to obtain. Indeed, it is a relation that may obtain whether or not the statement is believed to be true. Truth, in the correspondence sense, is a non-epistemic relation, which is not defined in terms of method or rational justification.

Given the separation of method and truth, the question arises of the relation between them. What bearing does method have on truth? Why should use of method lead to theories that are either true or approximately true? This is the problem of method and truth. To illustrate it, I will now turn to Lakatos's 'whiff of inductivism' and the internalist conception of truth that is due to Putnam and Ellis.

[3] The problem of method and truth is not restricted to truth-orientated forms of realism. For the entity realist must face exactly the same challenge of explaining why use of the methods of science leads to knowledge of the way the world is. The problem is the general one of explaining how a methodological procedure conduces to knowledge of an objective reality.

2.1 Lakatos's plea for a 'whiff of inductivism'

The problem of method and truth may be illustrated within the context of Popper's philosophy of science by means of the connection between corroboration and verisimilitude. For Popper, a theory is corroborated by successful performance in an empirical test of a prediction made by the theory. The theory receives high corroboration if it passes a range of such tests, especially ones which comprise severe tests of the theory. By contrast, the concept of verisimilitude is a measure of the truth-content relative to the falsity content of a theory, which Popper proposes as an analysis of the idea that one theory may contain more truth than another. One theory has greater verisimilitude than another if it has greater truth-content relative to falsity content than the other.

The question is whether there is any reason to believe that a theory with a higher degree of corroboration than another should also enjoy a higher degree of verisimilitude than the other. In other words, is corroboration an indication of verisimilitude?

In his contribution to *The Philosophy of Karl Popper*, edited by P.A. Schilpp, Imre Lakatos expresses the concern that Popper's 'fallibilism is nothing more than scepticism together with a eulogy of the game of science' (1974, p. 257). Lakatos's concern is precisely that, as a fallibilist and anti-inductivist, Popper is not prepared to:

> say unequivocally that the positive appraisals in his scientific game may be seen as a—conjectural—sign of the growth of conjectural knowledge; that corroboration is a synthetic—albeit conjectural—measure of verisimilitude. (1974, p. 256)

Nor may Popper assert that high corroboration provides any positive reason to believe that a theory is close to the truth.

In order to address this concern, Lakatos enters a plea for a 'whiff of inductivism' to the effect that Popper's methodology be supplemented with a 'synthetic inductive principle' (1974, pp. 254-7, 260).[4] Such a principle would connect corroboration with verisimilitude by treating the former as a 'sign' (1974, pp. 254, 256) or 'measure' (1974, p. 256) of the latter. Only in this way, Lakatos argues, can the methodological concept of corroboration and the 'logico-metaphysical' notion of verisimilitude be combined into a properly epistemological theory of the growth of scientific knowledge.

In his reply to Lakatos, Popper does not explicitly address the plea for a synthetic inductive principle. He does, however, allow that corroboration serves as an 'indication' of verisimilitude in the sense that 'we may guess that the better corroborated theory is also one that is nearer to the truth' (1974a, p. 1011). But he denies that corroboration is to be understood as in any sense a measure of verisimilitude.[5]

[4] I take Lakatos's point in describing the required inductive principle as synthetic to be that the principle is a substantive claim, the truth of which depends on facts about the way the world is. Such a principle contrasts with an analytic principle that is true in virtue of the meaning of the words 'corroboration' and 'verisimilitude'. This contrast will become clearer in section 2.2, where we will consider the internal realist conception of truth, which leads to an analytic relation between method and truth.

[5] See also Popper (1972, p. 103). For related discussion, see Newton-Smith (1981, pp. 67-70).

There is one point in the Schilpp volume, though, where Popper does seem to concede a 'whiff of inductivism'. In his reply to A. J. Ayer, Popper explains the importance of the notion of verisimilitude:

> ... there is a probabilistic though typically noninductivist argument which is invalid if it is used to establish the probability of a theory's being true, but which becomes valid (though essentially nonnumerical) if we replace truth by verisimilitude. The argument can be used only by realists who do not only assume that there is a real world but also that this world is by and large more similar to the way modern theories describe it than to the way superseded theories describe it. On this basis we can argue that it would be a highly improbable coincidence if a theory like Einstein's could correctly predict very precise measurements not predicted by its predecessors unless there is 'some truth' in it. (1974b, pp. 1192-3, fn. 165b)

Popper goes on to remark that 'there may be a "whiff of inductivism" here', which 'enters with the vague realist assumption that reality, though unknown, is in some respects similar to what science tells us' (1974b, p. 1193).

It is unclear why Popper fails to make this concession in the context of his response to Lakatos. In any event, the assumption of a real world that is 'by and large similar to the way modern theories describe it' would appear to be a metaphysical assumption of the very kind that Lakatos proposes. If there is a real world which contains the entities and laws which science tells us that it contains, then this fact is itself the explanation of why contemporary theories which say that there are such entities and laws receive high corroboration. For if the world contains things which do what a theory says they do, then that is why what the theory says about those things is true. But such an explanation may only be provided on the assumption that theories which succeed in the manner indicated by high corroboration are close to the truth.[6]

As I will attempt to show in sections 3 and 4, it is precisely such an appeal to metaphysics that is lacking from the epistemology of Musgrave's realism. In this respect, Musgrave seems to side with Popper against Lakatos in resisting the call for a metaphysical inductive principle. But, as I will attempt to show, to defend the epistemological basis of realism, the realist must put the world to good use.

2.2 Putnam on the ideal limit of inquiry

As we have seen, Lakatos proposes to bridge the gap between method and truth by means of a 'synthetic inductive principle'. An alternative approach is to close the gap in an analytic manner by defining truth in terms of method. This is the path of internal realism (e.g., Putnam, 1978, 1981; Ellis, 1980, 1990). In this section, I will

[6] This is not to say that the connection between the approximate truth or verisimilitude of a theory and its empirical success is unproblematic. In fact, it cannot be assumed that a theory with a high degree of approximate truth will be successful. For example, many of its observational claims might be false even though it contains a great deal of true theoretical claims (cf. Laudan, 1981, p. 31). But the present point is not that there is an unproblematic connection between approximate truth and success. Rather, the point is that Popper appears to make a metaphysical assumption about the nature of reality, on the basis of which some non-analytic relation between verisimilitude and corroboration might be shown to obtain.

briefly explore this path before indicating why it is not one that can be taken by the realist. Since Musgrave has forcefully argued for this conclusion, I will draw on his work in showing that realism cannot go down the internalist path.

In his (1978), Hilary Putnam notes that according to the position which he describes as 'metaphysical realism', truth is 'radically non-epistemic' (1978, p. 125).[7] For metaphysical realism, truth is a semantic relation of correspondence between linguistic items and entities in the external world. Such a concept of truth is defined independently of epistemic factors, such as evidence, confirmation or simplicity.

Putnam illustrates the non-epistemic nature of metaphysical realist truth with the example of the ideal theory which would ultimately result if science were pursued to the ideal limit of inquiry. Such a theory would maximally satisfy all methodological constraints. Putnam says the ideal theory would be:

> ... complete, consistent ... predict correctly all observation sentences ... meet whatever 'operational constraints' there are ... be 'beautiful', 'simple', 'plausible', etc... (1978, p. 125)

Given the non-epistemic nature of truth, however, it is possible that even such an ideal theory might be false. For while it might be extraordinarily unlikely for the ideal theory to be false, the fact that it maximally satisfies all methodological constraints does not entail that it is true.

Putnam rejects both metaphysical realism and the non-epistemic conception of truth.[8] He proposes instead an internal realist stance on which truth is understood in epistemic terms as an idealized form of rational justification:

> 'Truth', in an internalist view, is some sort of (idealized) rational acceptability – some sort of ideal coherence of our beliefs with each other and with our experience as those experiences are themselves represented in our belief system ... (1981, pp. 49-50)

[7] In his (1978, p. 125), Putnam describes metaphysical realism as the thesis that there is a determinate relation of reference between terms and items in a mind-independent reality. Later, in his (1981), Putnam adds that for metaphysical realism 'the world consists of some fixed totality of mind-independent objects' (1981, p. 49). While Putnam's characterization of the doctrine is perhaps intended to capture the views of many realists, it contains elements which may not be entirely acceptable to all realists. In his 'Metaphysical Realism versus Word-Magic' (2001), Musgrave argues that realists should not uncritically accept the idea of a mind-independent reality, since there is a range of mind-dependent objects (e.g., artifacts) about which one should be thoroughly realist. Musgrave also objects to the idea that there is a 'fixed totality' of mind-independent objects, since what objects there are depends on a prior specification of what sort of object is in question.

[8] Putnam presents a number of objections to metaphysical realism. One is that truth is not radically non-epistemic because the ideal theory cannot possibly be mistaken. This objection rests on his well-known model-theoretic argument against realism that since every consistent theory has at least one model, the ideal theory (which is stipulated to be consistent) must be true (1978, pp. 125-6). A second objection is that in order to describe the position of metaphysical realism it must be possible to adopt a God's eye point of view. But it is impossible to remove ourselves from our limited human perspective to adopt the external viewpoint of such an omniscient being (1981, p. 50). A third objection is that metaphysical realism opens the door to the possibility of radical scepticism, since it allows the possibility of massive illusion (e.g., evil demons, brains in vats). But such radical sceptical scenarios are not in fact possible scenarios. Hence, metaphysical realism is mistaken because it allows the possibility of such scenarios (1981, p. 15).

The internalist conception of truth differs from the metaphysical realist conception on two counts. First, it is an epistemic conception of truth which takes truth to be a form of rational acceptability. Second, because truth is idealized rational acceptability, the epistemically ideal theory produced at the ideal limit of scientific inquiry must necessarily be true.

The internal realist conception of truth provides a clear example of one way to deal with the problem of method and truth. The internalist closes the gap between method and truth by setting up an analytic or conceptual relation between method and truth. If truth just is a form of rational justification, then a theory which satisfies methodological standards of theory-acceptance is to be accepted as true, or nearly so. For that is what it is to be true. Equally, a theory which better satisfies methodological standards than a predecessor thereby displays a higher degree of truth, since increased satisfaction of such standards constitutes increase of truth.

Such an analytic resolution of the problem of method and truth is not, however, one that is open to the scientific realist. For, as Musgrave has argued, the internalist conception of truth leads to an idealist metaphysics that is unacceptable to realists. In his paper, 'The T-Scheme Plus Epistemic Truth Equals Idealism' (1999, ch. 10; cf. 1996, p. 30), Musgrave argues that epistemic theories of truth, such as internal realism, entail the dependence of reality upon belief.[9] According to Musgrave (1999, p. 188), 'the general form of an epistemic truth theory' is as follows:

(E) Necessarily, S is true if and only if S satisfies epistemic condition E.

To obtain a particular epistemic theory of truth from this general form, it suffices to replace the epistemic condition E with the preferred epistemic condition of the relevant truth theory.

Musgrave employs the example of Brian Ellis's evaluative theory of truth, which is a form of internal realism closely related to Putnam's. According to Ellis, truth is what it is epistemically right to believe. So we have:

Necessarily, S is true if and only if it is epistemically right to believe S.

Now, given the T-scheme:

(T) S is true if and only if P,

Ellis's evaluative theory of truth entails that:

Necessarily, P if and only if it is epistemically right to believe S.

Thus, to take a particular example (Musgrave 1999, p. 189)

(ET) Electrons exist if and only if it is right to believe that electrons exist.

[9] For related analysis, see Devitt and Sterelny (1987, p. 196).

But, surely, Musgrave points out, (ET) might be false. There might be no electrons even though 'our best methods optimally pursued ... lead us to think electrons exist' (1999, p. 189). The only way for (ET) to be true is for the world to depend on our methods of inquiry or our theories in idealist fashion. In this case, electrons would exist if that is what our methods of inquiry and theories lead us to believe. But that is evidently not something that a realist can accept.

2.3 The problem restated

Lakatos's plea for a 'whiff of inductivism' and Putnam's and Ellis's internalist conception of truth represent two different approaches to the problem of method and truth. The question is why we should suppose that the rules of method have any positive bearing on truth. The response proposed by Putnam and Ellis is to define truth in terms of method. But such a response is unavailable to the realist who takes truth to be non-epistemic, as Musgrave does. The other response which we have seen is to appeal to a synthetic metaphysical principle in the manner suggested by Lakatos with his 'plea for a whiff of inductivism'. But this response appears not to be the response favoured by Musgrave, as we shall now see.

3. MUSGRAVE ON METHOD AND TRUTH

As a scientific realist, Musgrave adheres to the view that it may be rational to believe that a scientific theory is true. A theory which passes critical scrutiny by means of the rules of scientific method may be accepted as true, where truth is understood in the non-epistemic sense of the realist. The question is why it is rational to believe that a theory which satisfies the rules of method is true. If truth is non-epistemic, then what does method have to do with it?

In this section, I will consider two answers that have been proposed by Musgrave. The first involves the idea that it is reasonable to believe the best explanation of a fact. The second is that it is rational to believe the hypothesis which best survives criticism. As we will see, neither approach succeeds in showing why it is rational to believe a theory to be true.

3.1 'The Ultimate Argument for Scientific Realism'

The standard argument for scientific realism is the so-called 'success argument', or, as Musgrave calls it, 'the Ultimate Argument'.[10] According to scientific realism, the entities postulated by mature scientific theories by and large exist, and the claims that theories make about those entities are by and large true, or close to the truth. Such a realist account of the relation between theories and the entities they postulate provides a compelling explanation of the empirical success of science. For if the entities postulated by a theory exist, and what the theory says about the entities is

[10] The name, 'the ultimate argument', is due to van Fraassen (1980, p. 39), who is one of the targets of Musgrave (1988).

true, then it is no surprise that the theory should meet with empirical success. By contrast, any anti-realist philosophy which rejects the realist view of the relation between theories and the entities they postulate must render the success of science an inexplicable miracle (cf. Putnam, 1975, p. 73). But to say that the success of science is a miracle is to fail to provide an adequate explanation of such success. Since realism provides a compelling explanation of success, and anti-realism fails to provide an adequate explanation, realism is evidently the best explanation of the success of science.

In his paper, 'The Ultimate Argument for Scientific Realism' (1988, pp. 232-9), Musgrave presents an analysis of the success argument.[11] It is standard practice to construe the success argument as an inference to the best explanation. In line with this practice, Musgrave also construes the argument as an inference to the best explanation. However, in a novel departure, Musgrave argues that application of the success argument is to be restricted to theories which successfully predict novel facts. He formulates the argument as an epistemic argument to the effect that it is reasonable to accept realism, rather than to the effect that realism is true. He further stipulates that in order to be acceptable, the best explanation must satisfy minimal conditions of explanatory adequacy. Otherwise, it would not be reasonable to accept the best explanation as true.

Opinion is divided over the nature of inference to the best explanation. Some take it to be a form of inductive inference. Others take it to be a *sui generis* form of inference that is more fundamental than induction (cf. Harman, 1965). Perhaps the most novel feature of Musgrave's analysis of the success argument is his suggestion that inference to the best explanation may be formulated as a deductive inference.

Musgrave proposes that inference to the best explanation be construed in deductive form as follows:

> It is reasonable to accept a *satisfactory* explanation of any fact, which is also the best available explanation of that fact, as true.
> *F* is a fact.
> Hypothesis *H* explains *F*.
> No available competing hypothesis explains *F* as well as *H* does.
> Therefore, it is reasonable to accept *H* as true. (1988, p. 239)

He then comments that 'the Ultimate Argument for scientific realism ... is an inference to the best explanation':

> The fact to be explained is the (novel) predictive success of science. And the claim is that realism ... *explains* this fact, explains it *satisfactorily*, and explains it *better* than any non-realist philosophy of science. And the conclusion is that it is reasonable to accept scientific realism ... as true. (1988, p. 239).

On such a construal, the success argument is a valid deductive argument. The fact to be explained is the novel predictive success of science. The conclusion of the

[11] I refer here to the original version of Musgrave's article in Nola (1988). The paper is reprinted in Musgrave (1999). However, the section of the article on inference to best explanation, which is of central relevance to scientific realism, has been removed. It appears, instead, in the context of a discussion of psychologism (1999, pp. 284-5).

argument is an epistemic conclusion to the effect that it is rational to believe realism to be true. For realism is the best explanation of predictive success. The conclusion depends crucially on the epistemic principle that it is reasonable to accept the best satisfactory explanation of a fact as true, which figures as the initial premise of the argument.

Musgrave's analysis of the success argument is an important advance in a number of respects. The emphasis on predictive novelty is important because it may be employed to eliminate a number of historical counterexamples which have been proposed to the success argument.[12] Musgrave's formulation of the success argument in epistemic terms makes clear that the argument must play a pivotal role in response to anti-realist critics who object to scientific realism on epistemological grounds. His emphasis on minimal conditions of explanatory adequacy is crucial, since it excludes the possibility that the best available explanation fails to be a satisfactory explanation. Finally, the explicit use of the epistemic principle in the argument makes evident the extent to which the success argument depends on the assumption of the epistemic importance of explanation.

Despite initial appearances, however, Musgrave's analysis of the success argument provides little assistance in relation to the problem of method and truth. To see this, let us further examine the notion of a *best* explanation. On what might the judgement that a theory is the best explanation be based? Musgrave does not elaborate. But it seems reasonably clear that the assessment of the explanatory merit of a scientific theory will depend upon methodological criteria of theory appraisal. Relevant criteria will include considerations of explanatory strength and unification, as well as simplicity, coherence and fit with background knowledge.[13] But since truth is understood by Musgrave in the non-epistemic, realist sense, it is unclear why theories which satisfy such methodological criteria should be accepted as true.

The question is why it is reasonable to accept the best explanation as true. Might it not be equally reasonable to accept the best explanation as empirically adequate, useful for practical purposes, or even true in some non-realist sense? Nothing Musgrave says in support of the principle that it is reasonable to accept the best explanation as true shows that the anti-realist might not accept an anti-realist

[12] It is a major weakness of earlier formulations of the success argument that the notion of success is imprecisely defined. If success is left overly vague, the success argument is vulnerable to historical counterexamples, such as those presented by Laudan of theories which attained a degree of success but were false and/or non-referential (Laudan, 1981).

[13] It is an interesting question whether evidential considerations, such as confirmation or corroboration, are of relevance to assessment of explanatory merit. Musgrave develops his analysis of inference to the best explanation as a modification of C.S. Peirce's idea of abduction. However, in his definition of abduction Peirce himself seems to exclude evidential considerations as irrelevant: 'The first stating of a hypothesis and the entertaining of it, whether as a simple interrogation or with any degree of confidence, is an inferential step which I propose to call *abduction* [or *retroduction*]. This will include a preference for any one hypothesis over others which would equally explain the facts, so long as this preference is not based upon any previous knowledge bearing upon the truth of the hypothesis, nor on any testing of any of the hypothesis, after having admitted them on probation' (Peirce, 1955, p. 151). This passage suggests that, for Peirce at least, an explanation may be evaluated *qua* explanation independently of any evidence which might be gained by empirical test of the explanation.

analogue of the principle. Nor does Musgrave provide an explanation of why it is reasonable to accept the best explanation as true.

It might, however, be thought that the issue is not whether the best explanation is to be accepted as true. Rather, the issue is whether realism is the best explanation. Musgrave addresses this issue in the pages that follow his analysis of the success argument (1988, pp. 240-4). He considers a range of anti-realist explanations of predictive success, and argues that all provide inferior explanations to the realist explanation. On the assumption that realism has been shown to be a superior explanation to anti-realism, it might therefore appear that realism is to be accepted as true.

But this only succeeds in pushing the problem back another level. Even if it is granted that realism is the best explanation of the success of science, it does not follow that it is to be accepted as true. There are other possible modes of acceptance available at this level, apart from acceptance as true. For example, one might simply agree that realism is the best explanation without proceeding to accept it as true. Alternatively, one might merely accept realism as if it were true. Or realism might be accepted as true, but truth might be understood in some non-realist sense. Nothing about best explanation, as such, clearly precludes such alternative forms of acceptance.

In sum, to show that a theory is the best explanation of a fact does not entail that the theory is to be accepted as true. Given this, Musgrave's analysis of the success argument in terms of an epistemic principle of best explanation does not succeed in showing why it is rational to accept a theory as true. It does not, in other words, provide a response to the problem of method and truth.

3.2 Critical rationalism

I turn now to a second context in which Musgrave addresses issues which relate to the problem of method and truth. In his treatment of Popper's solution of the problem of induction, Musgrave proposes a critical rationalist account of scientific theory acceptance (1999, ch. 16). I will now consider the implications of Musgrave's critical rationalism with respect to the problem of method and truth.

Popper's philosophy of science is sometimes described as 'negativist' (cf. Lakatos, 1974, p. 258). In an attempt to solve Hume's problem of induction, Popper dismisses induction as a myth. Instead of offering a positive justification of induction, Popper argues that the attempted falsification of a theory may provide rational grounds for tentative acceptance of the theory. It is possible neither to prove that a theory is true nor to provide inductive support for the theory. However, if a theory has survived rigorous empirical tests, then it may be rational to tentatively accept the theory.

Since Popper denies that there may be any grounds which provide positive support for a theory, the question arises of how his claim that it may be rational to accept a theory is to be understood. To address this question, it is necessary to introduce a distinction between Popper's critical rationalist account of rationality and the traditional justificationist conception of rationality to which Popper's account is

opposed. Perhaps what most fundamentally characterizes Popper's account of rationality is his outright dismissal of the justificationist conception of rationality.

The justificationist conception of rationality is the conception of rationality that underlies most traditional and contemporary thinking about rational belief. According to justificationism, in order to have a rational belief the belief itself must be rationally justified. There must be reasons which provide support for the belief.

Musgrave characterizes justificationism by means of the following principle:

> (J) A's believing that P is reasonable if and only if A can justify P, that is, give a conclusive or inconclusive reason for P, that is, establish that P is true or probable. (1999, p. 321)

As this formulation of justificationism makes clear, reasons may either be conclusive or inconclusive. Conclusive reasons are reasons which show that a belief is true. Inconclusive ones merely show it to be likely or probable. In either case, rational belief requires there to be reasons which support the belief itself.

By contrast with justificationism, critical rationalists deny that there may be reasons for a belief or theory. But this does not mean that there is no rationality. On the contrary, as Popper remarked, 'there is nothing more "rational" than the method of critical discussion, which is the method of science' (1972, p. 27). Criticism, rather than justification, is the key to rationality.

Accordingly, Musgrave offers the following principle as formulation of critical rationalism:

> (CR) It is reasonable to believe that P (at time t) if and only if P is that hypothesis which has (at time t) best withstood serious criticism. (1999, p. 324)

In other words, if a hypothesis is subjected to serious criticism and survives, while alternative hypotheses do not, there is good reason to accept the hypothesis which stands up to criticism in favour of those which succumb to it. By contrast with justificationism, such a conception of rationality does not involve good reasons for a hypothesis. It is belief in the hypothesis, rather than the hypothesis itself, for which there may be good reason. Critical rationalism alters the locus of rationality. 'It is', Musgrave explains, 'acts of belief (actions of believing?) that are reasonable or rational, not the things we believe, belief-contents, propositions, theories, or whatever' (1999, p. 322).

On Musgrave's analysis of critical rationalism, it is rational to believe 'the theory which best survives critical scrutiny' (1999, p. 330). To believe a theory is to believe that it is true (cf. 1999, pp. 321, 326). And the method of criticism is the method of science. The critical rationalist account of theory acceptance is therefore of clear relevance to the problem of method and truth. For the critical rationalist asserts that survival of critical scrutiny provides the basis for rational belief in the truth of scientific theories.

But what is it for the method of criticism to be the method of science? As earlier noted, within the context of a Popperian falsificationist theory of method, the primary means of criticism is the attempt to falsify a theory by rigorous empirical test. Within a strictly falsificationist framework, it is possible to criticize a theory in a variety of ways. A theory may entail a false prediction or it may be unfalsifiable. It might predict no novel facts, be poorly corroborated, or be *ad hoc*. But there is no need for the method of criticism to be restricted to strictly falsificationist resources. A theory might also be criticised on grounds which have no immediate connection with empirical falsification as such. For example, a theory might lack coherence, be overly complex, have limited explanatory scope, or be inelegant.

A variety of methodological considerations may therefore play a role in the critical method. But it remains to be asked how the critical method warrants belief in the truth of a theory. By itself, the rejection of justificationism does not suffice to resolve the problem of method and truth. If truth is non-epistemic, and the critical method is the basis of theory acceptance, the connection between method and belief in the truth is left entirely unexplained.

It would be misguided to suppose that survival of criticism provides positive support for a theory. For the critical rationalist, survival of rigorous test or other attempts to criticize a theory does not lend positive support to a theory. To assume that criticism yields positive support is to assume a justificationist conception of rationality. But, for the critical rationalist, survival of criticism does not prove that a theory is true, nor does it render the theory more likely to be true. It does not provide any positive justification for the theory at all. Rather, survival of criticism provides one with a basis to tentatively believe in the truth of a theory, as opposed to alternative theories which have been exposed to criticism and failed to survive.

The trouble is that nothing has been done to secure belief in truth as the unique mode of theory acceptance. It is possible to agree with the critical rationalist conception of scientific inquiry, but to deny that theories are to be accepted as true. To take but one example, it would be perfectly consistent for an anti-realist to endorse the critical method while at the same time embracing a constructive empiricist view of theory acceptance along the lines of Bas van Fraassen (1980).[14] On such an account, it would be rational to accept a theory which best withstands critical scrutiny. But the theory is to be accepted as empirically adequate, rather than as true. That is, it is to be accepted as true at the observable level, without commitment to the truth of its non-observational content.

Nothing about the critical method entails that a theory which survives criticism is to be accepted as true. Critical rationalists are fallibilists. As such, critical rationalists themselves insist that a theory which survives rigorous empirical test may fail to be true. But, if it does not follow from survival of criticism that a theory is true, then neither does it follow that the theory is to be accepted as true. There is

[14] Indeed, van Fraassen comes close to such a position when he remarks that 'the success of current scientific theories is no miracle. It is not even surprising to the scientific (Darwinist) mind. For any scientific theory is born into a life of fierce competition, a jungle red in tooth and claw' (1980, p. 40). Of course, this remark is made in the context of van Fraassen's discussion of the realist's success argument. But the talk of fierce competition suggests that van Fraassen approaches the question of theory acceptance with a decidedly Popperian cast of mind.

nothing about the notion of criticism as such which requires one to believe that a theory which survives criticism is true.

Musgrave introduces a modification of critical rationalism which may seem to go some way toward disarming this objection. The modification relates to the 'epistemic primacy' of perception (1999, p. 342). Perception is the source of the empirical evidence which is employed to test our theories. But on what basis are perceptual reports accepted? In ordinary circumstances, perceptual reports are not accepted as the result of test. Rather, they are accepted at face value. Perception is only subjected to test when something goes wrong. As Musgrave notes, "only when we have some specific reason to suspect perceptual error do we 'check out' a perceptual belief"(1999, p. 342). But if it may be rational to accept a perceptual report which has not been subjected to test, then survival of criticism cannot be necessary for rational belief.

This point requires that critical rationalism be amended. For if it may be rational to accept a perceptual belief without submitting it to test, then it may be rational to accept such a belief without it having survived criticism. Musgrave, therefore, introduces a distinction between perceptual and non-perceptual beliefs:

> A non-perceptual belief is reasonable if it has best withstood criticism—a perceptual belief is reasonable if it has not failed to withstand criticism. The latter is just the commonsense view 'Trust your senses unless you have a specific reason not to'. (1999, p. 342)

On the modified version of critical rationalism to which this distinction gives rise, rational theory acceptance requires survival of criticism. But perceptual belief is rational provided only that no problem has so far arisen with respect to the perception on which it is based.

But even if the primacy of perception is granted, this does not affect the objection. It may simply be conceded that perception provides a *prima facie* rationale for the acceptance of a perceptual report. No such rationale is thereby provided for theory acceptance. This is particularly apparent in light of Musgrave's epistemic distinction between perceptual and non-perceptual belief. The primacy of perception specifically relates to perceptual belief. Nothing follows from the primacy of perception with respect to the rationality of non-perceptual belief. If the primacy of perception is to be of any relevance to theory acceptance, then an additional assumption is required which extends the primacy of perception to the non-perceptual realm.

The point may be illustrated by means of the earlier example of the constructive empiricist version of critical rationalism. Such a constructive empiricist accepts the critical rationalist account of theory acceptance with the qualification that theories which survive criticism are to be accepted as empirically adequate. It is entirely consistent with such a position to grant the epistemic primacy of perception, and to agree that perception provides a *prima facie* rationale for perceptual belief. But the primacy of perception only entails that perceptual beliefs be accepted as true. It does not extend to the level of theory. Hence, the constructive empiricist may restrict theory acceptance to empirical adequacy.

Thus, even if the primacy of perception is granted, it does not follow that theories which pass critical scrutiny need be accepted as true. Given this, and the earlier point that survival of critical scrutiny does not entail belief in the truth of a theory, I conclude that the critical rationalist position presented by Musgrave does not resolve the problem of method and truth. It remains to be shown why use of the critical method provides any reason to believe that a theory is true.

3.3 Epistemic versus metaphysical principles

We have now considered two approaches proposed by Musgrave which are of relevance to the problem of method and truth. Both of the approaches are based on epistemic principles of rational belief. As such, both of the approaches proposed by Musgrave contrast with the approaches to the problem of method and truth canvassed in sections 2.1 and 2.2.

In section 2.1, we considered Lakatos's 'plea for a whiff of inductivism' that Popper's methodology be supplemented by a metaphysical principle which connects corroboration with verisimilitude. Such a principle would consist of a substantive synthetic claim about the world in the light of which corroboration is revealed to be an indication of verisimilitude. By contrast, Musgrave's epistemic principles say nothing about the world. Instead, they specify conditions under which it may be rational to believe a proposition or hypothesis to be true.

In section 2.2, we considered the analytic approach to the problem of method and truth that is due to internal realism. The internalist identifies truth with satisfaction of methodological criteria. Given such an identification, it may be rational to believe that a theory which satisfies methodological criteria is true. For that is what it is to be true.

By contrast with internal realism, Musgrave is a realist for whom truth is a non-epistemic correspondence relation. As such, Musgrave must reject the analytic approach on two counts. As a realist, he must reject the internalist conception of truth because of the idealism to which it leads. And as an advocate of a non-epistemic conception of truth, he must reject the internalist identification of truth with satisfaction of epistemic criteria.

But while it is clear that Musgrave must reject the analytic approach, it is not entirely clear why he rejects metaphysical principles in favour of epistemic principles of rational belief. It may be that Musgrave rejects metaphysical principles because he takes them to be inductive principles of the uniformity of nature of a kind that Hume showed to be unjustified (cf. Musgrave, 1993, pp. 157ff). It may be that he takes the rejection of justificationism to entail the rejection of metaphysical principles (cf. 1999, p. 327). It may be that he takes there to be no need for metaphysical principles over and above scientific theories which may be accepted on critical rationalist grounds (1999, pp. 328-9). It may be that he takes such principles to rest on an anthropocentric metaphysics (1999, pp. 283, 285). Or perhaps the point is simply that realism should avoid excess metaphysical commitment (1999, p.131).

Whatever Musgrave's exact reason for rejecting metaphysical principles may be, I shall now attempt to show that such principles are necessary in order to solve the

problem of method and truth. The truth of an empirical claim about the world depends upon the way that the world in fact is. In order to show that use of an epistemic method leads to such truth about the world, it is necessary to say something about the world. Otherwise, no connection is made between method and truth. In short, the problem of method and truth is at least partly one of metaphysics.[15]

4. METAPHYSICS AND NATURALISM

In my own recent work, I have sought to develop a naturalistic response to the problem of method and truth. I understand the rules of method in instrumental fashion as means for the pursuit of the aims of inquiry. The relation between epistemic means and ends is a synthetic relation, rather than an analytic one. Hence, the reliability of rules of method may be subject to empirical appraisal. For it is an empirical matter whether use of a particular method reliably conduces to a given cognitive goal.[16] Empirical evidence cannot directly reveal use of a method to lead to truth at the theoretical level. However, I argue that the best explanation of the role played by method in the success of theoretical science is that the rules of method are reliable means of promoting the realist aim of truth (Sankey, 2000, 2002).

I shall say nothing further about my approach to this issue, other than to locate it within the broader perspective of which it forms part. This perspective reflects a non-anthropocentric conception of human inquirers and their place in our environing reality. We humans are organisms who inhabit a pre-existing natural world. We interact with this world. But we did not create it. Its basic structure and composition are independent of us. Yet our survival requires that we act in the world. To promote survival, our actions must be informed by reliable knowledge of our environment. But it cannot be known *a priori* how best to acquire such knowledge. This is a contingent matter which depends on our epistemic capacities and their relation to the world. We can only learn such things by empirical investigation of ourselves and our surroundings.

This perspective is a blend of epistemological and metaphysical ingredients. It combines claims about reality with claims about our knowledge of reality. Within such a perspective, epistemological claims may derive support from metaphysical claims. For example, general considerations about the nature of reality may be

[15] Musgrave is not completely dismissive of metaphysical principles. Against those who treat laws and theories as inference licenses, Musgrave claims that they may be under the influence of a positivistic bias against metaphysics (1999, p. 283). Moreover, he notes against positivism that metaphysical principles of theory construction may play a significant role in science and may even be subject to rational appraisal (1999, p. 309).

[16] I follow Laudan (e.g., 1996, ch. 7) in endorsing a form of normative naturalism. According to normative naturalism, the epistemic warrant for a rule of method derives from empirical evidence of reliable promotion of the cognitive aims served by the rule. In contrast with Laudan, however, I set normative naturalism within a realist framework on which the methods of science are seen as reliable means of advancing toward the realist aim of truth (cf. Sankey, 2000). As will become apparent in section 4.1, my approach also has certain affinities with the methodological pragmatism of Rescher (e.g., 1977), who treats methods as cognitive instruments subject to empirical appraisal and pragmatic justification.

employed to explain why certain methods of inquiry constitute a reliable means of inquiry into that reality.

To illustrate the relevance of metaphysical considerations to the problem of method and truth, I will now examine two examples of the epistemological application of metaphysical considerations. The first case is that of Nicholas Rescher's methodological pragmatism. The second is Hilary Kornblith's grounding of inductive inference in natural kinds.

4.1 Rescher's methodological pragmatism

For the classical pragmatist, a true proposition is one the acceptance of which leads to practical success. Rescher refers to such pragmatism as thesis pragmatism, since it relates to specific propositions or theses. He rejects the pragmatist view of truth in favour of a correspondence conception. Instead of thesis pragmatism, he proposes a methodological pragmatism, which applies the criterion of practical success at the level of the methods of inquiry (Rescher, 1977). The rules of method are to be evaluated in the manner of instruments in terms of their success in practical application. If a rule reliably performs the function for which it is designed, it thereby receives pragmatic justification (1977, pp. 3-4). By contrast, individual claims are not practically justified, but receive indirect support from the methods by which they are certified (1977, pp. 71-2).

For Rescher, pragmatically warranted methods of inquiry are to be regarded as 'truth-indicative' (1977, p. 83).[17] A proposition which satisfies a rule of method is therefore to be accepted as true. Thus, while truth and utility are distinct at the level of propositions, Rescher takes pragmatic success to have a bearing on truth at the level of method. Because Rescher takes certification by rules of method to warrant acceptance as true, his methodological pragmatism is therefore of relevance to the problem of method and truth. The question is why practical justification of method should be taken to be truth-indicative. The answer, as we shall now see, turns on metaphysical considerations.

In order to explain how practical success relates to truth, Rescher places the use of method within a broader metaphysical setting. This is characterized by the following principles which relate to human agency, the community of inquirers and the nature of reality (1977, pp. 84-9). *Activism*: our survival and welfare require action on our part; since we act on the basis of beliefs, our beliefs are of practical relevance. *Reasonableness*: belief guides action in a way that coordinates action with beliefs and needs. *Interactionism*: our active intervention in the world produces outcomes which may either satisfy or frustrate our intentions. *Purposive constancy*: to establish the reliability of a method, inquirers must employ the same method for

[17] Rescher's expression 'truth-indicative' may seem to suggest that a proposition that satisfies a methodological rule is thereby definitively shown to be true. Indeed, Rescher sometimes uses the expression 'truth-criterion' (e.g., 1977, p. 81), which may suggest that satisfaction of a rule suffices to establish the truth of a proposition. But I do not think that Rescher takes satisfaction of a rule to be criterial for truth in the sense that it either constitutes or demonstrates truth. Rather, satisfaction of a rule provides a warrant or justification for acceptance of the proposition as true (cf. 1977, pp. 79-80).

the same purpose. *Uniformity of nature*: continued use of a method depends upon the underlying constancy of nature and the conditions of application of the method. *Nonconspiratorial nature of reality*: nature is indifferent to our beliefs and needs, neither conspiring for nor against belief-based actions.

Against this metaphysical backdrop, Rescher argues that a method of inquiry whose use systematically meets with success is to be seen as truth-indicative. False belief may sometimes lead to success, but it could hardly be supposed to do so on a routine basis:

> Isolated successes can be gratuitous and probatively impotent, but the situation will be otherwise when what is at issue is not isolated actions based on particular beliefs, but a general policy of acting, based on a generic and methodologically universalised standard of belief-validation. When one views man as a vulnerable creature in close interaction with a hostile (or at best neutral) environment, it is—to be sure—conceivable that action on a false belief or even set of beliefs might be successful, but it surpasses the bounds of credibility to suppose that this might occur systematically, on a wholesale rather than retail basis. Given a suitable framework of metaphysical assumptions, it is effectively impossible that success should crown the products of systematically error-producing cognitive procedures. (1977, pp. 89-90)

Here, in a manner that recalls the rejection of miracles in the success argument (cf. section 3.1), Rescher dismisses the idea of a pragmatically successful but systematically erroneous method as incredible. The crucial factor is the rational implementation of belief in what Rescher describes as a 'highly reactive environment' (1977, p. 84), 'a duly responsive nature' that is 'complex and volatile' (1977, p. 91). In such a world, a method of belief-formation that regularly gives rise to successful practical action cannot, in Rescher's words, be 'systematically error-producing'. Quite the contrary, it must surely be 'truth-indicative'.

I shall delve no further into the intricacies of Rescher's methodological pragmatism, though pertinent questions might usefully be raised regarding the line of reasoning that underlies the proposed metaphysical rationale for the truth-indicativeness of method.[18] The purpose of my discussion of Rescher is simply to illustrate how metaphysical considerations may be brought to bear on the problem of method and truth. To further illustrate this, I will now turn to Kornblith's account of the ground of inductive inference.

[18] It is, however, important to note two issues to which Rescher's approach immediately gives rise. The first is the apparent circularity involved in drawing upon substantive principles about the world in arguing that methods of inquiry yield truths about the world. Rescher admits the circularity. Instead of being vicious, however, he seeks to show that the justification of method by practice is cyclical and self-supporting (1977, ch. 7). The second is the nature of the reasoning from metaphysical principles to the truth-indicativeness of inquiry procedures. In our (2000a, p. 51), Robert Nola and I assimilate the reasoning involved to inference to the best explanation. However, Rescher resists this interpretation (private communication). He argues that it is instead an inference to best systematization. (See Rescher, 2001, ch. 10 for comparison of inference to the best explanation with inference to the best systematization.)

4.2 Kornblith's natural ground of induction

In his book, *Inductive Inference and its Natural Ground*, Hilary Kornblith proposes a naturalistic account of the reliability of induction. The account combines psychologically informed epistemology with a realist metaphysics of natural kinds. Kornblith takes epistemology to be directed to two questions: '(1) What is the world that we may know it?; and (2) What are we that we may know the world?' (1993, p. 2). His reply is that mind and world fit together. On the one hand, properties which occur together in natural kinds make reliable induction possible. On the other hand, our minds are naturally equipped with a conceptual and inferential apparatus tuned to the natural kind structure of the world.

Kornblith adopts Richard Boyd's account of natural kinds as homeostatic property clusters (Boyd, 1991). According to this account, natural kinds comprise complexes of properties which form relationships of homeostatic equilibrium (Kornblith, 1993, pp. 35-6). Such cohesive properties work together to maintain the stability of a substance or organism. However, not all sets of properties may enter homeostatic equilibrium, since 'only certain arrangements will form stable configurations in a homeostatic relationship' (1993, p. 36). It is precisely because the formation of homeostatic relationships is subject to constraints that natural kinds may ground induction. Given that properties may only be conjoined in limited ways, it is possible to'reliably infer the presence of some of these properties from the presence of others' (1993, p. 36).

Kornblith takes the success of science to show that natural kinds are the ground of induction (1993, pp. 41-2). Such success is due to the development of theories about the unobservable structures that underlie the observable properties of things. The classifications devised on the basis of such theories reflect real divisions between natural kinds of things, rather than merely nominal or interest-relative kinds.

> Inductive inferences can only work, short of divine intervention, if there is something in nature binding together the properties which we use to identify kinds. Our inductive inferences in science have worked remarkably well, and, moreover, we have succeeded in identifying the ways in which the observable properties which draw kinds to our attention are bound together in nature. In light of these successes, we can hardly go on to doubt the existence of the very kinds which serve to explain how such successes were even possible (1993, p. 42).

Thus, Kornblith argues that the reliable use of induction in science can only be explained by means of real natural kinds which support induction. It is only if the properties of a member of a kind form a union on the basis of which they must co-occur that induction which projects such properties to unobserved members of the kind could possibly succeed on a reliable basis.

To complete the fit between mind and reality, Kornblith argues that the human mind is disposed to form concepts and draw inferences in ways that reflect real natural kinds. However, I shall not discuss this issue here, since my principal aim in discussing Kornblith is to draw attention to the role of metaphysics in dealing with the problem of method and truth. Kornblith explains the reliability of induction on the basis of real kinds in nature. It is because members of a natural kind share

properties in common with other members of the kind that our inductions about the properties of members of the kind prove to be reliable. Thus, Kornblith employs facts about the nature of reality to explain why induction is reliable. He therefore employs metaphysical considerations to explain why use of a method of inquiry leads to truth.

4.3 The moral of the metaphysical story

The approaches of Rescher and Kornblith represent two contrasting approaches to the problem of method and truth. Rescher argues that success in practical application reveals the truth-indicative character of rules of method. Kornblith takes successful use of induction to require the existence of real kinds in nature which make reliable induction possible. Rescher emphasizes the practical implementation of method, while Kornblith draws on empirical research. Rescher's approach forms part of a general theory of the nature and justification of method, whereas Kornblith's account is restricted to the reliable use of induction.

But, despite the contrasts, the approaches of Rescher and Kornblith are united by a deeper commonality. For both approaches exemplify a synthetic solution to the problem of method and truth, which employs metaphysical considerations to establish a connection between method and truth. Both Rescher and Kornblith appeal to the success of science and action in order to argue that our methods provide epistemic warrant with respect to the truth of our beliefs and theories. Both approaches locate the success of method within a broader metaphysical framework which involves assumptions about the nature of the world we inhabit as well as about ourselves as actors and inquirers. Moreover, the metaphysical assumptions employed by both approaches are all broadly consonant with realism.[19]

The latter point deserves emphasis. In their attempt to connect method with truth, both Rescher and Kornblith deploy metaphysical assumptions that are realist in spirit. Such assumptions cannot therefore be rejected by the realist on metaphysical grounds. The question is whether such metaphysical assumptions should be allowed to play the epistemological role which Rescher and Kornblith ascribe to them. Yet it is entirely unclear how to solve the problem of method and truth in the absence of metaphysical assumptions. I therefore see no alternative but to put the realist's metaphysical assumptions to epistemological use in a manner such as that illustrated by Rescher and Kornblith.

[19] That the metaphysical considerations to which Rescher and Kornblith appeal are broadly consonant with realism is perhaps most tellingly illustrated by noting that both of their approaches are compatible with a metaphysical realist commitment to an objective, mind-independent reality. Rescher adopts a general principle of uniformity of nature, while Kornblith opts for a somewhat more substantive metaphysics of natural kinds. But both the commitment to the uniformity of nature and to the reality of natural kinds are entirely consonant with a metaphysical realist commitment to mind-independence.

5. CONCLUSION

In this paper I have sought to raise the problem of method and truth as a challenge to epistemological aspects of Alan Musgrave's scientific realism. The paper has been largely an exercise in comparative epistemology, which examines alternative solutions to the problem. In line with Musgrave's analysis of the inherent idealism of internal realism, I have argued that the internal realist solution to the problem is not available to the scientific realist. I have also sought to show that Musgrave's own appeal to strictly epistemic principles fails to provide a satisfactory solution to the problem, since such principles do not preclude anti-realist forms of theory-acceptance. By contrast, I have attempted to show that metaphysical considerations are necessary in order to explain why satisfaction of methodological norms warrants acceptance of a theory as true. In this final section, I seek to extract relevant lessons from my analysis with respect to the epistemology of Musgrave's scientific realism.

In the first place, as a realist, Musgrave should have no particular cause to baulk at metaphysical assumptions of the sort described in the previous section. For example, the metaphysical principles introduced by Rescher in relation to human agency, causal interaction and the nonconspiratorial nature of reality, are in full accord with realism.[20] The principles are compatible with a realist commitment to an objective, mind-independent reality. They are no more, at base, than an articulation of a commonsense view of ourselves, our surroundings and our relationship to those surroundings. And, in Musgrave's view at least, the scientific realist is not just a realist about science but a realist about common sense as well.

But Musgrave might baulk at appeal to the uniformity of nature. The reason would not be his realism, though, but his anti-inductivism (see Musgrave, 1993, ch. 9). Here Musgrave's realism must simply be played off against his anti-inductivism. For what is it to be a scientific realist, if it is not to say that there is a real world in which observed phenomena are brought about by the action of unobservable entities? Of course, we might wrongly identify the causal processes and laws of nature which govern the phenomena. Or the world might be radically transformed overnight. But these are merely sceptical points. The world that we inhabit is a world of objectively existing things, real causal relations and law-governed phenomena. Such a world is characterized by underlying natural uniformities which it is the business of science to discover. A realism that denies this is realism in name only. Indeed, it is realism without the real world.

In section 3.1, I objected to Musgrave's epistemic principle of best explanation that nothing prevents the adoption of an anti-realist analogue of the principle. Yet, as we saw in section 4, metaphysical resolution of the problem of method and truth

[20] As for the natural kinds to which Kornblith appeals in his account of induction, here the realist might have cause to object either to the particular account of natural kinds that Kornblith employs or to the existence of natural kinds, as such. But the idea that there is a real world, in which there are real, non-conventional differences between different sorts of things, is not something to which any realist should seriously wish to raise objections.

proceeds by way of inference to the best explanation of success.[21] It might appear inconsistent to object to inference to the best explanation in one context while embracing it in another. My point, however, is not that the realist may do without an explanatory pattern of inference altogether. Given the gap between method and truth, some form of explanatory reasoning must play a role in the epistemology of scientific realism. My point, rather, is that inference to the best explanation as such is not the exclusive domain of the realist. The anti-realist may take it to be justified to accept the best explanation but decline to accept it as true in the realist sense.

However, a realist outcome may be secured once explanatory inference is set within an appropriate metaphysical framework. In the spirit of the approaches considered in section 4, I suggest that the problem of method and truth is to be dealt with along the following lines. Realism at the level of common sense may be taken as our point of departure. The world of common sense is an independently existing reality of causally interacting objects. These objects may or may not be observable by us. We employ a variety of methods to inquire into the ways of this world. Some methods are purely observational, while others are rules of theory appraisal. On the whole, our sense experience provides us with true beliefs about the observable world. In addition, our theoretical reasoning about unobservable states of affairs is frequently rewarded with success at the level of observation and practical action. Given the sort of world we inhabit, the best explanation of the systematically successful implementation of a method of inquiry is that the method provides a reliable means of discovery of truth about the world. Like us, our methods are fallible. But in a world such as ours the use of such methods could not consistently meet with success, if they were not for the most part a reliable guide to the truth.

In section 3.2, I objected that critical rationalism does not explain why survival of criticism warrants truth as the unique mode of theory acceptance. Yet I do not oppose the method of criticism as such. Indeed, I take the method of criticism to be largely constitutive of the methodology of science. For, as pointed out previously, both falsificationist norms of empirical test and non-falsificationist criteria of theory appraisal may serve as the basis of the critical method in science. The question is simply one of why a theory which survives criticism need be accepted as true.

As with the previous point, this question becomes manageable if the critical method is placed within a broader metaphysical context. If a theory is subjected to a battery of demanding tests, consistently yielding accurate predictions in a range of different circumstances, such performance under test is to be accorded evidential weight with regard to the truth of the theory. It is true, of course, that occasional predictive success may occur as the result of good fortune or accident. But in the sort of world that we inhabit pervasive error is not rewarded by systematic success. A theory which survives a range of rigorous tests may ultimately fail as a result of deeper and more detailed investigation. But in order to sustain systematic success across a great variety of tests, it must either contain a considerable portion of truth or

[21] To be more precise, metaphysical resolution of the problem of method and truth proceeds by way of inference to best explanation *or similar form of inference*. For, as we saw in note 18, Rescher prefers to characterize his pragmatic account of method in terms of inference to best systematization.

approximate the truth sufficiently closely for it to be empirically indistinguishable from the truth.

It might, finally, be objected that appeal to metaphysical considerations in an epistemological context must proceed in a circle. In order for a claim about reality to justify a method of inquiry there must be reason to accept the claim about reality. But there can be no reason to accept a claim about reality until some method of inquiry is justified.

Such circularity is surely to be avoided. But to insist that epistemology proceed without metaphysics is to fail to appreciate the task with which the realist is confronted. It is not just that the methods of inquiry must be shown to be rationally justified. Since the purpose of inquiry is to discover truth, the methods must be shown to promote the search for truth. But since truth is a matter of how the world is, it must be shown that the methods lead to truth about a mind-independent world. But this requires that something substantive be said about the nature of the world in virtue of which the world is accessible to our methods of inquiry.

The ultimate aim of such an account is a coherent structure in which claims about methods and claims about reality fit together in relations of mutual support. To suppose that such relations of mutual support must result in circular justification is to mistake the nature of epistemology. For human knowledge is a natural phenomenon like any other. To explain how humans know the world requires that we explain how human inquirers may be related to reality in such a way that they may know it. Thus metaphysics and epistemology go hand in hand. For the realist, at least, facts about reality must be brought to bear on facts about inquiry if we are to explain how inquiry yields truth about reality.[22]

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[22] *Acknowledgments:* I am grateful to Harold Brown, Paul Hoyningen-Huene, Robert Nola and Marcel Weber for comments on earlier drafts of this paper.

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