**Contemporary Scientific Realism and the Challenge from the History of Science**

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Project website: <http://community.dur.ac.uk/evaluating.realism/index.html>

**Research questions or problems**

Of the things very distant from immediate human concerns – the very small, the very distant, events in the distant past, processes happening over very long periods of time – it is commonly assumed that science can, and does, give us knowledge. Perhaps science got many things wrong in the past, but it is assumed that many/most contemporary scientific theories are definitely on the right lines, if not plain true; this is *scientific realism*. But what makes us so sure we are right now, when we have been wrong so often in the past? If genuine scientific practice can readily lead to false theories of the very small, the very distant, etc., doesn’t that cast significant doubt on what is today commonly referred to as ‘scientific knowledge’?

Philosophers of science have spent more than thirty years refining their response to this challenge. This project addresses one of the most sophisticated contemporary scientific realist positions, summarised by the following claim:

When a scientific theory (broadly construed) brings about substantial scientific successes (e.g. novel predictions), then the elements of that theory which *did the work* to bring about those successes are *very likely* at least approximately true.

Call this *selective scientific realism.* Despite deep issues concerning several of the key concepts here, there is widespread agreement that selective scientific realism *can be tested by the history of science*. That is, one can look to specific episodes in the history of science to see whether they support this claim. One can think of the position as analogous to a scientific theory which has been put forward, warranting extensive and thorough tests. But the position has not been thoroughly tested by the historical record: philosophers have focused on the same few cases for the past thirty years. In addition, philosophers have not adequately tracked the contemporary realist responses; in particular, they have not adequately concerned themselves with identifying the components of the theory that were responsible for novel predictive success.

This lacuna in the literature is addressed by this project. By analysing and assessing a range of new cases identified in previous work by the PI and Co-I (e.g. Lyons 2002, 2006, and Vickers 2013b), it will make a step-change contribution to assessing the viability of selective scientific realism. More precisely, the guiding research question (GRQ) will be as follows:

*GRQ: Which cases in the history of science threaten selective realism, and which substantive versions of selective realism (if any) are capable of addressing those cases?*

The reference to different ‘versions’ is necessary, since there are different takes on what should be meant by ‘did the work’, ‘approximately true’, and so on. Currently established versions of selective realism which will be considered are semirealism (Chakravartty 1998), structural realism (Worrall 1989, Ladyman 2008), and the positions put forward in Kitcher (1993) and Psillos (1999). Other possible characterisations of the position will also be considered, especially building on the suggestions in Lyons (2002, 2006, 2009b) and Vickers (2013b).

The historical episodes to be considered have been selected by the PI and Co-I from previous work (e.g. the list in Vickers 2013b). The following are the most promising candidates to move the debate forward significantly, and in different directions than have been previously explored.

Cases from thermodynamics

1. Rankine’s vortex theory of thermodynamics
2. Taking the thermodynamic limit
3. Modelling in statistical mechanics, assuming at the same time that particles do not interact, but *do* share energy

Cases from the history of chemistry

1. Scheele’s phlogiston theory (a distinctive history of science not currently detailed in the literature on ‘phlogiston theory’)
2. Dalton’s atomic theory
3. Mendeleev’s periodic law
4. Kekulé’s theory of the Benzene molecule

Cases from the history of biology and medicine

1. Drug receptor theory
2. Teleomechanist theories of organic development and the prediction of gill slits in human ontogenetic development
3. Reduction division in the formation of sex cells

In several of these cases important work has already been done by historians. For example, in the case of (a), Ben Marsden (Aberdeen) is currently completing the first major scientific biography of Macquorn Rankine. In the case of (h) Holger Maehle (Durham) has been at the forefront of work on the history of drug receptors (e.g. Prüll et al. 2009); this case will stand as a test case from the history of medicine, which is completely unexplored within the realism debate. And Kyle Stanford (2006, 2009) has very briefly introduced cases (i) and (j), but the philosopher is yet to draw on the available wealth of historical work which has been done (e.g. Churchill 1970, Gould 1977, Roll-Hansen 2009).

Going beyond these specific examples, the investigators have reason to anticipate that the exploration of further cases will be fruitful. Some of these are listed in Lyons (2002, 2006, In Press) and Vickers (2013b), but others are such that they have yet to be publically introduced to the realism debate. A PhD student will take on at least two major case studies over the course of the project. A balance will be struck between investigating cases in depth and investigating a significant number of cases. The balance will be dictated by considering at all times the significance of the analysis for answering the guiding research question (GRQ), as given above.

**Research context**

This project follows on directly from an AHRC ‘Science in Culture Exploratory Award’ pilot project which ran from February-September 2012 (see [here](http://www.sciculture.ac.uk/project/evaluating-scientific-realism-a-new-generation-of-historical-case-studies/)). It culminated in a publication in *Philosophy of Science*—‘[A Confrontation of Convergent Realism](http://www.jstor.org/discover/10.1086/670297?uid=2&uid=4&sid=21104816288123)’ (Vickers 2013b)—wherein a large number of examples from the history of science are presented as potentially problematic for contemporary scientific realist positions (it is currently one of the ‘most accessed’ papers in that journal). The paper is in part an updated version of Larry Laudan’s seminal paper ‘A Confutation of Convergent Realism’ (Laudan 1981). The latter transformed the realism debate by laying down a challenge: how could realists insist upon a close link between success and truth, when historically so much success can be linked with untruth?

Since 1981 Laudan’s historical cases have been carefully assessed, and as a result the pendulum has (to some degree) swung back in the realist’s favour. The realist insists that the following criteria are (a) independently motivated, and (b) show why all/most of Laudan’s cases don’t threaten the realist:

1. An example from the history of science must be *sufficiently successful* to warrant a realist commitment (e.g. by achieving *novel predictive* success).
2. Realist commitment must be restricted to the elements of a theory which actually *did the work* in bringing about the successes in question. It is *these* elements which must be false (and not approximately true) to cast doubt on realist claims.

In addition, the realist can sometimes defend her position from a threatening historical example by arguing that the case only *looks* threatening because it has been anachronistically reconstructed and/or overly simplified. This leads to complications, since it must be acknowledged that there can be no ‘pure’ history of science: all historical reconstruction requires a perspective (Schickore 2011). But the realist can at least make use of the fact that some reconstructions should definitely be ruled out as ‘unacceptably ahistorical’.

There are still controversies about some of the cases introduced by Laudan (e.g. Chang 2003, 2012, Saatsi 2005, Ladyman 2011). But for the past thirty years the realism debate has progressed by analysing the same handful of cases (especially the Fresnel/Poisson spot, caloric, and phlogiston) without anybody having any idea just how many more relevant cases might be lying dormant in the history. Vickers’ pilot project led to a long list of potentially highly relevant cases, several of which were taken from a little known 2002 work by Timothy Lyons (Lyons 2002) and Lyons (2006). In addition to collecting more cases for exploration (Lyons, In Press), Lyons has also done much to emphasise the additional work demanded by the debate: not only do we need far more in-depth historical case studies, but we also need to think carefully about how exactly the selective realist’s statement can be made less vague than Psillos’s influential 1999 account (Lyons 2006), and to clarify some of the confusion that has come about in the debate, for instance between Psillos and his prominent contemporary critic Kyle Stanford (Lyons 2009b).

**Research methods**

The basic aim of the project is to make a step-change contribution to assessing the validity of selective scientific realism by amassing a large amount of relevant ‘data’ (loosely speaking) from the history of science, and bringing that data to bear upon selective scientific realist positions. Major objectives along the way will then be:

1. to develop new, detailed historical case studies relevant to the debate, especially (a)-(j) as given above;
2. to investigate how these cases bear on different variations of selective scientific realism as detailed in the literature;
3. to investigate possible adjustments to the current selective realist positions warranted by the new case studies (including an adjustment sketched as part of the pilot project);
4. to investigate the circumstances in which a theory has been *sufficiently successful* to merit realist commitment;
5. to determine the prospects for prospective identification of the success-fuelling constituents of a theory, including a development of the approaches introduced in Lyons (2006, 2009b) and Vickers (2013b).

Meeting these objectives requires a combination of the research methods associated with historical scholarship and philosophical analysis. What is required is philosophical reconstruction of history of science which:

1. is sensitive to the historical details, including the historical context of the science in question;
2. recognises that all history of science ‘requires a perspective’, and a choice of conceptual tools, but which eliminates (insofar as it is possible) particularly problematic biases in the method of reconstruction;
3. focuses on the different selective realist positions in the process of reconstruction in order to pick out the relevant history/histories which will inform the philosophical questions.

Meeting these conditions requires both philosophical and historical skills, but the PI and Co-I are well placed to meet the challenge. For example, concerning (b) the PI and Co-I would build upon articles already published (Saatsi and Vickers 2011, Lyons 2009b, 2012) which both (i) demonstrate for specific cases how it is possible to develop case studies to answer philosophical questions in the realism debate without letting any realist or anti-realist intuitions play a role, and (ii) provide general arguments that this is possible. In short, for given, independently motivated definitions of ‘working posit’ and other key concepts, one can investigate whether working posits were preserved in the successor theory quite independently of the lessons one might want to draw. One can thus hope to establish which definitions of ‘working posit’ etc. are ruled out from use in statements of the realist position, given the history of science. Over the course of the project this should lead to a conclusion concerning *how* realist an historically informed selective realist position can be.

On the matter of historical skills, we have both engaged directly with primary sources in our published research – especially Vickers (2013a) and Lyons (2006, In Press). But, importantly, previous work tells us that in many cases we would be able to draw on the work and knowledge of professional historians, such as those who have already agreed to be involved in the project (including Jed Buchwald, Keith Hutchison, William R. Newman, Betty Smocovitis, Larry Principe, Trevor Levere, William B. Jensen, Angela Creager, Ben Marsden, Holger Maehle, Matthew Eddy, and Greg Radick – see below for further details).

Some of the research questions would require more familiar, traditional analytic philosophy. For example, some work has already been done towards objective (iv)—e.g. Forster (2007) and Fahrbach (2011)—and we would look to evaluate and extend this work. The pilot project also indicated that work within Bayesian epistemology might be fruitfully applied to this corner of the realism debate, and this would be further investigated. But even here it would be a priority to combine this work with historical reconstruction, applying the findings to the specific cases investigated, balancing the history and philosophy as appropriate.

In addition to the research methods noted above, the research will be enhanced by two workshops, two conferences, a symposium, presentations at external conferences, and six international project reading groups bringing together a number of historians and philosophers of science which comprise a ‘wider project network’:

* **Indiana-Purdue, Indianapolis**: Timothy Lyons (Co-I), Victoria Rogers, Cornelis de Waal, Peter Schwartz, Jason Kelly
* **Indiana, Bloomington**: Jutta Schickore, Jordi Cat, Sander Gliboff, Amit Hagar
* **Purdue, Lafayette**: Dana Tulodziecki, Paul Draper, Martin Curd
* **Durham**: Peter Vickers (PI), Matthew Eddy, Holger Maehle, Nancy Cartwright, Julian Reiss, Wendy Parker, Ian Kidd, Robin Hendry
* **Leeds**: Juha Saatsi, Steven French, Greg Radick

Project timetable

* **August 5th-9th 2014**: Vickers and Lyons to present papers, promote the project, and network with key actors in the scientific realism debate *and invited leading scientists*, at the major international conference New Thinking About Scientific Realism (Cape Town, South Africa). Vickers and Lyons hope to publish in the conference proceedings, and meet a number of individuals who will participate in the forthcoming project conferences/workshops. The organisers have agreed to display a ‘project poster’ at the conference.
* **November 2014**: International reading group 1.
* **December 2014**: Workshop in Indianapolis ‘The History of Chemistry and Scientific Realism’.
  + *Confirmed speakers*: Robin Hendry, Eric Scerri, William B. Jensen, Alan Rocke, Alex Manafu, Moti Mizrahi, and Huginn Thorsteinsson.
* **April 2015**: International reading group 2.
* **April 2015**: Workshop in Durham ‘Thermodynamics and Scientific Realism’
  + *Provisionally confirmed speakers*: Ben Marsden, Keith Hutchison, Owen Maroney, Craig Callender, Jos Uffink, John Norton. A call for papers will be sent out for other speakers.
* **August/September 2015**: Dissemination of project findings at the biennial meeting of the European Philosophy of Science Association, including the option to submit articles for the conference proceedings.
* **September 2015**: International reading group 3.
* **January 2016**: Three day international conference at Indianapolis ‘Contemporary Scientific Realism and the Challenge from the History of Science’. This would be the biggest meeting of historians and philosophers of science in recent years to discuss a specific topic.
  + *Provisionally confirmed speakers*: Stathis Psillos, Kyle Stanford, Anjan Chakravartty, Jed Buchwald, Betty Smocovitis, Larry Principe, Angela Creager, and Jutta Schickore.
  + In the following months Vickers and Lyons would co-edit a volume bringing together the best papers presented at the conference, possibly combined with the best papers from the two workshops.
* **April 2016**: International reading group 4
* **September 2016**: International reading group 5
* **November 2016**: Symposium at the biennial meeting of the Philosophy of Science Association: ‘History of Biology and Medicine and Scientific Realism’.
* **April 2017**: International reading group 6
* **July 2017**: End of project international conference in Durham: ‘Quo Vadis Selective Scientific Realism?’. Line-up to be organised as the project proceeds, and will include leading philosophers and relevant scientists with whom we will come into contact during the course of the project.

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