

Introduction

The aim of this book is to articulate and defend a scientific realist philosophy of science. Throughout my philosophical work, I have adopted a thoroughly realist outlook. This was an outlook I acquired in the course of my initial training in philosophy in New Zealand. It was then reinforced by immersion in the Australian philosophical scene. But until recent years I have not overtly sought to defend the position of realism.

The situation began to change not long after the publication of my first book, *The Incommensurability Thesis* (1994). In that book, I sought to show that the semantic variance which lies behind claims of semantic incommensurability may be analyzed in an unproblematic manner within a scientific realist framework.¹ I employed a modified causal theory of reference to argue that translation may fail between the special vocabulary of scientific theories, while sufficient commonality of reference is maintained to ensure that the content of the theories may be compared. Thus, the occurrence of profound conceptual change within science poses little threat to either a realist view of scientific progress or a rationalist view of scientific theory-choice.

Following publication of *The Incommensurability Thesis*, my philosophical interactions began to take place in a more global arena. As a result, I came into sustained contact with philosophers of science working in continental Europe, for whom scientific realism was a profoundly problematic position, if not simply anathema. While I had sought to show that a basis for theory comparison exists within the sciences, little common ground was afforded by realism in these discussions. Indeed, I found realism to be a decidedly unpopular and poorly understood position, all too easily dismissed as a naive doctrine subject to decisive objections. I soon came to realize that realism requires careful elaboration and defence, if it is to be made plausible to philosophers schooled in opposing philosophical traditions.

That is one of the tasks that I have undertaken in several of the essays that are included in the present book. At the same time, this book is an attempt to make good on a promissory note issued in the Introduction to my second book, *Rationality, Relativism and Incommensurability* (1997). That book too dealt with aspects of the problem of semantic incommensurability, while also addressing the question of rational theory-choice in the context of variant standards of theory-appraisal. While realism figured only marginally as a topic in *Rationality, Relativism and Incommensurability*, the views of conceptual change and rationality which I presented there fit comfortably into a realist framework. At the end of the Introduction I wrote that I hoped soon to provide an elaboration of the connection between realism and the

1 I distinguish semantic incommensurability, which arises due to semantic variation between theories, from methodological forms of incommensurability, which stem from variation in methodological standards of theory-evaluation (see Sankey and Hoyningen-Huene, 2001, ix).

views of conceptual change and rationality that I presented in that book. In various ways, the essays collected in the present book all seek to deliver on that promise.

My main reason for not dealing with realism as a central topic of *Rationality, Relativism and Incommensurability* was that I then regarded the issues of conceptual change and theory-choice to be distinct issues from the issue of realism.² This is perhaps the nub of the issue. For the realist, the world we inhabit, and which science investigates, is an objective reality whose existence and character are independent of human thought. Truth, too, is objective, since it is a non-epistemic relation of correspondence between language and the mind-independent world. Neither variation of concepts nor choice of theory impinges on the nature of the objective world or on the truth about that world. In this sense, the issues of conceptual change and rational theory-choice are indeed distinct from the issue of realism.

But it was just this separation of realism from conceptual and epistemic issues which was placed in dispute in my exchanges with European philosophers. The issue was often expressed in terms of the relationship between epistemology and ontology. ‘Since Kant’, I was told, ‘epistemology and ontology must go hand-in-hand.’³ Sometimes, the point was the simple one that one must reflect upon the epistemic basis of one’s views about the world rather than dogmatically assert the world to be a given way. At other times, the point was the stronger one that the world of which we have knowledge is in part constituted by our conceptual and epistemic activities. On still other occasions, I was told that we must do away with the entire distinction between subject and object on which the distinction between epistemology and ontology is based.

As a realist, I hold that the way the world is does not depend on what we believe about it or how we conceive of it. In that sense, epistemology and ontology are distinct. But I have come to agree in part with my European colleagues that epistemology must go hand-in-hand with ontology. Given the realist insistence on the mind-independence of reality, human cognitive activity is not constitutive of reality. There is a gap between mind and world. This raises the question of how knowledge (scientific or otherwise) is possible. The realist must explain how human cognitive activity gives rise to genuine knowledge of a mind-independent reality.

While epistemology and ontology are distinct in the sense that reality is independent of thought, they must be brought into a relation of mutual support within the context of a realist philosophy of science. On the one hand, scientific realism requires an epistemology. For it must be shown how the methods of science are able to produce knowledge of a world that exists outside the mind. On the other

2 It is also the case that the defence of untranslatability, methodological pluralism and a non-algorithmic conception of rationality, which was the principal aim of *Rationality, Relativism and Incommensurability*, is neutral with respect to the question of scientific realism. One need not be a realist to endorse these views.

3 For example, in an interview which I conducted with Paul Hoyningen-Huene in 1996, he commented that: ‘I think since Kant in philosophy in general it has been on the agenda that epistemological questions cannot be discussed apart from metaphysical questions, and *vice versa*. I mean it doesn’t make sense to speak about metaphysics without questioning our possibilities of access to the things which there are’ (Sankey and Hoyningen-Huene, 1996, 61).

hand, the epistemology of realism requires support from ontology. For in order to explain how the methods of science produce knowledge, it must be explained how the world is such that it is accessible by such means. Thus, epistemology and ontology do go hand-in-hand, but not in the sense that knowledge and world are mutually constitutive.

As for how epistemology and ontology are to be conjoined, here I draw on a theme that came to the fore in the final chapters of *Rationality, Relativism and Incommensurability*. There I advocated a turn toward naturalism in the philosophy of method. In particular, I sought to show how a normative naturalist account of epistemic warrant of the kind advocated by Larry Laudan may be employed to meet the challenge of relativism. Unlike Laudan, though, I hold that the normative naturalist account of warrant is able to serve the purposes of a realist epistemology of science. I agree with Laudan that the methods of science may be regarded as tools of inquiry that are employed in pursuit of epistemic goals. I agree too that the warrant for such methods rests on their historical track record in furthering such goals. Where I depart from Laudan is in arguing that the best explanation of the success of theories produced on the basis of these methods is that the methods are in fact a reliable guide to truth. Epistemology and ontology are thus conjoined because the world we inhabit is one in which the methods of science are a reliable means of securing knowledge about it.

With the foregoing as background, I will now present an overview of the essays that follow. The first priority is to formulate scientific realism in as clear a manner as possible. Hence, Chapter 1 spells out the scientific realist position as I understand it, and presents the basic arguments on its behalf. I propose what I take to be a standard construal of the scientific realist position as a form of the traditional metaphysical realist doctrine that the world exists independently of the mental. The realist position is a position of epistemic optimism, which holds against the sceptic that humans are able to acquire knowledge of the world. The specifically scientific realist dimension arises because such knowledge extends to unobservable aspects of the world investigated by theoretical science. For the realist takes scientific progress to consist in advance on truth about both observable and unobservable aspects of the world. Truth is understood, as indicated previously, as a correspondence relation. Apart from these basic elements of the scientific realist position, a number of further semantic and metaphysical tenets will also be discussed, though I regard them as optional extras which are not essential to the scientific realist position.

As for the arguments for scientific realism, here it is important that scientific realism be understood as a form of realism in general. For a number of powerful arguments which provide groundwork for the case for scientific realism are in fact arguments for realism in general. There are two such arguments. The first is an argument for realism as the position which best reflects a non-anthropocentric view of our place in the natural world. The second is an argument for realism at the commonsense level, which treats realism about unobservable entities as an outgrowth of commonsense realism. Such arguments provide the groundwork for scientific realism. Once the general realist outlook is established, one may then proceed to argue for realism about science. Here, too, my approach tends to follow realist orthodoxy. The basic argument at this level turns on the success of science. It is the argument that scientific

realism is the best explanation of the success of science. I shall present this argument at two levels. First, at the level of theories, I argue that the success of science is best explained by the truth or approximate truth of theories. Second, at the level of method, I argue that the success of theories produced by the methods of science is best explained by the truth-conducive character of such methods.

One of the major concerns with scientific realism that I have encountered relates to the perspective occupied by the philosopher who adopts the realist stance. In proposing that humans acquire knowledge of a mind-independent world, it would appear that the realist must adopt a perspective that is situated outside the human perspective. For in order to be able to judge that human mental states are true representations of such a world, it must be possible to adopt an objective stance from which to compare the human perspective with reality. That stance must surely lie outside the human perspective. In the words of Hilary Putnam, it must be a God's Eye point of view. Since no human could possibly occupy such a perspective, and the realist position requires such a perspective, the realist position may be rejected as untenable.

In Chapter 2, I consider the objection from the God's Eye point of view. I argue, in the first place, that it is not necessary for the realist to adopt a God's Eye point of view, since realism may be proposed from within our human perspective as a hypothesis about the relation between mind and reality. However, I also attempt to show that there is a perfectly intelligible sense in which we are able to adopt an external perspective. This may be seen by reflecting in a naturalistic manner on the scientific study of animal cognition. Scientists are able to investigate the epistemic relations which non-human animals bear to reality. But there is no reason why a similar investigation may not be undertaken of our own epistemic relations to the world. Just as we may study animal cognition, so, too, we may investigate the relations between our own minds and the world. Thus, even if realism were to require an external standpoint, this is no basis for an objection to realism.

The notion of truth plays an important role in scientific realism on my construal of the doctrine. For the aim of science is to discover the truth, and thereby to advance our knowledge of the world. Thus the form of scientific realism which I propose differs from a version of scientific realism that has been advocated by a number of influential realist authors. Michael Devitt, Brian Ellis, Ian Hacking, and others, have argued for an ontological version of scientific realism that is known as entity realism. Entity realists eschew or downplay the notion of truth, emphasizing instead the reality of the unobservable entities discovered by science. By contrast with entity realism, the form of scientific realism presented in this book constitutes a semantic version of realism in Michael Devitt's sense, since it makes use of the notion of truth (e.g., Devitt, 1991).

There are reasons to find the stance of entity realism appealing. Avoidance of the notion of truth is attractive, since it may enable objections which relate to the notion of truth to be evaded. Moreover, the emphasis on entities rather than theories promotes the study of experimental practice, which is a significant corrective to traditional emphasis on theoretical science. Still, for a number of reasons, I favour the more standard, truth-orientated conception of scientific realism described above. For one thing, a scientific entity realism which eschews semantic notions

such as truth seems to assume the possibility of referring to theoretical entities in the absence of individuating descriptions which are true of such entities. Such a position presupposes the viability of a pure causal theory of reference determination for theoretical terms, of a kind which seems quite implausible.⁴ For another thing, there is the matter of semantic ascent. Assertion of the existence of an entity commits one, via semantic ascent, to the truth of at least the existence claims relating to the entity. So it is not clear that use of the notion of truth may be entirely avoided by the entity realist. Nor is it clear, therefore, that semantic issues may be evaded by the entity realist. Finally, one of the best-known arguments for entity realism is the so-called experimental argument for realism, which was originally presented as a distinct argument from the success argument for realism (Hacking, 1983, 271). But it seems clear that the experimental argument is simply a version of the success argument applied in the context of experimentation (Resnik, 1994). So it fails to import a new argumentative strategy into the realist's repertoire.

While I support a truth-orientated version of realism, it is important to emphasize that this indicates no less a commitment to realism about the mind-independent world than the commitment of the entity realist. Entity realists are right to insist that the fundamental commitment of realism is a metaphysical commitment to the existence of a mind-independent world, as well as to the various entities which are found to populate it. But such metaphysical commitment is fully compatible with endorsement of a semantic version of realism. Indeed, commitment to the mind-independent world and to the entities of science and common sense constitutes a major component of the truth-orientated version of scientific realism advocated here.

I am inclined to regard entity realism as a version of scientific realism. The entity realist is a close ally in disputes with a range of anti-realist critics of realism, such as Kantian constructivist positions, and epistemically sceptical positions. Still, the question arises of whether the position of entity realism is a genuine alternative to scientific realism. In Chapter 3, I examine the question of whether entity realism does constitute a distinct position from semantic formulations of scientific realism. I seek to show that it can indeed be legitimately distinguished from semantic versions of scientific realism. Entity realism does not express, nor does it immediately entail, a semantic thesis involving the notion of truth. While it is possible to derive a semantic thesis from entity realism by semantic ascent, the resulting semantic thesis is not committed to any particular theory of truth. So entity realism entails a semantic thesis in only an attenuated sense.

Semantic concerns are also the focus of Chapter 4, where I revisit the problem of incommensurability. The phenomenon of conceptual change or meaning variance in science raises a fundamental difficulty for the realist in relation to the progress of science. Given the realist view that scientific progress consists in advance on truth, such progress requires an increase in truth known about the world. The connection between truth and reference is therefore of crucial relevance to the issue of progress. For in order for the transition between theories to constitute progress in a realist

4 For discussion of problems relating to the reference of theoretical terms, see my (1994, Ch. 2).

sense, a later theory must yield an increase in the truth known about the same entities as those investigated by earlier theories. With the exception of cases of radically mistaken ontology, a later theory must refer to the same set of entities as earlier theories referred to. Otherwise it is not possible for the transition between the theories to constitute progress toward truth in the same domain of inquiry.

The problem of semantic incommensurability is a major problem for a realist account of scientific progress precisely because it casts doubt on the continuity of reference between theories. For if theoretical change involves significant change in the concepts expressed by scientific terms, then there may be a discontinuity of reference in the transition between theories. The problem of stability of reference between meaning variant theories is at base a problem in the theory of reference about the nature of reference determination. This was a major topic of *The Incommensurability Thesis*. For detailed coverage of the topic, I refer the reader to that book.

In Chapter 4, I present an overview of the emergence of the problem of incommensurability within the context of 20th century philosophical thinking about the language of science. The chapter traces discussion of the language of science from the verificationism of the early logical positivists through to the partial interpretation model of later positivism and the theoretical context account of meaning favoured by post-positivist philosophers of science of the historical school. It then considers the problem of reference change in light of alternative (descriptive, causal) models of reference determination, before presenting the causal-descriptive model for which I argued in *The Incommensurability Thesis*.

While realism is an underlying theme of the chapter, it is the principal focus of the final two sections. The implications with respect to realism of the taxonomic incommensurability thesis proposed by Kuhn in his later work are examined, and it is argued that such incommensurability poses no threat to a realist philosophy of science. The chapter closes by rebutting the claim of Paul Hoyningen-Huene, Eric Oberheim and Hanne Andersen (1996) that my causal-descriptive approach to the problem of incommensurability presupposes realism and thereby succumbs to a meta-level incommensurability with anti-realist proponents of the incommensurability of scientific theories.

From semantic aspects of realism, attention then shifts to concerns of an epistemological nature. Throughout the four final chapters of the book, I adopt a broadly naturalistic approach to the epistemological questions under consideration. My principal aim is to demonstrate that the normative naturalist account of epistemic warrant may be embraced within a realist framework, and to employ this account of warrant as part of my argument for a realist epistemology of science. In the process, I explore the idea that the epistemology of scientific realism must draw on considerations of a metaphysical nature. This exploration commences in Chapter 5, which illustrates the epistemological relevance of metaphysical considerations in the context of the traditional Humean problem of induction. The leading idea of the chapter is a familiar one from the history of attempts to solve the problem of induction. It is the idea that what ultimately provides the rationale for our use of induction is the fact that the world is an ordered reality governed by underlying laws. This is a version of the principle of the uniformity of nature. Philosophers

have usually rejected the principle of uniformity as a solution to the problem of induction because it is unable to be established independently of induction. It cannot, therefore, serve as justification of induction.

But I think that such a rejection of the principle of uniformity of nature is ill-advised for the realist. Rather than reject the principle out of hand, the realist may instead employ realist metaphysical commitments as the underpinnings for an epistemology. This will require the realist to articulate a metaphysical position that goes beyond a minimal commitment to an objective reality. In certain contexts, it is useful to characterize realism (as I do in Chapter 1) as committed to the existence of a mind-independent reality, for example, in order to distinguish realism from a Kantian or idealist position. But a mind-independent reality may be an amorphous, unordered world. Such a world is hardly a world worth fighting for. The world in which the realist should believe is not just a mind-independent reality, though it is at least that. It is a world with structure and order. But the existence of such structure and order has epistemological implications. Recognizing this is crucial to the development of a realist epistemology.

Though the argument of Chapter 5 is a version of the traditional appeal to the uniformity of nature, it is not couched in the usual way as a blanket resemblance of past and future. Rather, I understand the uniformity of nature in terms of the operation of laws of nature which it is the task of science to discover. Following Brian Ellis, I see a close connection between laws of nature and the natural kinds with which our world is populated. Laws of nature are grounded in the irreducible causal powers of things that characterize members of a given natural kind. So, rather than understand the uniformity of nature as some sort of general resemblance of past and future, I see it as residing in the inbuilt behavioural tendencies of individual members of natural kinds.

This line of argument derives from the position proposed by Hilary Kornblith in his book, *Inductive Inference and its Natural Ground*. Kornblith argues that reliable inductive inference is grounded in the existence of natural kinds whose members share sets of homeostatically clustered properties in common. I depart from Kornblith only on points of detail. Where Kornblith chooses in naturalistic vein not to directly address Humean scepticism, I suggest instead that the appeal to natural kinds can be used to justify induction against the Humean sceptic. I also espouse the more substantive metaphysics of Brian Ellis's scientific essentialist theory of natural kinds, rather than rest content with the homeostatic property cluster model favoured by Kornblith.

It will not escape notice that this attempt to solve the problem of induction draws on metaphysical views of the kind that are set aside as optional doctrines of realism in Chapter 1. A brief word of explanation is therefore in order. My aim in Chapter 1 is to articulate the position of scientific realism in a manner that reflects the standard understanding of the position construed in a generic fashion. As it happens, the position of scientific realism presented in Chapter 1 is the general version of scientific realism that I espouse. However, the formulation of the realist position in Chapter 1 is intended to serve as a generic statement of the position that is capable of embracing paradigmatic examples of scientific realism, while at the same time allowing for variation amongst diverse realists on non-essential matters.

As the book progresses, my attention turns to the more specific task of developing an epistemology for realism. Thus, increasingly, the position presented is my own specific version of scientific realism, rather than a generic form of the doctrine, such as that propounded at the start of the book.

Kornblith's approach to the problem of induction is based on a thorough-going epistemological naturalism. It is antisceptical. It draws on empirical claims from and about natural science in establishing a metaphysical framework within which to treat epistemological questions. It employs research in cognitive psychology in approaching conceptual and inferential aspects of knowledge-acquisition. In my view, such a naturalistic approach to epistemological questions is a model of how the realist should proceed in developing a realist epistemology for science.⁵

Because of the non-epistemic character of correspondence truth and the mind-independence of reality, the realist must explain how use of the methods of science yields knowledge. Against those who deny the possibility of a realist epistemology, the naturalistic realist may treat the problem of knowledge as the broadly empirical problem of explaining how cognitive agents embedded in the natural world are able to use their epistemic capacities to promote their survival. The success of practical activity based on common sense and scientific exercise of our epistemic capacities serves as robust confirmation that such knowledge is not only possible but actual.

The main outlines of the naturalistic epistemology that I favour are presented in Chapter 6. As previously mentioned, I adopt a realist version of Larry Laudan's normative naturalist account of the warrant of the rules of method. According to normative naturalism, the rules of method are tools of scientific inquiry, which may be evaluated on the basis of their historical track record in securing the cognitive aims of science. The most widely attested strength of this approach is its ability to serve as a counter to epistemological relativism (see *Rationality, Relativism and Incommensurability*, Chapter 10). Given Laudan's opposition to realism, it is less widely appreciated that normative naturalism may be used in support of a realist epistemology of science. The aim of Chapter 6 is to show that normative naturalism is able to be incorporated within a scientific realist framework. I seek to show, *pace* Laudan, that it is possible to have knowledge at the theoretical level. I argue that it may be rational to pursue truth as an ideal, even if it is unattainable. And I attempt to show, again *pace* Laudan, that we are able to monitor our pursuit of truth because satisfaction of the rules of method may serve as a fallible indication of our progress toward that aim.

The fundamental epistemological problem of realism is the problem of establishing a connection between epistemic methods and non-epistemic truth. In Chapter 7, I explicitly confront this problem, which I refer to as the problem of method and truth. Those anti-realists who take truth or reality to depend on epistemic activity resolve the problem by treating truth as a product internal to the application of method. Those anti-realists who are sceptics about theoretical science deny that the problem may be solved since they deny that a connection may be established between method and truth. By contrast with anti-realists of either variety, I seek to

5 A similar naturalistic program for realism is found in Devitt (1991, 5.7-5.10; 2002, 22-5).

resolve the problem in the context of realism on the basis of a naturalistic account of the epistemic warrant of methodological rules. In particular, I argue that what best explains the use of the methods of science to produce successful theories is that the methods comprise a reliable means of securing the truth. The realistic version of normative naturalism proposed in Chapter 6 is the basis for the solution of the problem of method and truth that is presented in Chapter 7.

I continue to develop this approach to the problem of method and truth in Chapter 8, which is the final chapter of the book. I examine two solutions to the problem of method and truth that may be found in the work of one influential scientific realist, my former teacher, Alan Musgrave. Musgrave proposes two epistemic principles which indicate conditions under which it is rational to believe that a theory is true. The first is the principle that it is reasonable to believe the best explanation of a fact to be true. The second is that it is reasonable to believe the hypothesis which has best withstood criticism. While both principles highlight important principles of rational belief, I argue that in the case of neither principle is it explained why it is rational to believe that a theory is true, as opposed to, say, empirically adequate. To explain why it is rational to believe that a theory is true, it is not enough to enunciate a principle of pure epistemology. To explain why it is rational to believe that a claim is true of the mind-independent world something must be said about the world. Ontology must be conjoined with epistemology if the problem of method and truth is to be solved in a realist framework.

It may be seen from this overview that the essays contained in this book develop a number of interwoven themes. Because they were originally written for publication as separate articles, there is some overlap of content between some of the chapters of the book. However, in revising the papers for inclusion in the book, I have sought to remove excessive repetition of material. At the same time, the individual chapters remain self-contained, and may be read as stand-alone pieces.

The papers were originally prepared for a variety of different audiences with different backgrounds and levels of expertise. A number of the papers were consciously written in an attempt to bridge a communicative gap between philosophical traditions. Some were originally prepared for oral presentation, while others were conceived solely as written papers. The target audience of a number of the papers was envisioned to be specialists in the philosophy of science, while a number of others were directed at a non-specialist audience. While I have sought to maintain an even tone throughout the revised versions of these papers, it is unavoidable that the variation in original audience will have left its traces.