# Routledge Handbook of Scientific Realism

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# INTRODUCTION

## Scientific realism in the 21st century

Realism debates in philosophy, like debates between political views, are an essential fibre in humanity's reflective fabric. The debate about *scientific* realism, more specifically, is an essential part of our reflection and critical appreciation of scientific knowledge, its nature and its reach. Outside the realism debate many naturally adopt an uncritical stance according to which science unquestionably provides us knowledge of quarks, electrons, DNA, black holes, quantum entanglement, and other mind-independent, unobservable features of reality that centrally feature in our best science. This arguably naïve stance is widely shared and unsurprising given the astonishing predictive and instrumental successes of science, but it is attacked from all sides in the realism debate. Although science commands authority as a source of empirical knowledge, there are serious philosophical challenges to any unsophisticated realist position. Defending anything like the uncritical stance quickly turns out to be hard work!

Scientific realists, it is sometimes said, take scientific theories (more or less) 'at face value'. Instrumentalists, by contrast, regard theories as 'mere instruments' for predicting and manipulating observable phenomena. And whereas realists 'believe in unobservable entities' like electrons and quarks, empiricists 'only care how well our theories save the observable phenomena'. Such crude caricatures are useful for initial fixing of ideas, even if they quite fail to convey the intricate contours of the debate. What scientific realism in actual fact amounts to is perhaps best thought of in relative, contrastive terms (much like the political Left/Right). A scientific realist defends a degree of rationally justifiable optimism regarding scientific knowledge, progress, or representational adequacy with respect to directly unobservable features of reality, beyond what an anti-realist acknowledges. What does anti-realism amount to, then? The connotation is partly historical, associated with grand themes of empiricist, instrumentalist, social constructivist, and pragmatist traditions in philosophy, characterised in terms of broad categories of mind-dependence, language-dependence, relativity, and so forth. And partly it is again a relative matter of anti-realists challenging the kind of optimism that realists attest to. Such optimism and challenges thereof can manifest

themselves in a rich variety of ways, resulting in a range of more specific '-isms' on both sides of the vague divide.

The debate between realists and anti-realists is a venerable one, going back beyond the logical positivist roots of professional philosophy of science. By now hundreds of noteworthy research articles and dozens of landmark publications have accumulated, spanning over several decades, indicating the debate's maturity and lively history. While some specific disputes inevitably have become stale, uninspiring, or even forgotten, the realism debate at large – like most illustrious topics in philosophy – is vibrant as ever, due to its capacity to renew itself by finding fresh perspectives and positions on the issues at stake, and evolving with the sciences and the rest of philosophy of science. The key questions animating the debate, concerning the very nature of scientific knowledge and its extent, are still firmly at the core of philosophy of science. This handbook aims to provide an up-to-date review of the state of the debate, going now well into the 21st century. With thirty-four chapters written by many of the leading (anti-)realist thinkers and active participants in the current debate, it aims to provide solid grounding for further work.

**Part I** opens the volume with two chapters that map the historical trajectory of the contemporary realism debate from the logical empiricist era onwards. In order to properly grasp the shape of any grand philosophical '-ism', one must appreciate the historical backdrop against which it has developed and evolved. For late 20th century scientific realism, this backdrop was provided by logical positivism and logical empiricism, but one should not view the latter as a clear-cut foil to realism, since various realist tendencies can be traced back to logical empiricist philosophers themselves. Post-logical empiricist (re-)emergence of realism in the 1960s and 70s – the 'realist turn' in philosophy of science – was characterised by a shift from verificationist semantics to a more literal construal of scientific theories, accompanied by an appreciation of the explanatory endeavour of science itself and also of realism as an optimistic epistemology of science that best explains its empirical success. Much of today's discussion around scientific (anti-)realism still takes place in the context of now-classic debates in the 70s and 80s that ensued the blooming realist revival.

**Part II** offers nine chapters of contemporary review of the core issues, arguments, and the resulting '-isms' of this golden era of the scientific realism debate. Anti-realists quickly challenged one of the new cornerstones of the 'realist turn', the simple but intuitively extremely attractive idea that one can defend realism by capitalising on the empirical success of science. One set of challenges turned on the ('Duhem-Quine') underdetermination thesis, alleging that all theories are underdetermined by data in a way that makes it impossible to empirically confirm theories in a way required for realist optimism. Another challenge followed the very influential historicist critiques of realism by, e.g., Thomas Kuhn and Larry

Laudan, in the spirit of integrated history and philosophy of science, suggesting that a form of relativism or constructivism provides a better imagine of science as the historicists know it. The more abstract concern of underdetermination partly motivated van Fraassen's constructive empiricism – a hugely influential redevelopment of an antirealist tradition that views science as a matter of 'saving the phenomena'. Realists' resistance to the siren call of empiricism or instrumentalism – for those who did resist – was largely due to the unshakeable intuition that in empirically increasingly successful science as we know it, theories are by and large getting better as representations of reality. The latter notion of theoretical progress has kept exercising realists ever since the 1970s, as they have attempted to articulate more precisely and more convincingly what (increasing) 'approximate truth', or *'truthlikeless'* should amount to.

**Part III** comprises ten chapters that focus on significant themes that have emerged over the past fifteen or twenty years to stimulate the contemporary realism debate. The emergence of these themes is partly due to shifting interests and points of emphasis in philosophy of science at large. For example, the increasing interest in models and modelling practices in science – including simulations – is clearly influencing the way in which some of the key issues in the realism debate are conceived. While the way in which modelling essentially involves idealisations, and their relevance to the realism debate more specifically, has been much discussed in the literature since the 1980s, the idea that the modelling practices of science may support distinctively *perspectival* realism about scientific knowledge is a much more recent one. Progress in other topics of philosophy of science has also had an impact on the contemporary realism debate. For instance, while much of the realist gambit since the 'realist turn' has revolved around vindication of abductive reasoning (inference to the best explanation), only fairly recently the epistemology of explanatory reasoning has started to benefit from advances in the philosophy of explanation itself.

Some of the contemporary themes are fruitful reconceptualisations of old issues. The way in which the problem of unconceived alternatives reshapes the historicist anti-realist challenge of Laudan (and others) from the early 80s is a case in point. The history of science is indeed still widely taken to provide a 'testing ground' of sorts, in the spirit of integrated HPS, for various philosophical theses propounded in the realism debate, and further historical case-studies and illustrations have kept throwing interesting new light on the viability of particular realist ideas. Using the history of science as 'second-order' evidence in the realism debate – complementing the 'first-order' scientific evidence – raises significant meta-level questions about the level of generality on which the realism debate should take place. For several decades, from the 'realist turn' onwards the scientific realism debate has belonged firmly to *general* philosophy of science, which strives to provide a unified understanding of science on the whole, abstracting away from whatever methodological and other differences there are

between individual sciences. But is scientific realism best construed as a 'macro-level' thesis about all of (mature) science? Or should the realist claim, and challenges thereof, be assessed at a more local level – even if not 'micro', perhaps as a 'meso-level' affair – without going the whole hog? While historically much of the realism debate has been conducted in global terms (experimental or entity realism being an exception), in the contemporary debate some prefer to defend and debate realism as a more local thesis, one discipline or domain of science at a time. And, if we choose to discuss our epistemic commitments regarding all of science, perhaps realism and anti-realist are best characterised as *epistemic stances*, as opposed to theses to be defended by reason alone?

A more local approach to the realism debate is encouraged by the increasing specialisation within philosophy of science. For years there has been something of a disconnect between the philosophies of specific sciences and the scientific realism debate as conducted within general philosophy of science. This has recently begun to change as philosophers have started to pay more attention to the potential implications of discipline-specific issues – pertaining to, e.g., underdetermination – in geology, historical sciences, quantum physics, cosmology, and so on. The eight chapters in **Part IV** examine (anti-)realism in specific disciplinary contexts, ranging from the aforementioned areas of science to high-energy physics, chemistry, cognitive science, and economics. The issue of underdetermination comes up in a specific and powerful way in the context of quantum physics and its different interpretations, for instance. This is just one example of the fascinating ways in which discipline-specific details can drive the realism debate further. There is a lot more work to be done in this spirit, and hopefully the chapters here set a fruitful agenda for thinking realism-related issues further in a way that is fully informed by relevant, rich scientific details.

While one can examine issues of scientific knowledge and progress in a narrow disciplinary context, the broader connections of scientific realism to other debates in philosophy also loom large, lending further importance to the subject. Traditionally realism has been taken to have epistemic, semantic, and metaphysical dimensions. Corresponding to these dimensions, the five chapters of **Part V** discuss broader connections between the central realist tenets and theories of truth; epistemology; philosophical naturalism and philosophy of mathematics; and the status of metaphysics, and (more specifically) natural kinds.

I am delighted to have had the opportunity to edit the first ever collected edition of this kind to the service of continuing research on this important and fascinating topic. The quality and richness of the work that I gratefully received from the contributors has given me further confidence in the bright future and continuing importance of this area of philosophy. No handbook can pretend to be 100% complete in its coverage of relevant issues, and there are some omissions that no doubt will be noted by the experts. But I trust the volume will

achieve its central purpose: to provide a first-rate resource for researchers in philosophy, and a pedagogical resource for philosophy of science lecturers and for advanced undergraduate students, and more broadly for anyone interested in cutting-edge philosophical reflections on the nature and extent of scientific knowledge.