Quentin Ruyant

Modal Empiricism

Interpreting Science Without Scientific Realism

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Preface

This book aims at presenting the precise articulation of a pragmatist stance towards science, a stance which takes the form of an anti-realist position in the debate on scientific realism: modal empiricism.

Various forms of scientific realism seem to dominate the current philosophical landscape, whether they are actively defended, or simply assumed for the sake of doing metaphysics. Such a "realist stance" towards science is often associated with bare common sense, and in contrast, anti-realism could seem like nothing but misplaced scepticism. Perhaps some philosophers are even reluctant to call themselves antirealist for fear of being associated with people who entertain a certain defiance towards science, and admittedly, such defiance is a pressing problem of our times. However, entertaining overly optimistic positions about science might not be the best way of addressing these worries. But more importantly, as explained in chapter 1 of this book, I think that it is a mistake to view anti-realism as a lack of trust in science, or to assume that realists actually side with scientists more than anti-realists do. What is really in question is the *interpretation* of science, its activities, aims and achievements, not trust in science. This is how modal empiricism should be understood, and I hope that this book will demonstrate the viability of this project.

Modal empiricism, as its name implies, is a version of empiricism that is committed to the idea that there are possibilities in the world, and natural constraints on these possibilities. According to modal empiricism, our best scientific theories reflect the way these constraints affect our possible observations and actions, and thus allow us to navigate in this world successfully. This is the kind of understanding that science provides. Abstract representations, such as scientific models, are generally indexical: they convey norms for their applications in particular contexts, and these norms are geared towards empirical success in all possible situations that are accessible to us. In this book, I argue that modal empirical adequacy is achievable, that modal empiricism makes better sense of scientific practice than constructive empiricism does, and that it can respond to the main arguments in the debate on scientific realism without assuming that theories are true descriptions of a mind-independent reality.

The developments and arguments of this book are largely based on an account of epistemic representation, presented at the end of chapter 2 and detailed in chap-

ter 3, which acts as a framework for modal empiricism. This account of epistemic representation is meant to be an important contribution in its own right, and I hope that it will be considered as such. In his Stanford Encyclopedia entry dedicated to the structure of scientific theories, Winther distinguishes a syntactic, a semantic and a pragmatic view of theories, and he claims that "[t]he analytical framework of the Pragmatic View remains under construction", implying that it is not as developed as its syntactic and semantic counterparts. This might be due to the emphasis on informal and practical aspects that characterises pragmatic approaches, as well as to the pluralist stance often adopted by pragmatist philosophers. Nevertheless, I believe that it is possible to make some steps in the direction of a more developed unified "analytical framework" for a pragmatic view of theories, without neglecting the complexities of scientific practice. My proposed reconciliation, which I call the "two-stage account of epistemic representation", consists in understanding abstract, communal representations in terms of norms constraining or licensing the contextual use of representational vehicles. This view is largely inspired by Grice's philosophy of language, and in particular, by the distinction between speaker-meaning and expression-meaning. Assuming this two-stage account, the debate on scientific realism can bear on the status of the representational norms developed by the scientific community, and in particular, on their aims and the implications of their success. In sum, as said earlier, this is a debate about interpreting science.

According to modal empiricism, the aim of science is empirical success for all possible contexts of use, whatever one's purpose. The corresponding notion of empirical adequacy is developed in chapter 4. I explain how it differs from van Fraassen's notion, in particular by its modal and situated character, and I argue that it is better apt to account for scientific rationality. A notion of situated possibility, together with an inductivist epistemology, is presented in chapter 5, so as to defuse sceptical reluctance to endorse natural modalities. Chapters 6 and 7 address more traditional themes of the debate on scientific realism: the no-miracle argument and the pessimistic meta-induction. I explain how modal empiricism can account for scientific success without inference to the best explanation, how exactly it differs from structural realism, and how these differences make it better apt to respond to the problem of theory change. Finally, chapter 8 is concerned with semantic aspects. I explain how one can make sense of scientific discourse, and even take it "at face value", without being a scientific realist, by adopting a pragmatist conception of truth. This final chapter also presents a pragmatist and revisionist approach towards metaphysics that incorporates indexical and normative aspects at its core. Although this is not the most developed part of the book, it promises to deliver an important message: that philosophy, including metaphysics, can be (and then, should be) practically relevant.

The philosophical stance that emerges from this book consists in assuming that philosophy of science, even when it is interested in a broad picture or in metaphysical issues, should put situated representations of concrete objects at the centre stage of its analysis, rather than idealistic (and, in effect, non-existent) representations of the whole universe. Modal empiricism is more than a mere position in the debate on

scientific realism: it is a pragmatist framework for interpreting science, and for doing philosophy of science.

I very much enjoyed writing this book, and I hope that its readers will enjoy reading it and gain a new perspective on science.

Mexico City, October 2020 *Quentin Ruyant*

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Chapter 1
The Debates on Scientific Realism

Abstract The debate on scientific realism results from a tension between the empiricist methodology, which is a defining feature of science, and claims to the effect that science can unveil the fundamental nature of reality. What distinguishes realist and anti-realist positions is not necessarily that the former take scientific knowledge "at face value" or take the side of scientists in general while the latter do not. Rather, realists and anti-realists propose different ways of interpreting science as a whole, and in particular its aim (axiological realism), its possible achievements (epistemic realism) and its content (semantic realism). The aim of this book is to defend an interpretation that potentially applies to each of these three levels: modal empiricism. This position purports to be the articulation of a pragmatist stance towards science. This introductory chapter briefly presents the position, then outlines the structure of the book.

1.1 What Is at Stake With Scientific Realism?

What do we know about reality? When asking this question not about reality in general, but about a specific subject area, the natural attitude is to turn towards science for an answer. What do we know about living organisms? At least what biology tells us: complex organisms are composed of living cells, which reproduce by duplicating their genetic code, which is stored in DNA molecules, and so on. What do we know about combustion phenomena? Well, what we can read in chemistry books: they involve reactions where big molecules break into smaller ones and release energy.

Now turning back to our initial, general question, its answer could be that our best knowledge about reality is provided by the best theories offered by science. The content of these theories should be taken *at face value*: they literally describe what exists in the world, and the entities described (objects, processes, properties, relations...) do not depend on our interests, representations or activities for their

existence. Science unveils the nature of reality. This is, roughly, the content of the doctrine of scientific realism.

It could seem, on the surface of it, that scientific realism is nothing but a common-sense trust in the capacity of science to give us knowledge about the world. To those who would object that blind trust is irrational, the realist can respond by qualifying her attitude: only mature science is concerned, for example. But a general distrust that would concern all of science could be perceived as misplaced. This could explain why realism sometimes seems to be used in the philosophical literature as a mark of seriousness, and why it is often deemed important that such or such philosophical view is "compatible with scientific realism".

I think that such a surface reading of the debate, which places anti-realism in an uncomfortable position, is inaccurate. This is not to deny that some anti-realist positions entertain an attitude of defiance towards science in general, but this is not an essential feature of anti-realism. Anti-realists rarely deny that science is extraordinarily successful, that it has progressed, and that theories can explain a variety of phenomena. An anti-realist can even accept that science gives us knowledge that is more valuable than the one that we could obtain by other means, and she can make sense of the natural attitude consisting in turning to scientific theories for answers to specific questions about the world. An anti-realist does not necessarily put into question the achievements of science or the content of theories, but rather challenges their realist interpretation. Is science really concerned with the deep nature of reality? Or is it concerned with something more practical and mundane? Science provides explanations and understanding, but is there really more to explanations and understanding than the functions they play in our interactions with the world? So, the choice is not really (or not always) between trust and scepticism towards scientific knowledge, but rather between various ways of interpreting this knowledge. In sum, I believe that the debate on scientific realism is more accurately framed as a debate over the interpretation of science.

The aim of this book is to present and defend a certain interpretation of science as an alternative to scientific realism. I call the corresponding position "modal empiricism". Empiricist positions are often characterised as the idea that the aim of scientific theories is to "save the phenomena", and as a first approach, modal empiricism can be understood as the idea that theories aim at saving the *possible* phenomena. I will defend this position by arguing that it fares better than its opponents in the debate on scientific realism. However, in light of what has just been said, this position should not be merely understood as a technical solution in response to specific philosophical arguments, nor as a mere form of scepticism towards science. My ambition is to propose a positive way of interpreting science, which has implications beyond the debate on scientific realism, including, for example, for the metaphysics of science. More precisely, modal empiricism purports to be the articulation of a pragmatist stance towards science, which puts practice at the centre of interpretational issues, and I am convinced that this position constitutes the best way of articulating this pragmatist stance.

Interpreting science can mean interpreting the activities of scientists and the aims of these activities, or it can mean interpreting the products of these activities, in

particular, scientific theories. For this reason, the debate is multifaceted, which can easily be overlooked when one looks at it in terms of defiance versus trust. Before saying more about modal empiricism, let us examine these multiple facets.

1.2 The Components of Scientific Realism

Scientific realism is often described as a commitment to three theses: the metaphysical thesis, according to which a mind-independent reality exists, a semantic thesis, according to which scientific theories are "about" this reality, and an epistemic thesis, according to which scientific theories are at least approximately true. Let us detail them in more precise language.

The metaphysical thesis has two components. First, there is the idea that an external, mind-independent reality exists, which opposes idealism, according to which reality is mental. Second, there is the idea that reality is structured in a way that is in principle intelligible, which typically opposes both Kantian views and some versions of constructivism, according to which the phenomena that our intellect can grasp are somehow constituted by our representations or activities. According to the metaphysical realist, "the world has a definite and mind-independent natural-kind structure" (Psillos, 1999, p. xvii).

None of these components of realism will be discussed at length in this book, because a metaphysical stance is often made implicit by the semantic stance one adopts, or at least, it seems reasonable to be clear on semantic issues before discussing metaphysical issues: after all, we need language to talk about reality. Nevertheless, as I said earlier, modal empiricism has implication for metaphysics, and this topic will be touched upon in the concluding chapter of this book.

The semantic thesis of scientific realism has to do with the relationship between our representations and reality. It consists in adopting *semantic realism*. Again, two components can be distinguished in the realist stance: (i) a truth-conditional semantics, and (ii) a conception of truth that is not epistemically constrained (Shalkowski, 1995) (or that is such that truth conditions are "potentially evidence transcendent" (Miller, 2003)). Such a conception of truth can be, for example, the idea that a statement is true if it corresponds to reality.

The first component, truth-conditional semantics, differentiates semantic realism from what Psillos (1999) calls "eliminative instrumentalism", which takes theories to be mere instruments without truth-values (theories would be good or bad rather than true or false). The second component, the conception of truth, differentiate it from "reductive empiricism". Although it accepts that theories have truth-values, reductive empiricism attempts to reinterpret the content of scientific theories in terms of mere observables (theories would not be about mind-independent entities), which makes theoretical truth epistemically constrained. In sum, semantic realism claims that theories are capable of being true or false, in virtue of reality. Or, as Psillos puts it:

> The semantic stance takes scientific theories at face-value [. . .]. Theoretical assertions are not reducible to claims about the behaviour of observables, nor are they merely instrumental devices for establishing connections between observables. The theoretical terms featuring in theories have putative factual reference. So, if scientific theories are true, the unobservable entities they posit populate the world.

Here, Psillos puts emphasis on observables, so as to contrast semantic realism with reductive empiricism, but semantic realism is more general. A conventionalist who claims that scientific theories are nothing but implicit definitions for a theoretical vocabulary, and that therefore they are true by convention, is not a semantic realist, for instance. For a semantic realist, the content of scientific theories should not be interpreted as mere conventions, nor in terms of notions such as measurements, observations, intentions, information, social norms or any other epistemically loaded or anthropocentric term, at least not if these are taken to be unanalysable, irreducible notions associated with the users of the theory. Such notions are incompatible with the idea that scientific theories describe a mind-independent reality. This idea seems to be an important desideratum in the metaphysics of science (Bell (2004)'s disdain for the notion of measurement is often cited to that effect in the philosophy of physics literature). Not all positions called "realism" satisfy this condition. For example, Putnam's internal realism explicitly rejects semantic realism. Nevertheless, semantic realism is generally accepted as an essential component of scientific realism.

The fact that scientific realism incorporates a semantic component should clarify why the debate on scientific realism can be understood as a debate over how science ought to be interpreted, and why an anti-realist does not necessarily deny that science gives us knowledge. Maybe it is hard to see how a theory conceived of as a mere instrument for making predictions could give us knowledge. Perhaps it is more accurate to say that an instrument *affords* practical knowledge, or "know-how", because one can learn how to use it as a tool for various purposes, but it seems to be part of common-sense intuitions that science provides *factual* knowledge, or "know-that". An eliminative instrumentalist would most certainly reject these intuitions. However, this is not something that a reductive empiricist would deny. The reductive empiricist would only reinterpret this knowledge in terms of observables.

The term "reinterpret" as well as its opposite "at face value", employed by Psillos, suggest that the semantic realist pays more respect to science than the semantic anti-realist does. I think that this is a mistake. Close attention to the way theories are used to represent shows that this idea of interpreting theories "at face value" is far from clear. As will be explained in chapter 2, scientific theories are rarely considered to be linguistic statements by contemporary philosophers, so there is work to do in order to understand what theoretical truth amounts to exactly, and the realist route, which would take truth not to be epistemically constrained, is not necessarily the most natural one. At any rate, no semantic theory is imposed on us by scientific discourse, so there is no reason to think that the realist stands on the side of scientists in these matters.

As will be explained shortly, modal empiricism can be understood as a position that challenges semantic realism, but not in the same way as a reductive empiricist does. The debate on semantic realism will be addressed explicitly in the conclusion

of this book. It will also appear more or less implicitly in many discussions along the way. However, this work is primarily focused on the debate over the epistemic thesis of scientific realism. One reason for this focus is that this epistemic thesis takes centre stage in contemporary discussions, while the semantic thesis is rarely discussed. Discussions on the epistemic thesis generally take semantic realism for granted (and I will do so as well, for the sake of the discussion, until the concluding chapter). Another reason is that just as it is more appropriate to discuss metaphysical issues after having clarified semantic issues, I think that it makes more sense to discuss semantic issues after having clarified epistemic ones.

So, let us now turn to the last component of scientific realism: the epistemic thesis. According to this thesis, science is able to produce true, or approximately true theories (in a realist sense of true). To quote Psillos again, this entails that "the entities posited by them, or, at any rate, entities very similar to those posited, do inhabit the world". This thesis is more easily associated with an attitude of trust, as opposed to defiance, towards science, since it concerns its achievements. However, things are a bit more complex than this.

It can be useful to break down this epistemic thesis into two parts: first, the idea that science *aims at truth*, and secondly, the idea that it is successful in this aim. Let us call the first aspect *axiological realism* and the second one *epistemic realism*.

The advantage of this formulation is that it makes room for van Fraassen's approach towards the debate on scientific realism. Van Fraassen (1980, p. 8) characterises realism as the claim that "[s]cience aims to give us, in its theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true". He argues for a different axiological position, constructive empiricism, according to which the aim of science is to produce empirically adequate theories.

As proposed by Ghins (2017), the difference between axiological realism and epistemic realism can also be understood in terms of a distinction between a "pragmatic approach", which is focused on scientific activity, and a "contemplative approach", focused on the end-products of this activity: scientific theories. These two approaches imply different kinds of discussions. A pragmatic approach demands that we pay close attention to scientific practice. The purpose of an axiological thesis is to make sense of scientific practice as a rational activity, or to inquire into the aims and norms of this activity. For the realist, the aim of science is truth, while for the empiricist, it is empirical adequacy: conformity with experience is the final judge for the acceptability of theories and hypotheses. Others, which we shall call pluralists, deny that science has a unified aim. These are stances that concern the pragmatic approach. On the contrary, a contemplative approach will be focused not on the activity itself, but on the theories that this activity produces. An epistemic thesis is concerned with the justification of various attitudes towards these theories. Issues of justification can be addressed more abstractly, without paying too much attention to the way theories are actually constructed. However, the two are not unrelated, since it would be odd to attribute an aim to science if this aim was not achievable, or to consider that science achieves something that is not even part of its aims (although Lyons (2005) has defended the former).

Here, we can see a second reason why anti-realism should not necessarily be considered an attitude of defiance towards sciences: if the aim of science is not truth, then one can be an anti-realist and at the same time consider that science is a successful endeavour.

The position that I will defend in this book, modal empiricism, challenges both axiological and epistemic realism. According to modal empiricism, the aim of science is not truth, but modal empirical adequacy, and science is successful in this aim, in the sense that the adequacy of theories can be justified by experience. The axiological thesis is roughly the focus of the first half of this book (from chapters 2 to 4), and the epistemic thesis is defended in the second half (from chapters 5 to 7). Let us now present the main characteristics of this position in more detail.

1.3 Modal Empiricism: an Interpretation of Science

Why challenge scientific realism? There are many reasons, but perhaps the main one is that there is an inherent tension in the position. This tension is introduced by the semantic component, in particular the assumption that truth is not epistemically constrained, and it is manifest in the epistemic component, and in particular in the idea that science can achieve truth. In a word, semantic realism introduces a principled gap between truth and our epistemic capacities, and this casts doubt on the idea that truth, as understood by the realist, is achievable.

The tension is particularly salient in the case of science, because arguably, systematic confrontation with experience (rather than blind reliance on intuitions, for instance) is the cornerstone of scientific methodology. But how can we claim to have knowledge of universal laws of nature if those are only ever confirmed by particular, limited sets of observations? And how can we claim to have knowledge of unobservable entities such as electrons if their existence is only ever confirmed by their indirect consequences on our observations? What is at stake is the validity of ampliative modes of inference, that is, inferences that go beyond mere appearances.

All this could seem like unfounded philosophical worries to the scientific mind: "Look how well our theories work, are you doubting that electrons or gravity really exist?" To which the anti-realist could respond: "Look at the history of science. Theories come and go. Being willing to abandon theories in the face of new evidence is at the core of scientific methodology. Are you really confident that electrons and gravity will never be replaced by different concepts?" This is, in a nutshell, how the contemporary debate is framed.

As said earlier, the aim of this book is to present and defend an original position in this debate, which I call "modal empiricism". The term "empiricism" marks the emphasis of the position on our interaction with the world through experience, rather than on reality itself, and the term "modal" refers to the notions of possibility and necessity. As already explained, modal empiricism can be roughly understood as the

idea that scientific theories "save the possible phenomena"[1]. The position can be summarised as follows:

Modal empiricism (1): the aim of science is to produce theories that correctly account, in a unified way, for all our possible manipulations and observations within particular domains of experience, and science is generally successful in this aim.

This position challenges the epistemic and axiological thesis of scientific realism presented above. However, it is still committed to the idea that science has a certain unity, and that it can be characterised by an aim, which is empirical adequacy. In this sense, it shares similarities with van Fraassen's constructive empiricism, which also challenges the axiological thesis, and considers that empirical adequacy is the aim of science. The main difference lies in the modal aspect of modal empiricism, which makes the position more ambitious than traditional versions of empiricism. This aspect should be understood in terms of *natural* modalities, that is, not in terms of what is or is not conceivable or likely to be the case, but in terms of what is or is not possible in this world given natural constraints on phenomena.

In the conclusion of this work, I will suggest a possible reformulation of the position as challenging the semantic thesis of scientific realism instead of the epistemic and axiological ones. Adopting a different, pragmatist notion of theoretical truth, which happens to coincide with the modal version of empirical adequacy just presented, it is possible to maintain that indeed, science aims at truth and that it is successful in this respect. However, this is not the notion of truth that the scientific realist has in mind. This reformulation is a way of making sense of the natural attitude described in the opening of this chapter, without troubling ourselves with the unnecessary features of scientific realism, and as I will argue in the conclusion of this book, this semantics is in line with Peirce's conception of pragmatism, and it is also consistent with scientific discourse. This gives us another understanding of modal empiricism:

Modal empiricism (2): our best scientific theories are true, or approximately true, in the sense that they correctly account, in a unified way, for all our possible manipulations and observations within their domains.

[1] The label "modal empiricism" has been co-opted in the epistemology of metaphysics to denote a different position from the one that I have in mind. It is employed in particular in debates concerning the validity of an inference from conceivability to metaphysical possibility (for example, from the conceivability of "phenomenal zombies" to their metaphysical possibility in the philosophy of mind). In this context, modal empiricism opposes modal rationalism. The idea can be that metaphysical possibility should be understood in terms of conceivable empirical justification (Hanrahan, 2009), or that knowledge about metaphysical possibilities can be acquired by experience (Roca-Royes, 2017). Although there are a few similarities between these positions and the one defended in this book, I use "modal empiricism" in a different sense: the position to which I refer is not concerned with metaphysical modalities, but with natural modalities, and it does not oppose modal rationalism in the epistemology of metaphysics, but non-modal empiricism in the philosophy of science. Giere (Churchland and Hooker, 1985, ch. 4) and Ladyman and Ross (2007) use the term in the same sense as I do. I hope that the fact that its different meaning is used in another area of philosophy will be enough to avoid confusion.

The idea is to identify truth with a certain notion of ideal success. Assuming this notion of truth, modal empiricism can be understood as a form of realism. However, this is only true if realism is understood in a broad sense, and not in the traditional sense of the term. Modal empiricism is closer to Putnam's internal realism than it is to standard scientific realism. I will argue that this approach has the capacity to connect metaphysical debates to more tangible considerations.

As its formulation in terms of pragmatic truth makes clear, modal empiricism is a form of pragmatism, in the tradition of Peirce (with whom I also share a commitment to natural modalities). I understand pragmatism as being characterised by an emphasis on a practical, active conception of knowledge, as opposed to what Dewey calls the "spectator conception of knowledge". From a pragmatist perspective, the starting and end point of any inquiry into the aim and achievements of science should be scientific practice. In order to interpret scientific theories, we should first have a look at how they are used in particular contexts, and an interpretation should have practical implications in one way or another.

Modal empiricism is based on an account of scientific representation that clearly articulates the contextual uses of theories and the abstract structure of these theories. In a pragmatist spirit, I understand scientific theories and models as conveying norms of representation that constrain particular uses. This account also does justice to the fact that in general these contextual uses are not passive, but partly performative, hence the mention of manipulations in the definition above. This account of scientific representation constitutes our framework for inquiring into the aims and achievements of science.

According to modal empiricism, the aim of science is to produce norms of representation that are ideally empirically successful, in all circumstances, whatever one's particular purpose is. As I just said, these norms are conveyed by scientific theories and models, so the aim of science is to produce ideally successful models and theories. This notion of ideal success is not characterised in abstract terms, for example, in terms of a general correspondence between the structure of the theory and the world, but rather by quantifying over possible uses of the theory. This is the situated aspect of the position. Combined with the idea that experimentation is not a passive activity, this leads us quite directly to the modal aspect of the position. Merely possible observations could concern actual states of affairs, but merely possible manipulations cannot, because they would create non-actual states of affairs. So, we have to assume that ideal success concerns mere possibilities. An adequate theory tells us what it is possible to do and observe in this world.

However, the kind of modality that characterises modal empiricism is quite distinct from traditional construals of natural modalities, for example in terms of laws of nature, precisely because it is situated. Understanding these modalities in terms of possible worlds is inappropriate, because these possibilities are, so to speak, anchored to actual contexts. I will propose an understanding in terms of possible situations.

This understanding of natural modality is crucial. It is what makes the position distinctively empiricist, as opposed to structural realism, for example. Modal empiricism does not claim that we can have knowledge of the laws of nature, or of the "modal structure of the world", however it is interpreted. We can only have

knowledge of the way natural constraints affect our observations and manipulations in context. Since the contexts to which we have access are limited by our situation in the universe and by our cognitive constitution, a form of epistemic relativity (or perspectivality) ensues. So, even though modal empiricism is more ambitious than non-modal versions of empiricism, it cannot be classified as a version of scientific realism. As I will argue in this book, this understanding of modality is what allows modal empiricism to be the best compromise in the debate on scientific realism, because it is able to make sense of scientific success without relying on problematic modes of inference, and it is not threatened by arguments based on theory change.

In sum, modal empiricism purports to articulate a pragmatist stance towards science, and this stance is characterised by the following aspects:

Normativity:	abstract representations convey norms that apply to concrete uses
Situatedness:	concrete uses are sensitive to a local context
Performativity:	concrete uses involve observations as well as manipulations
Modality:	ideal success also concerns merely possible uses

1.4 The Two Battles to Be Fought

Now that we have a better idea of what modal empiricism is, let us outline the structure of this book. The book can be roughly divided into three parts of two chapters each.

The first two chapters set the stage for the discussion by presenting the account of scientific representation on which modal empiricism is based. Chapter 2 is a review of the debates on the nature of scientific theories and models and their relations to users, experience and the world. This review serves as a motivation for an approach that takes as a starting point contextual, situated uses of scientific theories, while also paying attention to the communal, normative aspects of representation. An account of scientific representation and of the nature of scientific theories that takes this starting point is proposed in chapter 3. As explained earlier, this account of scientific representation is the framework on which modal empiricism is based. According to this account, the main function of scientific models is to convey indexical norms of representation, and using a model to represent a concrete object in a particular context is applying these norms. This chapter introduces important notions, such as context, model, interpretation, relevance and accuracy, which are used throughout the rest of the book.

The remaining chapters are dedicated to the presentation and defence of modal empiricism. As a middle position between scientific realism and traditional versions of empiricism, modal empiricism must be defended against two main opponents: the more pessimistic ones and the more optimistic ones. There are two battles to be fought.

The second part of the book, constituted of chapters 4 and 5, serves two roles: developing the position, and explaining why it should be adopted rather than other versions of empiricism. This is the first battle.

In chapter 4, the focus is on the axiological component of the debate. According to empiricism, the aim of science is to produce theories that are empirically adequate, but various versions of empiricism can differ in their understanding of empirical adequacy. The chapter first develops the notion of empirical adequacy that modal empiricism endorses, with its characteristic modal and situated aspects, by adopting a bottom-up approach, starting from a consideration of success in contextual uses of models and leading up to a definition of ideal success at the theory level. This gives us the main criteria by which, according to modal empiricism, models and theories are accepted in science. Theoretical unification plays an important role in this respect. Then, the resulting position is compared to van Fraassen's constructive empiricism, the leading contemporary empiricist position. I argue that modal empiricism, thanks to its modal and situated aspects, better accounts for scientific practice as a rational activity, and in particular for the interventionist component of experimentation.

In chapter 5, the focus is on modalities more specifically, and I start to focus on justification issues. The defining characteristics of situated modalities, conceived of in terms of alternative ways actual situations could be, are presented and discussed, as well as their differences with other kinds of modalities, in particular, the ones associated with the laws of nature. I give a few preliminary reasons to accept them in our ontology. Next, I address what I take to be the main obstacle to accepting modalities in an empiricist's world-view: the alleged principled impossibility of modal knowledge. In order to overcome this obstacle without resorting to problematic modes of inference, I propose an inductivist epistemology for situated modalities, based on the idea that realised possibilities are representative of non-realised ones. I show that since we do not know a priori which possibilities are realised and which are not, the status of statements of necessity is actually the same as the status of universal generalisations within a possible situation framework. This eliminates the reluctance one could have to adopt modal empiricism instead of non-modal versions of empiricism.

So much for the first battle. The second battle, which is the focus of the final part of the book, is against scientific realism and other related positions, such as structural realism. I take on the two arguments that structure the contemporary debate on scientific realism: the no-miracle argument for scientific realism in chapter 6, and the pessimistic meta-induction in chapter 7.

The no-miracle argument is an inference from empirical success to theoretical truth, and it involves a particular mode of inference: an inference to the best explanation. In chapter 6, I examine this type of inference, the way it is used for solving underdetermination problems, and the criticisms that it has received. According to the realist, the main problem with empiricism is that it is unable to explain the success of science, and in particular the capacity of theories to lead to successful novel predictions. In response, I explain how modal empiricism can actually account for novel predictions, in so far as the notion of empirical adequacy that it adopts can be justified. Novel predictions are among the possibilities accounted for by modal empirical adequacy, so, if our theories are empirically adequate, then these novel predictions are no miracle. I argue that the empirical adequacy of theories can indeed

be justified by using a particular form of induction: an induction on the models of a theory.

The pessimistic meta-induction is a direct response to the no-miracle argument, which starts from the observation that most successful theories of the past have by now been replaced by better ones. Since these past theories are now considered false, this casts doubt on the idea that contemporary theories are true. A move in response to this argument consists in adopting structural realism. This position restricts realist claims to the *structure* of reality, without assuming that scientific theories correctly describe the *nature* of reality, or assuming that this nature is entirely structural. The argument that structural realists put forth is that there is structural continuity between successive theories, so that theory changes do not threaten this form of realism.

Some contemporary structural realists claim that the structure of reality is modal. This position is not far from modal empiricism, to the extent that some have claimed that a modal version of empiricism is nothing but structural realism. In chapter 7, I examine this claim, and argue that it is untrue. The crucial difference between the two positions lies in the kinds of modalities that they adopt. The modal relations postulated by past theories are generally viewed as relative rather than absolute in light of their successors. I argue that for this reason, structural realism is actually unable to respond to the pessimistic meta-induction, unless it adopts a notion of relative modality, such as the situated modalities of modal empiricism. However, in such a case, the position cannot be considered a version of realism. This chapter clarifies the main differences between modal empiricism and scientific realism.

This argument completes our defence of modal empiricism against its opponents. Modal empiricism can make better sense of scientific practice as a rational activity than other versions of empiricism. The reasons to be a modal sceptic are unwarranted, given that statements of situated necessity are justified by induction as much as universal regularities are. Finally, modal empiricism can account for the empirical success of science, and it is not threatened by an induction on past theory changes. It comes out as the best position of compromise in the epistemic debate on scientific realism.

The conclusion of this book, chapter 8, is an opportunity to return to the facets of the debate that have been left out in other chapters: the semantic and the metaphysical aspects. Semantic realism is rarely discussed in the literature, but why should we take it for granted? Does it make better sense of scientific discourse in general? Are there reasons from philosophy of language to adopt it with respect to scientific theories? I answer by the negative to these two questions: semantic realism is much more problematic than generally thought, and we have good reasons to assume that modal empirical adequacy is the right notion for delineating the cognitive content of scientific theories. This means adopting a pragmatist notion of truth for theories, which comes very close to Peirce's conception of truth. In this sense (and this is a final twist), modal empiricism can actually be understood as a realist position, albeit not in the traditional sense.

This final move has important implications for the metaphysics of science. It favours adopting a revisionary pragmatist stance towards metaphysics, by connecting metaphysical considerations to more tangible aspects, and this has the potential of

resolving (or perhaps sometimes dissolving) various debates through a pragmatist reinterpretation of them. At the same time, the commitment to natural modalities that characterises modal empiricism is a way not to fall back to an impoverished metaphysics that would fail to do justice to the various debates. For this reason, the position I advocate in this book should not be merely understood as yet-another-position-in-the-debate-on-scientific-realism, but it should be understood as a more far-reaching proposal. It is a proposal concerning the way of interpreting science in general, and the way of understanding the role of metaphysics of science. This proposal has a normative dimension: sound metaphysical speculations should seek systematic connections with possible experiences in order to have practical relevance. In sum, modal empiricism purports to be the precise articulation of a pragmatist approach towards the philosophy of science. I hope that it can serve as a useful basis for all philosophers sharing this pragmatist stance.

References

Bell J (2004) Against "Measurement'. In: Speakable and Unspeakable in Quantum Mechanics, Cambridge University Press, pp 213–231

Churchland P, Hooker C (1985) Images of Science: Essays on Realism and Empiricism. University of Chicago Press

van Fraassen B (1980) The Scientific Image. Oxford University Press

Ghins M (2017) Defending Scientific Realism Without Relying on Inference to the Best Explanation. Axiomathes 27(6):635–651

Hanrahan R (2009) Consciousness and Modal Empiricism. Philosophia 37(2):281–306

Ladyman J, Ross D (2007) Every Thing Must Go: Metaphysics Naturalized. Oxford University Press

Lyons TD (2005) Toward a Purely Axiological Scientific Realism. Erkenntnis 63(2):167–204

Miller A (2003) The Significance of Semantic Realism. Synthese 136(2):191–217, DOI 10.1023/A:1024742007683

Psillos S (1999) Scientific Realism: how Science Tracks Truth. Philosophical issues in science, Routledge, London ; New York

Roca-Royes S (2017) Similarity and Possibility: An Epistemology of de re Possibility for Concrete Entities. In: Fischer B, Leon F (eds) Modal Epistemology After Rationalism, Springer International Publishing, Cham, pp 221–245, DOI 10.1007/978-3-319-44309-6_12

Shalkowski SA (1995) Semantic Realism. Review of Metaphysics 48(3):511 – 538