Frameworks for Historians & Philosophers[1]

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Abstract

The past can be a stubborn subject: it is complex, heterogeneous and opaque. To understand it, one must decide which aspects of the past to emphasise and which to minimise. Enter frameworks. Frameworks foreground certain aspects of the historical record while backgrounding others. As such, they are both necessary for, and conducive to, good history as well as good philosophy. We examine the role of frameworks in the history and philosophy of science and argue that they are necessary for both forms of enquiry. We then suggest that the right attitude towards frameworks is pluralism rather than monism: there is no single correct framework to be applied to a given scientific episode. Rather, a multitude of different frameworks are more or less appropriate given various contexts and aims. From this perspective, good frameworks generate and further, rather than frustrate, historical and philosophical enquiry. Our view sheds light on historical disagreement, and on the relationship between philosophy and history of science.

Keywords

History, philosophy, frameworks, explanation, pluralism

1   Introduction

The past is a multi-faceted beast: episodes relate through networks of interlinking circumstances, occurrences and happenstances. In order to weave coherent narratives, historians and historically-minded philosophers must simplify matters: they need to emphasise some aspects of the past and minimise others. To this end, they rely on frameworks. Frameworks tell you which aspects to foreground, and which to background.

In this paper, we're interested in drawing together a range of ideas regarding the nature of historical explanation, pluralism, and the relationship between the philosophy and the history of science. In particular, we're going to argue that the practice of history and philosophy (1) unavoidably involves the use of frameworks, properly understood, that (2) this has consequences for the nature of disagreement within those disciplines, and (3) offers insight about the relationship between the history and the philosophy of science. We suspect that much of what we have to say will be familiar, but we nonetheless think it is important and useful to state the position explicitly.

We'll draw liberally from the history and philosophy of science (HPS). HPS is suitable for considering the relationship between history and philosophy, because it has already housed significant and sophisticated discussion of that very question—and our conception of frameworks, we'll argue, helps us understand their relationship.[i] Historians and philosophers often have different interests—philosophers tend towards the general, historians the local; philosophers tend towards the normative, historians the interpretive; philosophers tend towards the abstract, historians the concrete. However, on our account, the lines separating the historian and the philosopher are blurred. For one thing, insofar as philosophers are framework-smiths, their work is central to historiography; insofar as historians utilise, critique and examine frameworks, their work is philosophical. For another, the ways both historians and philosophers understand and make use of science's past are sensitive to the considerations we'll lay out.

In section 2, we provide an account of frameworks and their relationship with the practice of history. This task, and much of the paper, uses Isaac Newton's first optical paper as a case study. Our aim is not to make substantive claims about historical explanation, but rather show how widely-agreed features of such explanations underwrite our broader notion of frameworks and their inescapability for historical inquiry. In section 3, we'll situate our account within HPS discussions of the relationship between history and philosophy. Our pluralism suggests that, rather than attempting to do without frameworks, or—*sotto voce*—using them implicitly, philosophers and historians should instead develop an explicit tool-kit of frameworks. We take steps towards articulating such a tool-kit by analysing frameworks along a series of parameters throughout the paper. In section 4, we draw two lessons: one concerning disagreement about history; the other, the relationship between philosophy and history.

2   Foregrounding and Backgrounding

Once we take on the task of writing a history of science we have to have some principle of selection which enables us to pick out relevant historical facts from irrelevant ones (Chalmers 2016, 28).

Good history requires 'principles of selection' which guide in identifying the relevant and irrelevant aspects of the target episode: they tell us what to foreground, and what to background. As Danto says, "Not to have a criterion for picking out some happenings as relevant and others as irrelevant is simply not to be in a position to write history at all" (Danto 1962, 167). In essence, telling us what to foreground and background is a framework's job.

Consider, for instance, Steven Shapin's emphasis on the 'invisible' in science, particularly lab technicians. On his view, shifting our focus to such features challenges the "predominant biases in the Western academic world [which] have traditionally portrayed science as a formal and wholly rational enterprise carried out by reflective individual thinkers", an understanding which "block[s] naturalistic understanding of scientific activity in favour of a set of idealizations" (Shapin 1989, 563). For us, Shapin is *backgrounding* the 'formal' and 'wholly rational' aspects of science, and *foregrounding* the role of unsung actors as well as the relevant social dynamics. In short, he is choosing one framework over another.

Picking between frameworks—deciding which principles shall guide foregrounding/backgrounding decisions—is necessary insofar as historical narratives purport to explain. This is because some good explanations tell us why events are similar, while others are contrastive: they tell us why one thing happened as opposed to another. As such, it is necessary to pick which events, and which contrasts and comparisons, we are concerned with. And so frameworks, insofar as they allow us to make these decisions, are necessary. We'll make some general points about the nature of historical explanation, before articulating the necessity of frameworks. Moving forwards, we'll often use the term 'historian' in reference to both historians of science and philosophers whose work interprets or otherwise relies on science's history.

2.1 Historical Explanation

The past is complex, contingent, and stubbornly ephemeral. Because of this, historians are often contrasted with paradigm scientists, juxtaposing the scientific aim for generality and the historical aim for local understanding.[ii] In this section, we won't provide an *account* of historical explanation, rather, we identify commonly agreed-upon features which drive our view on frameworks. It is often thought that the kinds of explanations offered by historians, namely, narrative explanations, are distinct from other kinds of explanations, and these differences have been analysed variously.[iii] David Hull's account is illuminating, makes minimal commitments, and suits us our purposes, so we'll follow it here.

Crucial to Hull's account of historical explanation is the idea that different features carry the 'explanatory load' across different explanations (Hull 1975, 1989); what generates an

explanation's value is sensitive to context. On his view, for some explanations (covering-law explanations most obviously), regularities do explanatory work by drawing together the *explanandum* with other events and showing why the event was expected. For historical explanations, by contrast, explanatory load is carried by 'central subjects': "The role of a central subject is to form the main strand around which the historical narrative is woven" (Hull 1989, 255). My autobiography, for instance, is not a unified whole because it accords with a set of rules or instantiates a set of patterns, but because it is about *me*: the central subject. We will be open as to what kinds of things central subjects might be; the point is simply that explanatory load is carried by something other than a pattern, or regularity.

Assuming that Hull captures—or nearly well enough—what is different about historical explanations, we can make the following two claims about historical explanation:

The *negative claim*: historical explanation is not primarily or necessarily about, nor does it fundamentally depend on, unifying events as types.[iv]

The *positive claim*: historical explanation is primarily about situating events and processes in terms of their *historical trajectory*—their relationship with other events and processes in time.[v]

There is a plurality of ways of situating an event, process, or central subject in a trajectory, and indeed this sometimes involves appeals to regularities (see, for instance, Currie 2014). However—crucially for us—they need not. With this quick sketch of the aim of historical explanation, we can identify our question: how might frameworks help or hinder situating events and processes in historical trajectories? In the next four subsections, we'll argue that frameworks play a foregrounding and backgrounding role, analyse how frameworks achieve this, argue that such foregrounding and backgrounding is necessary for historical practice, and finally make our account's pluralism explicit.

2.2   The function of frameworks

There are many approaches to philosophical analysis. In this paper, we take a pragmatic or functional approach:[vi] instead of gathering home truths about frameworks, offering normative accounts, or considering paradigm cases, we examine the role frameworks play in historical explanation.

Our account is built around a well-known case-study: Newton's first optical paper, his 'New Theory about Light and Colors'. The original, dated 6 February 1672 (Newton, 1959-1977: Vol. 1, 92-107) was read at the meeting of the Royal Society on 8 February 1672 (Birch, 1757: 9) and published in the *Philosophical Transactions* shortly afterwards (Newton, 1672a). It's striking how

much Newton does in such a short paper. He reveals a new phenomenon (the elongation of the spectrum produced by projecting white light through a prism) that, in turn, reveals a new property of light (the heterogeneity of white light). He then uses this insight to develop a new theory of colour which in turn explains the phenomena of coloured bodies.

But describing Newton's paper isn't in itself history. Recall the long-toothed distinction between a chronology and a history. The former is simply an ordering of events. Newton built and sent his new reflecting telescope to the Royal Society in January 1672. He sent them the letter containing his new theory in February 1672. It was then published in the *Philosophical Transactions*. Robert Hooke wrote a response a week later. And so on… But the historian is interested in providing a narrative: situating the events—historicising them. How is this to be done? One could focus on Newton's methodology, interpreting the 'New Theory' as a demonstration of the new experimental philosophy promoted by members of the Royal Society in the 1660s and 1670s (e.g. Walsh 2012, Anstey 2004, Jalobeanu 2014), or as an early version of Newton's own mathematico-experimental method (e.g. Dear 1995, chapter 8, Feingold 2001). In contrast, if one were to focus on the development of Newton's optical theory, then the 1672 paper would be treated as one of several reference points—others being Newton's *Optical Lectures* (c. 1670), the manuscript *Fundamentum Opticae* (c. 1690) and the *Opticks* (1704) (e.g. Shapiro 1980, Westfall 1962). In short, it is possible to situate the same work within a different historical context by unifying it with a different set of events and influences.

The challenge faced by the historian is not so much to discover historical events and situate them, but to decide which events and which situations. When the historian focuses on Newton's paper in the context of the history of the Royal Society, say, she inevitably highlights some features and ignores others. Given the Royal Society's interest in the development of new technologies, for example, particularly those related to navigation, the impact of Newton's reflecting telescope is important—it is *foregrounded*. However, if the historian decides to focus on the paper within the context of Newton's mathematico-experimentalism and his relationship with Isaac Barrow, the production of the telescope is far less central—it is *backgrounded*.

But foregrounding and backgrounding involves more than deciding which events, influences, and aspects of the past we want to unify or contrast. We also must decide which perspectives and tools to bring to our inquiry. So far, we've discussed Newton's work as a discovery—considering his paper as a primarily epistemic document. But this is not the only way to view it. Consider Simon Schaffer's approach to understanding Newton (Schaffer 1986). He insists that scientific discovery be set within a political context. In particular, he highlights the

role experimentation came to play in establishing authority. The driving force behind the eventual wide-spread acceptance of Newton's claims about the composition of light wasn't necessarily the recognition of the epistemic legitimacy of his scientific method. Rather, the driving forces were the prejudices, political interests, and machinations occurring both amongst the grandees of the Royal Society and across Europe more generally. On one approach, Newton's accomplishment is considered in light of its epistemic success; on the other, its political expediency. Foregrounding and backgrounding, then, isn't simply a matter of picking comparisons and contrasts—it also involves making decisions about the kind of story we want to tell.

So, what is a framework? Frameworks are ways of dividing up and unifying various historical episodes—they are recipes for shifting from chronologies to histories. They have, then, a functional role in historical enquiry: backgrounding and foregrounding. Different frameworks foreground and background different aspects of an historical episode. It is helpful to conceive of this in contrastive terms, fixed by a single event:

> Two historical explanations, *a* and *b*, deploy different frameworks regarding some historical event *e*, just in case *a* foregrounds and backgrounds a different set of *e*'s elements, than the set of *e*'s elements foregrounded and backgrounded by *b*.

Note that there are at least two related ways that elements of *e* might be emphasized or deemphasized. First, in the historical explanation some elements might be mentioned and others might not be. For example, as we shall see, Dana Jalobeanu's narrative about Newton's 'New theory' mentions his reflecting telescope, but William R. Newman's narrative doesn't. Second, the elements might themselves be situated in different trajectories. For example, Jalobeanu links Newton's 'New Theory' with developments in Baconianism, and Newman links it with the story of chymistry. In principle, these two routes to foregrounding and backgrounding come apart, but in practice they are coupled.

You might complain that this account is too narrow; that frameworks do more than we have described. A lot turns on what we take foregrounding and backgrounding to involve. In the next subsection (and expanded in section 3), we'll develop a scheme involving three dimensions which we think captures how frameworks situate events within trajectories. We're open to frameworks fulfilling other roles as well, but pluralism requires demonstration. Conversely, you might complain that our account is too broad: by our account, distinct narratives of the same episode entail distinct frameworks. Are there really so many? On our view, there is a multitude of tacit frameworks which underwrite differences in historical explanations. However, as we'll

discuss in 4.1, disagreements about matters of fact still have an important role in historical disagreement, even when different frameworks are in play.

Finally, you might worry that a notion of 'frameworks' is itself unnecessary: couldn't this all be achieved with philosophical reflections on explanation (as an anonymous referee urges)? We feel the force of this worry—especially if 'framework' implies monolithic world views—but think this should be resisted. We use 'framework' as a term of art, so in principle it may be swapped out for another term, but we think it useful for several reasons. Using it emphasizes the continuity between the Big Frameworks (such as the Rationalist-Empiricist Distinction, see below) and more local perspectives. This lumping together emphasizes that one cannot simply dismiss certain types of histories on the basis of their using frameworks *per se*: a more specific argument concerning that kind of framework is required. Further, this continuity underwrites a quite general discussion of the nature of historical disagreement and is, we think, crucial for understanding what a successfully integrated HPS looks like. Finally, our notion of 'framework' goes beyond particular explanations, and—as we're about to see—includes the broader perspectives and commitments which underwrite explanatory salience.

2.3   A Framework Schema

How do frameworks manage their foregrounding and backgrounding work? We'll make a preliminary three-way distinction which, we think, goes a long way towards capturing how frameworks determine explanatory salience—that is, how they guide us in foregrounding and backgrounding. We'll introduce our schema briefly in this section, and expand upon it in section 3, after seeing it applied. In short, frameworks determine narrative salience by specifying an *index*: the central subject targeted by some particular narrative; *explanatory expectations*: the features considered to be explanatory of that subject given the narrative context; and a *contrast/comparison set*: the other events, properties, processes or episodes that the index unites with or diverges from.

As we saw in our discussion of historical explanation, at least part of the explanatory power of such explanations lies in their central subject: the thing the narrative is about. In other words, to undertake an historical explanation you need a target: your explanation needs to be about some historical episode(s) or trajectory. We'll call this central subject the explanation's 'index'. By specifying an index, historians constrain their explanations to things which make sense of that subject. Whether anything at all can count as a subject, or whether there are restrictions, is an open question for our purposes here.

Different explainers have different ideas about what makes for a good explanation in some domain. In pedagogical contexts, for instance, we may allow for more distortion of the truth than in, say, research contexts (Walsh and Currie 2015a). Some may prefer explanations which appeal to economic factors, others to contingent happenstance, others to developments in technology. Such 'explanatory expectations' play a role in setting explanatory adequacy by constraining the *explanans* to elements which fall within those expectations. We also leave open the question of whether any old set of expectations is valid.

In situating a central subject in a historical trajectory, historians must select a trajectory amongst a plurality of options. Historical events are related in a multitude of ways, and to construct a sensible narrative, only so much of that complexity may be included. As such, explainers sometimes unify their event with a set of other (actual or possible) events, and they sometimes pick out what is unique about their event by contrasting it with others (Sterelny 1996). As such, the 'comparison/contrast set' at hand also constrains suitable explanations.

This schema, we take it, allows frameworks to encompass a variety of scientific features including (to co-opt a list provided by an anonymous reviewer) sets of theoretical beliefs, methodological guidelines about how to approach the past, sets of concepts for interpreting the past, narrative structures, and the topical interests of historians. Each of these play a role in foregrounding and backgrounding, and thus determining explanatory relevance and salience *vis-à-vis* some explanatory episode.

So, on our view, explanatory salience is set by (1) an index, which identifies the central subject with which the historical narrative is concerned, (2) explanatory expectations, which tell us what a good explanation looks like, given the index, and (3) a set of contrasts or comparisons, which tell us about the goal of the explanation. In combination, these act as principles of selection which tell the historian what to foreground and what to background. It is our thought that much historical and philosophical work on science has been carried out with more-or-less implicit frameworks—sometimes the index, expectations and contrast/comparison set are not explicitly stated. Perhaps in many cases it would be useful if they were.[vii]

2.4 Frameworking is Inescapable

So far, we've articulated a story about frameworks based on their function: foregrounding and backgrounding. A framework aids the historian in deciding which aspects of her subject she wants to focus on, and why. Our argument for the necessity of frameworks is simple: historians must make foregrounding and backgrounding decisions, and such decisions—unless they're random or arbitrary (which they are not!)—must rely, at least tacitly, on a framework.[viii] Here is

the quick and dirty version of our claim: insofar as frameworks are necessary for foregrounding and backgrounding, and foregrounding and backgrounding is necessary for historical enquiry, frameworks are necessary for historical enquiry.

What is the relationship between frameworks and historical explanation? Peter Railton's account of explanation provides a jumping-off point.[ix]

Railton appeals to the concept of an *explandandum's* 'ideal explanatory text'. Such a text, were it to exist, would contain full details of every event and process which is in any way relevant to the occurrence of the event or process in question. In Railton's terms, the ideal text contains every piece of information relevant to every 'due-to' relation pertaining to a phenomenon. 'Due-to' relations are extremely varied, capturing the wide range of causal (and arguably a-causal![x]) factors contributing to (or otherwise explaining) an event's occurrence. Railton offers two conditions for an explanation's sufficiency: an explanation is sufficient when (1) it meets a *salience* requirement—it can generate understanding in the relevant audience—and (2) the information cited is *relevant,* that is, it's part of the ideal explanatory text *vis-à-vis* that phenomenon. To bring Railton's account into an historical context, let's consider the first requirement in light of our previous discussion of the nature of historical explanation.

What makes for an *understandable* historical narrative? That is, how does the historian meet Railton's salience requirement? The answer is not, as we saw above, captured by notions of 'causal sufficiency'—the historian does not (at least not always) show how the combination of initial conditions and law-like regularities lead inexorably to the occurrence of their *explanandum*. Rather, historical explanations often involve picking out a central subject. A coherent story is told which traces the trajectory of the relevant historical sequence.[xi] Salience, then, is determined in part by the index: the target of explanation.[xii]

Considering that frameworks provide contrasts and comparisons, i.e. guidance as to which parts of the explanatory text to include and which to exclude, if an historian is not using a framework then they must either attempt to provide the ideal explanatory text, that is, cover every aspect of the historical individual or select information from among the set of relevant information in an arbitrary or random way. Where the former is unfeasible, the latter is irresponsible. Doing history requires that careful decisions be made about what to include and what to exclude. Historians must decide how to situate their *explanandum* in the nexus of the world; which parts of the ideal text to include and which to omit. And, as we've seen, salience requirements set by frameworks constrain historical explanation. The historian must provide a story which makes sense of the historical episodes which concern them. And this is where a

framework is required: an index, explanatory expectations and a comparison/contrast set are, at the very least implicitly, employed.

Let's tie the argument together by returning to Newton's first optical paper. Given that a full description of Newton's paper is undesired, unnecessary and impossible, and that we desire to explain the paper, or to draw upon it in an explanation, the historian must identify which parts of the paper and surrounding historical context matter. We'll provide examples of four different ways of explaining Newton's early optical work, and show how these presuppose—at least tacitly—frameworks.

Dana Jalobeanu investigates the 'Baconianism' of Newton's paper (Jalobeanu 2014). She identifies elements of Baconian natural history in the paper, thus interpreting it as closely aligned with the methodological positions of Boyle and Hooke. So she reads Newton as contributing to the epistemological and methodological debate over the purpose, practice and scope of Baconian natural history that took place in early 1670s Britain. Her analysis draws our attention to, for example, the open-endedness of the experimental sequence described in the first part of the paper, culminating in the *experimentum crucis*. Jalobeanu regards this sequence as an example of Bacon's *experientia literata*—the art of learned experience—and the *experimentum crucis* as an experimental fact obtained at the end of a carefully devised chain of experiments. Her analysis draws our attention, in particular, to two features of Newton's paper. First, the fact that Newton's description of the *experimentum crucis* lacks detail. This lack of detail is to be expected given the Baconianism of Newton's paper. In that tradition, replication is purposefully challenging: figuring out and performing the experiment plays a critical role in knowledge transmission. Second, the discussion of the implications of Newton's discovery for telescope design. Again following Baconian tradition, this discussion is not out of place (as is often thought). Rather, Baconian natural histories standardly include discussions of potential applications of theoretical results.

William R. Newman focuses on Newton's debt to seventeenth-century chymical corpuscularism (e.g. Newman 2010, 2016). He argues that Boyle's work on chymical analysis and synthesis, which revealed that chemical compounds were made up of heterogeneous components, provided the young Newton with an important heuristic for developing his theory that white light is a heterogeneous mixture of rays of immutable spectral colour. Newman's guiding questions lead him to notice, for example, that Newton's earliest descriptions of his theory are found amongst notes he took on Boyle's chymistry (Newman 2016). Newman also pays special attention to Hooke's 1672 criticism of Newton's theory. Hooke argued that we have

no more reason to suppose that white light consists of immutable colours than to suppose that the sounds made by an organ already exist in the air of its bellows. Newman notes that this is a particularly surprising criticism from Hooke, given that in his *Micrographia* Hooke appears to accept the idea that the ingredients of a chemical compound retain their identities after being mixed. This leads Newman to wonder why the burden of proof shifted to Newton in that case. Finally, this approach leads Newman to focus, not on the *experimentum crucis*, but on an experiment Newton describes near the end of the paper, which involves recombining the coloured light of the spectrum to reproduce white light.

Peter Dear investigates the mathematisation of natural philosophy (Dear 1995), so Newton's 'New Theory' matters for its mathematico-experimentalism—and in particular, for its debt to Isaac Barrow, the first Lucasian Professor of Mathematics at Cambridge University (Newton's mentor and predecessor). Dear follows Newton's methodological discussions with Hooke and Lucas and notes that Newton's conception of the role played by his *experimentum crucis* marks a potentially important point of difference between Newton and Barrow. Where Barrow argues that a single experimental event may suffice to establish a true physical principle, Newton argues that his experiment makes his conclusion logically unavoidable. The difference is subtle but turns on the generalisability of the result. Barrow thinks that, in cases where uniformity can be assumed, one can generalise from a single representative case, but Newton apparently takes the *experimentum crucis* to produce a general result: no generalisation required.

Jalobeanu, Newman and Dear take on partially overlapping indexes—Newton's paper— however, they have different comparison/contrast sets. Jalobeanu situates Newton within developments of Baconianism, Newman within chymistry and Dear under the mentorship of Barrow. These difference comparison/contrast sets determine differences in what each foregrounds and backgrounds: that is why Dear emphasizes Barrow, while Newman spends time on Hooke. By contrast, Simon Schaffer's entry point is the power dynamics which drive theory acceptance (Schaffer 1986), and so he focusses on dissent and the ways in which communities of scientists reach consensus—in particular, on how experiments are used to establish authority:

> Where experiments are interpreted as conveying unarguable lessons about the contents of Nature, this indicates that a controversy has reached a stage of provisional closure (Schaffer 1986, 68).

Schaffer focuses on Newton's *experimentum crucis* and the process by which it came to be regarded as a messenger of a 'self-evident' truth about nature. He notes initial disagreement among experimenters about what the experiment was supposed to teach us, which Schaffer attributes to other philosophers' inability to replicate it, in part due to Newton's inadequate instructions.

Schaffer attributes the eventual success of Newton's theory to his gaining political power and influence over the relevant institutions. He demonstrates that this process is closely bound up with the idea of a 'good prism' and the 'transparency' of an instrument as a messenger of truth. Schaffer frames the discussion in terms of the experimental context of the time: many of Newton's contemporaries were interested in telescope and microscope design, and Schaffer presents Newton's optical experiment as contributing to technical discussions about glass- and metal-working techniques and aberrations and artefacts produced by bad glass. We think it reasonable to say that Schaffer has different explanatory expectations to, say, Newman. Where the latter explains via epistemic influence, the former does via political power and expediency.

Each of these histories gives us a different picture of Newton. Jalobeanu gives us Newton the Baconian Experimental Philosopher—building on, and responding to, the Baconianism of the Royal Society. Newman tells of Newton the Chymist—building on Boyle's approach to alchemical research. Dear gives us Newton the Mathematician, Isaac Barrow's protégé. Finally, Schaffer gives us Newton the Politician. Which Newton we get depends in part on the framework the historian in question deploys. Sometimes these frameworks pick out different historical targets, indexes or different contrasts or comparisons. Where Newman is telling the story of the emergence of science as a development of alchemical practice, Jalobeanu's story is tied to the emergence of Baconian experimental philosophy in the early Royal Society. But sometimes the frameworks come apart due to philosophical contentions about what matters in history: explanatory expectations. Schaffer's approach identifies interacting, sometimes conflicting, power structures and political perspectives as explaining the spread and acceptance of ideas, while Jalobeanu, Newman and Dear tend to appeal to methodological and epistemic influence.

We can understand the justification behind presenting such different 'Newtons' in terms of our considerations of historical explanation above. For a narrative explanation to be salient, the relevant aspects must be tied together—*made sense of.* And frameworks do this by providing principles for foregrounding and backgrounding. Such principles are set by the index, explanatory expectations, and contrast/comparison set in play. We can understand the ways different historians and philosophers treat Newton's first paper, then, in terms of the different 'principles of selection' (the different frameworks) they employ.

To summarise the argument of this section so far. We've claimed that characteristically historical explanations target particular episodes—particular historical trajectories—and account for them not as a type of event, but by situating them historically. An upshot of this view is that

a good historical explanation must also include a non-arbitrary method of foregrounding and backgrounding. A framework can be understood broadly as something which does this job for us. As such, frameworks are necessary for historical enquiry; and insofar as philosophical claims rely on history, they are reliant on frameworks too. We now argue that this project is best understood pluralistically.

2.5 From Explanatory Ecumenism to Framework Pluralism

We advocate pluralism about frameworks in two senses. First, we argue that there is no single privileged way of framing an historical episode (although there may be invalid ways of framing it). If a framework serves to highlight a set of contrasts *vis-à-vis* some historical episode, and there are multiple sets of valid contrasts that might interest us, then there should be multiple legitimate frameworks applicable to a single historical episode. We call this 'ecumenism'. Second, there is a plurality of framework types: they come in varying shapes and sizes. While both kinds of pluralism are implicit in our account of frameworks, it is worthwhile making them explicit.

We take the term 'ecumenism' from a position which often crops up in debates about reductionism in various scientific contexts (see Jackson and Pettit 1992, Fodor 1974). Typically, such discussions are focused on sciences with limited historical dimensions:[xiii] psychology, chemistry, macro-economics, and so forth. The basic thought is that, for one phenomenon, event, or process, there are multiple, non-equivalent and legitimate explanations pertaining to it. Ecumenism often dissolves apparently vociferous debates by demonstrating that the sides had different things in mind—different contrasts—and thus have compatible perspectives. It's helpful to look at an example.

Angela Potochnik has argued for ecumenism between population genetics and evolutionary developmental biology (evo-devo) (Potochnik 2010). Both fields are concerned with explaining the evolution and spread of novel traits in biological populations but, as Potochnik puts it, each black-boxes different aspects of populations. Population genetics explains how a trait's advantage in reproduction and survival—its fitness—can lead to it becoming fixed in a population over generations. Evo-devo, by contrast, is interested in how new traits are generated and transformed over time. By Potochnik's lights, although the two approaches are interdependent epistemically—sometimes what is in the black-box matters to the explanation's empirical grounding—they are independent in terms of explanation. This is because they have different explanatory concerns, and thus, demonstrate different contrasts and comparisons. The population-geneticist asks why that trait (as opposed to another) became fixed in a population,

while the evolutionary developmental biologist would ask why that trait (as opposed to another) arose in the population in the first place.

In history, too, ecumenism has been urged (see, for instance, Førland 2004, Van Bowel and Weber 2008), and for similar reasons to those already discussed. Our contribution to this position is the thought that pluralism about explanation in history underwrites pluralism about frameworks. To see this, recall our discussion of explanation above. There, we discussed the role of frameworks in determining the salience of various parts of an historical trajectory or event. In a nutshell, we argued that explanatory sufficiency is sensitive to backgrounding and foregrounding requirements. For Schaffer's Newton, the *experimentum crucis* was, ironically, crucial—as it was this experiment which carried the authority of the paper. However, for Newman's Newton—the chymist—other experiments revealed the alchemical matter theory underlying his thinking, and these were central to Newman's discussion and important for his explanatory aims. As these different explanatory requirements are underwritten by and imply different frameworks, so pluralism in explanation leads to the same about frameworks. That is, there are a multitude of ways that we may situate an historical episode within time and place.

For this reason, we think that a commitment to the explicit use of frameworks in history is not in conflict with a commitment to localism about history. Using a framework as an ecumenicist involves conceding that any given historical inquiry is, by its nature, limited and incomplete, and that other perspectives may be legitimate. This need not make history a free-for-all: as Førland has urged, not just any history will do (Førland 2004).[xiv] Clearly, ecumenism about frameworks matters for the nature of historical disagreement, which we'll discuss in more detail in section 4.1.

Before proceeding, it is worth noting that ecumenism about frameworks goes hand-in-hand with the methodological expansion which history and philosophy are currently undergoing. Historians and philosophers increasingly supplement traditional approaches with digital tools, material remains, abstract models, and other odds and ends. Such methodological expansion is facilitated by broader conceptions of what counts as good historical explanation. Ecumenicism, we think, promises fertile ground for these different methodologies and techniques. Consider *The Newton Project*,[xv] which aims to publish, in full, an online edition of Newton writings— including notes, correspondence and other unprinted material. The volume of material is staggering: scholars now have hundreds of significant scientific, mathematical and theological texts, including all three editions of Newton's *Principia* and *Opticks* and their drafts, at their fingertips. This changes the historical game *vis-à-vis* Newton by opening up new indexes for

investigation, setting new explanatory expectations and shifting the comparison/contrast classes. Fully searchable digital texts, both diplomatic and normalised, enable Newton's language and ideas to be analysed in new ways. Moreover, the vast bulk of texts are drafts and/or unprinted material, opening the possibility of narratives in which Newton's work is much more dynamic and developmental. This, in turn, offers a much more nuanced understanding of the process of Newton's idiosyncratic thought. On our view, pluralism and ecumenism about frameworks is both motivated by, and enables the exploitation of, the insights such new media can provide. Another important development in the history of science and philosophy which accords well with our account is the expansion of the canon: as Shapin encourages us to look at the invisible in contemporary science, so also should we consider less-heard voices in science's history. We take the flexibility of framework pluralism to go hand-in-hand with this diversification.

3 Situating Frameworks

We have argued that a multitude of frameworks of varying types are applicable to a single episode. For example, Newton's 'New Theory' can be understood in many ways: as a revolution in the theory of light; as a development of the corpuscular philosophy; as an example of Baconian experimental philosophy; as a blurring between rationalist and empiricist epistemology; as an example of scientific development driven by technological need; and so on… Reflecting on this pluralism, we think that historians and philosophers would be well served by developing a more-or-less explicit *toolkit* of frameworks. That is, a set of approaches which, judiciously applied, aid the historian and philosopher in navigating the complex, contingent episodes that concern her. Such a toolkit would, at minimum, involve an effort (1) to be explicit—for instance, identifying an explicit set of contrasts or explanatory expectations—and (2) to consider the application conditions of such framework-types—that is, asking what are such frameworks good at or useful for? Although the use of frameworks is inevitable, we suspect that adopting practices of making explicit and considering applicability (and thus limitations) will make for more productive and integratable philosophical and historical practices.

HPS has been intimately concerned with the role of frameworks in our sense.[xvi] Towards this, our approach to explicitness and applicability will be via a summary of recent work which captures various aspects of the relationship between the history and philosophy of science, and how our account systematizes and brings these views into productive conversation. This does not in itself constitute a toolkit, but it shows how our account can accommodate previous insights and deploys them towards building one.

Some accounts of the relationship between history and philosophy—most explicitly Laudan's—take philosophical theories about science to be tested against the history of science (e.g. Laudan 1981). This view, what Jutta Schickore has called the 'confrontation model', is problematic: it fails to match actual historical and philosophical practice, it is insufficiently sensitive to the normative qualities of philosophy, and further assumes that history is primarily a descriptive enterprise (Currie 2015, Scholl and Raz 2016, Schickore 2011). Moreover, it breeds fairly dim views about the relationship between history and philosophy (Pitt 2001, Burian 2001). Sorrel, for instance, distinguishes between the caricatures of major philosophical figures made use of by philosophers, and the nuanced accounts of such figures provided by specialists:

> I do not know if there is a solution to this problem. Philosophers who have tried to produce philosophically relevant specialist commentary on Descartes often get disowned or ignored by one part or the other—the caricature-mongering philosophers or the specialist commentators (Sorrell 2010, 160).

Our discussion demonstrates a way of navigating this apparent impasse. It doesn't follow from framework ecumenism that we are allowed to do violence to the past—just as we are not licenced to say whatever we wish philosophically. Different frameworks, geared towards different purposes, license differing distortions, emphases and focuses (e.g. Walsh and Currie 2015a). Making these explicit, and understanding their different applications, would switch Sorrell's impasse into a potentially productive interchange between these differing frameworks.

In the wake of abandoning the Laudan-esque thought that history is a store of inductive evidence for philosophical theories, less pessimistic accounts of the relationship between history and philosophy have been developed.[xvii] These, in our view, are best thought of as mutually compatible. It is, then, fitting to take a short tour.

Hasok Chang argues that understanding history requires the development of new philosophical concepts:

> When there are no ready-made philosophical concepts through which a given historical episode can be properly understood, the historian needs to craft new abstract philosophical concepts (Chang 2011, 2011).

On Chang's conception, history—the 'concrete'—actively feeds into the 'abstract'— philosophy—by generating conceptual challenges. Newton's work is influential and utilizes a more-or-less novel method, and yet (as we'll discuss in more depth below) does not neatly fit the empiricist/rationalist distinction which has traditionally framed philosophical inquiry of the early modern period. On a view like Chang's, finding that Newton doesn't fit the traditional

philosophical categories is an opportunity for developing new perspectives, new frameworks; rather than an example of the failure of an inquiry or refutation of a framework[xviii].

Alan Chalmers' account of the relationship between contemporary and past science also fits here (Chalmers 2016). On his view, how science ended up—its later status—can help us decide which aspects of its history matter: the end of the story can help determine both the index and the contrast/comparison set. The flowering (particularly on the continent) of work inspired by Newton's *Opticks* is an important context from which to view his earlier optical papers. This approach dovetails nicely with Jim Lennox's 'phylogenetic' account of the relationship between history and philosophy (Lennox 2001). Where Chalmers emphasizes how later times can tell us what to care about in earlier times, Lennox points out that understanding later times— particularly contemporary scientific disputes—in terms of their histories, aids in untangling the conceptual confusions bequeathed by that history. Lennox describes his own work in biology as "the activity of attempting to better understand the conceptual and methodological foundations of biology through a study" (Lennox 2001, 657). Schickore adopts a similar position: "The kind of historical reflection on science which historicist thinking pursues is the project of understanding the present through tracing the past" (Schickore 2011, 475).

These perspectives can be understood as encouraging the development of historical narratives, albeit towards slightly different ends[xix]. They call to mind grander—but still historicised—frameworks from the history of ideas, such as Ian Hacking's and A. C. Crombie's 'scientific styles' and Latour's *epistemes* (Hacking 1994, Crombie 1994, Latour 1993). Here, ways of reasoning—the mathematical approach exemplified by Galileo, for instance—emerge and spread through the historical record. As Hacking develops it, the historical record provisions questions which more philosophical tools are well-positioned to answer: explaining the epistemic properties of styles which explain their stability and longevity.

But not all fruitful applications of history and philosophy take such an explicitly historicized, narrative form. Mary Domski argues that historical debates can enlighten contemporary philosophy by highlighting our own underlying assumptions (Domski 2013). The differences between historical and contemporary contexts can reveal otherwise unnoticed assumptions in the latter. Following Domski, differences between Descartes' and Newton's attitudes towards the successes of natural philosophy are marked by a decoupling of mathematics and physics—and thus two different types of 'certainty'—which are themselves in part determined by different views on God's relationship with knowledge. This, she argues, is revelatory:

> It is part and parcel of our historical situation to take for granted the relationship between mathematics and physics, a relationship that the early moderns found to be philosophically problematic and requiring justification (Domski 2013, 297).

This difference urges us to ask *why* we take such things for granted. Disparities between the past and present help reveal our own unquestioned assumptions.

Indeed, recognizing that there are many frameworks—and thus many narratives—within history highlights the importance of questions which are often ignored, or perhaps misunderstood. Descartes did not identify as the speculative philosopher that the Royal Society decried him as, but it is nonetheless interesting to understand Descartes in the Royal Society's eyes. That is, there is space for what Watson called 'shadow history' (Watson 1993). Sometimes we're not interested in explanatory frameworks as applied to historical figures themselves, but the frameworks which others, historical and contemporary, have used to understand them. In history, coming to grips with how influential thought has been misunderstood is often central.

So, how might we systematize the various types of frameworks which philosophers, historians, philosophical historians and historical philosophers bring to bear upon the historical record? The three-way distinction we have introduced, we think, makes headway here, and highlights at least the explicitness we think a framework toolkit should have.

There are plausibly many central subjects that historians and philosophers might care about and, unsurprisingly, these often cross-cut. Moreover, we might focus more on one aspect of a central subject than another. Historical research, then, requires an index: a central subject about which the narrative is concerned. Both Lennox and Chalmers highlight cases where our index is determined by where the narrative ends. Often, understanding intricate conceptual issues in contemporary science (or science at a later time) can involve unweaving their historical development. Moreover, putting forward, discovering, and articulating indexes is an important historical and philosophical task, as Chang emphasizes. Finally, indexes themselves come at a variety of scales and breadths. The large-scale, ambitious indexes of Crombie's and Hacking's 'styles' can be contrasted with the local indexes of microhistories. Although they fall on opposing ends of a continuum, all necessarily involve indexing.

But picking a central subject alone is insufficient to decide narrative salience—our foregrounding/backgrounding work is not yet complete. In addition to an index, philosophers and historians also have different ideas about what a good explanation of their index is like. That is, they have different explanatory expectations. Generally speaking, the old chestnut of 'internal' versus 'external' histories of science could be understood as expressions of different explanatory

expectations. Philosophers have traditionally been interested in explaining theory change in terms of a 'logic' of science: on an internalist account, one might argue that Newton's argument for the heterogeneity of white light was accepted (after some resistance) due to rational features of that argument, e.g. evidential support for the hypothesis. Others have different explanatory expectations, which necessitate 'external' resources pertaining to the historical context and practices of the time: on an externalist account, one might argue that it was Newton's political power, his control over the relevant institutions, which led to his argument gaining acceptance. There are also positions which combine these: Domski's use of Newton as a contrast to the modern world is a pertinent example. Different frameworks have different explanatory expectations, and these—often implicit—commitments, play a large role in deciding what to foreground and what to background. Expectations concerning Watson's shadow figures generate very different explanations to those focused on what the figures in fact thought and did.

Finally, historians and philosophers are often driven by which events they are interested in juxtaposing—different contrast and comparison classes are employed.[xx] Domski argues that contrasting how contemporary philosophical categories (in her case, varieties of structural realism) capture (or rather, fail to capture) past episodes can be importantly revelatory of the assumptions underlying contemporary debate. Hacking's styles often unify different practices across time—the construction of natural histories, for instance, can be meaningfully detected in both the Baconian-influenced Royal Society of the 17th century, and in its colonial botanic work in the 19th century. Generally speaking, historians interested in the local, particularly micro-historians, focus on contrasts more than comparisons. That is, they emphasize the uniqueness of central subjects, and are interested in other events only insofar as they differ. Historians of ideas and philosophers are often (but certainly not always) interested in comparisons rather than contrasts—in other words, they are more interested in identifying common or unifying features across several historical subjects. Foregrounding and backgrounding decisions are, to some extent, guided by whether the explanatory goal involves contrast or comparison, and with what those contrasts and comparisons are being drawn.

4   Concluding Discussions

We take ourselves to have articulated a view which is, in some sense, 'out there', but hasn't yet been explicitly and carefully articulated. In essence, this view claims that (1) different historical narratives are drawn from different 'principles of selection'—frameworks—and (2) historians and philosophers make choices about which frameworks they prefer. To conclude, we want to draw two lessons from this view. Firstly, although it needn't lead to pure, subjectivist

constructivism, accepting ecumenism about frameworks often makes disagreement a subtle matter. Secondly, seeing history and philosophy as two distinct ways of thinking about science's past is a mistake.

4.1 Historical disagreement

When historians and historically-minded philosophers disagree, what do they disagree about? Some disagreements are, we think, straightforward: one historian makes a claim about some historical episode(s), and another historian provides evidence to demonstrate that the claim is not accurate—for instance, that the episode(s) cited didn't occur, or not in the way described. Indeed, *prima facie*, we might understand Alan Shapiro's disagreement with Simon Schaffer in such terms. Recall that Schaffer grounds the gradual acceptance of Newton's theory of light and colour in power relations, arguing that Newton's influence in optical matters was tied up with his authority over the social institutions of experimental philosophy. Schaffer's account ostensibly explains why acceptance of Newton's theory wasn't immediate: in the 1670s, when he initially introduced his theory, Newton had no authority among the experimental philosophers of London; but after 1710, his authority was immense. Shapiro challenges Schaffer's version of events:

> […] not only does this explanation not satisfy the chronology of the acceptance of [Newton's] theory, which occurred in Britain well before 1710, but it does not account for its acceptance on the Continent (Shapiro 1996, 60).

Moreover, Schaffer's account, in part, seems to turn on the claim, allegedly made by Newton and his conspirators, that the experiments would only work with prisms made of British glass. Shapiro challenges this, arguing that Schaffer's sources, if anything, insisted on the exact opposite: that any glass would do. And so, on the surface, we have what looks like a fairly straightforward disagreement: Schaffer offers an account of an historical episode—the gradual acceptance of Newton's theory of light and colours—and Shapiro disputes the accuracy of the account, offering evidence that the episode didn't occur in the way Schaffer says it did. One way we might characterize this (owing to an anonymous referee) is to say that Schaffer's claims are simply not part of the ideal explanatory text relating to Newton's theory of light. But disputes between historians don't always have this character. They often occur at the level of frameworks: historians disagree over foregrounding and backgrounding decisions. The nature of such disagreement is subtle and, we think, our account offers guidance.

Historical dispute sometimes involves claiming that some explanation is unacceptable because the interlocutor prefers some other framework. That is, they prefer a different index, or

have different explanatory expectations, or are guided by different comparison/contrast classes. If we accept ecumenism, such objections look *prima facie* invalid, as such a view denies there is a single privileged frame of reference for some historical event (although see below). However, an argument that shows that the explanation under dispute skips over details that matter in that context is a legitimate, interesting, and fruitful way of proceeding. More generally, ecumenism about frameworks underwrites a kind of humbleness in historians: we shouldn't be too quick to dismiss another scholar's explanation because it fails to mention something which we take to be essential. Instead, we should ask whether the thing in question is essential from their perspective.

In addition to their simpler disagreement, we think aspects of Shapiro's objections to Schaffer can be read in these subtler hues. Shapiro's position is that, given that Schaffer's aim is to give a contextualist account of the role of the *experimentum crucis* in the acceptance of Newton's theory, then Schaffer's account fails *by his own standards*, since he allows his account of the past to be coloured by present-day notions of scientific practice. Shapiro writes:

> Applying the model of modern experimental science to Newton's experiments puts them in an alien context and burdens them with undue complexity. Schaffer exaggerates the difficulty of replication and the unusual nature of prisms when he tells us that we have "to recapture the sense of their contingent and controversial use" in Newton's day, when they were little used and understood (Shapiro 1996, 60-61).

Further on,

> […] adopting the model of a modern laboratory science implicitly molds the past in the image of the contemporary scientific community. The very concept of rigorous and public replication, which is often considered to play a central role in modern science and which certainly plays one in Schaffer's story, was by no means a standard feature of seventeenth- and early eighteenth-century science (Shapiro 1996, 61).

In short, Shapiro's beef with Schaffer's account isn't purely about the actual sequence of events and a lack of requisite textual evidence. Rather, he thinks that Schaffer's focus on controversy as the essential driving force of science leads him to miss the fact that the far stronger current was one of acceptance. That is, given Schaffer's index (the role of Newton's *experimentum crucis* in the widespread acceptance of his optical theory) and his broad explanatory goals (an externalist-contextualist account of this event), he apparently mistakenly focuses on the problem of replicating the experiment, rather than interpreting its results. Shapiro thinks that these mistakes manifest themselves in a faulty historical narrative.[xxi] As we've mentioned, a different objection would claim that Schaffer's account is simply false (that is, it is part of no explanatory text). However, here it is agreed that it is part of the explanatory text—replicating Newton's

experiment did matter at the time—but it is objected that it is not salient (or at least much over-emphasized) given Schaffer's framework.

Thus far, we have identified two kinds of historical disputes. The first turned on more-or-less simple matters of fact about the timing, nature and sequences of events in the historical record. These are straightforward empirical disputes (well, comparatively straightforward). The second was also in part empirical—it turned on the details of the acceptance of Newton's theories—but was contextualized. That is, for Shapiro to dispute Schaffer's claim, it wasn't simply a matter of getting the empirical facts straight, but of showing that those facts were not salient given Schaffer's framework. If, for instance, Shapiro was interested in some other set of questions, then they might easily have spoken past one another (indeed, a defender of Schaffer could argue that this is precisely what happened!). In a nutshell, for some putative historical fact *p*, the first kind of disagreement simply concerns *p's* occurrence or *p's* being part of an ideal explanatory text, while the second concerns *p's* explanatory salience *vis-à-vis* the framework at hand. This latter disagreement can be subtle as it involves the interweaving of both empirical questions and frameworks. In Shapiro's case, part of his argument is that by projecting modern ideas about experiment into the past, Schaffer misidentifies the main drivers of the acceptance of Newton's theory. In part, Schaffer's framework leads him to get the explanatory salience wrong. Shapiro doesn't dispute the broadly constructivist framework Schaffer operates within, but argues that *given this framework* Schaffer misses the explanatory and evidential action.

But these aren't the only ways historical disputes can unfold. It could be that there are principled arguments to be made concerning certain *kinds* of frameworks. That is, some indexes might be invalid, some explanatory expectations could lead us astray, or perhaps the utilization of some contrast or comparison is a mistake. Such disputes are complex; such objections should be moderated and specified.

For example, the so-called 'Otago School'[xxii] has argued that, instead of carving up early modern philosophy in terms of the distinction between rationalism and empiricism (hereafter 'RED'), we should frame the period in terms of the distinction between experimental philosophy and speculative philosophy (hereafter 'ESD') (e.g. Anstey 2005, Vanzo 2013, Walsh and Currie 2015a). An important line of argument has been to show that 'experimental philosophy' and 'speculative philosophy' were the key terms of reference used by the actors themselves, and that they characterised their own work in terms of this division. But the claim is not simply that actors' categories are preferable; the Otago School also argues that Newton, Locke and other members of the early Royal Society are better understood as experimental philosophers than as

empiricists. In their collection, *Newton and Empiricism*, Zvi Biener and Eric Schliesser argue against the Otago School, explaining why they prefer the RED in general, and the empiricist label for Newton in particular (Biener and Schliesser 2014). They argue that labelling Newton an 'experimental philosopher' obscures the idiosyncrasies of his approach to natural philosophy. Firstly, they think the label belies the significant influence of non-experimental philosophers on Newton's methodology, for example those who influenced his mathematical focus. Secondly, they think that the label unhelpfully groups Newton with Boyle and Locke, when many features of his work support a different grouping. For example, Newton's mathematical-system building suggests that his work should be grouped with Descartes'. Thirdly, they think that, since Newton did not employ the label himself until after the publication of the first edition of the *Principia*, he did not fully identify with it.

This dispute is of a different kind to those discussed earlier. For one thing, unlike the case of Shapiro versus Schaffer, the Otago School and Biener & Schliesser more-or-less agree on the historical facts of the matter. For example, both parties agree that 'speculative philosopher' and 'experimental philosopher' were terms in widespread use in the early modern period, and that the RED was introduced by Kant's followers to explain Kant's role in drawing the early modern period to a close. And for another thing, neither party attempts to show that the other has made mistakes regarding explanatory salience. That is, they never attempt to demonstrate that the opposing position fails by its own lights. Instead, both parties employ the strategy of pointing out failings, biases and foibles engendered by the frameworks themselves. In short, this is a dispute about which framework to adopt.

Prima facie, the dispute looks unproductive. Instead of telling us *with respect to what explanatory goals* their framework is preferable, each party seems to argue that their framework is preferable *in toto*. This seems to imply a kind of monism about frameworks: each side appears to think there is a single privileged way of framing early modern philosophy (or at least that the other framework is illegitimate). And yet, without common ground from which to compare the two frameworks, the criticisms appear to cross-cut one another, undermining the possibility of resolution.

Could such a dispute become productive? We're not sure; things could go in several different directions. Firstly, and rather pessimistically, we might (siding with a broadly early-Carnapian perspective) declare disputes of this third type invalid: if some joint framework is required to make rational decisions about favourability, then there is no common ground from which to compare frameworks. On this view, the dispute appears hopeless and the two sides

should either shift to the other two kinds of dispute or ecumenically doff their caps to one another and carry on.[xxiii] We do not think that this means that the two sides cannot engage in productive dialogue. But it does require recognition that the alternative narratives generated by the different frameworks are not in competition. Rather, the two frameworks should be appreciated for their abilities to bring different central subjects (events, ideas, etc.) into focus.[xxiv]

Secondly, we might think that there could be virtues, say illumination, or productivity, which can help us decide between frameworks.[xxv] Indeed, this is the route taken by Peter Anstey (e.g. Anstey 2010). Anstey argues that the ESD offers greater explanatory breadth than the RED, while allowing a more nuanced understanding of individual philosophical positions and debates. An important example of this is Newton's rejection of hypotheses, which is largely irrelevant to the RED and has therefore posed a problem for scholars who approach Newton from this framework, and yet is easily explained by the ESD. In opposition, Schliesser argues that the ESD overemphasises the importance of the self-identification of individuals in historical explanation—in other words, he accuses the Otago School of "fetishizing Actors's Categories" (Schliesser 2014). Again, Newton is a case in point: Schliesser argues that, by taking Newton's self-identification as an experimental philosopher too seriously, the ESD fails to recognise the influence of Huygens' *Horologium Oscillatorium* on the development of Newton's *Principia*.

The problem with appealing to the relative merits of opposing frameworks is that the opposing camps won't necessarily agree about what those merits are: they might disagree over which virtues to maximise, or over which framework in fact maximises the preferred virtues. Nevertheless, we think this kind of discussion might still be productive: while it won't necessarily bring the dispute to a swift resolution, it may encourage methodological reflection and yield better understanding of the scope and limitations of the different frameworks. To put our cards on the table, we suspect that the disagreement between the ESD and the RED needn't be put in terms of clashing frameworks. Instead we might argue that (1) the RED is simply false (that is, it is not part of any explanatory text relating to the early modern period), or (2) the RED doesn't achieve what it sets out to do by its own lights. That is, the failings of the RED are not due to its lacking certain theoretical virtues as Anstey discusses, but due to being unsuccessful through falsity or by not being explanatory.

Two points underwrite this discussion. First, while we think that there is no one privileged framework for any given index, it doesn't follow from this that all frameworks are equally good—it may even be the case that some frameworks should not be used for any purpose, and it could be that some frameworks are more useful given certain histories and purposes than others.

We have seen that both sides of the debate regarding the RED and the ESD see the opposing framework as inadmissible. But, from a historiographical perspective, it could be argued that both frameworks have been useful in different contexts, for different purposes, with some level of success. The Otago School's main criticism of the RED is that it no longer does the work it needs to do. Biener & Schliesser's main criticism of the ESD is that it is basically a relabelling of the RED. Neither criticism counts as a total rejection of the framework. Rather, the criticisms suggest that the opposing framework has a limited domain. In other words, the criticisms amount to a denial that the opposing framework gives us a privileged understanding of early modern philosophy.

Second, the choice of framework matters. Frameworks guide historical scholarship, helping the historian to wade through the material without drowning under the weight of historical facts. But frameworks also constrain historical scholarship: they help decide the direction of research, help us identify good historical scholarship, and influence the details of the narrative. For example, where the RED generates stories about foundational, *a priori* investigation into the nature of knowledge, the ESD tells a story of philosophical progress driven by scientific achievement, technological development and methodological innovation. These accounts emphasise the contributions of different historical figures. When the focus is epistemology, we fixate on theorists who provided accounts of knowledge and its justification—namely, the canonical seven: Descartes, Leibniz, Spinoza, Locke, Berkeley, Hume and Kant—to the exclusion of other historical figures. But when the focus is methodology, we shift to figures such as Boyle, Hooke and Newton. In other words, frameworks have the power to shape historical inquiry both locally, in that frameworks shape particular narrative explanations, and globally, to the extent that they set more general standards for what counts as a good historical explanation.

In short, frameworks are important tools for historical inquiry, and we must choose our tools carefully, minding the old adage, *if all you have is a hammer, everything looks like a nail.*[xxvi] Thinking of frameworks as tools contrasts with other recent thought in this area. Kuukkanen, for instance, envisions a 'comparative historiography of science' whereby different approaches are compared in virtue of their differing coherency *vis-à-vis* particular historical episodes. We're not convinced by Kuukkanen's suggestion. First, it relies on framework-independent criteria for comparison, and we're not sure what such criteria would look like (perhaps our Carnapian tendencies are stronger than we thought), and regardless think that whatever cross-framework criteria there may be, we will likely be pluralists about those as well. As Katherina Kinzel argues, insofar as there are agreed upon criteria, these underdetermine analyses of historical episodes, and stronger criteria are not framework-independent (Kinzel 2016). Second, the implied

competition in Kuukkanen's account—the point of comparing the frameworks is to determine which is more successful—is in tension with our ecumenism. Where both Kuukkanen and Kinzel seem to imply that pluralism is an unfortunate concession, we regard it as a feature of our account: historians should celebrate pluralism, rather than put up with it.

Much more remains to be said regarding comparisons between frameworks, and it falls outside our remit here to say anything systematic. Considering both normative questions about what makes a framework suitable, and historical cases of clashes between frameworks, would be productive ways of moving forwards.

So far, we've focused on disagreements between frameworks, however, another crucial line of investigation concerns agreement: that is, how can different frameworks be complementary or perhaps integrated?[xxvii] This is particularly pressing given the next section where we turn to the relationship between the history and the philosophy of science. Raphael Scholl and Tim Raz have recently argued that historical and philosophical uses of history can be productive through iterated stepwise-improvements (Scholl and Raz 2016). We suspect that it will be fruitful to analyse framework-agreement in this way. But, again, we leave this question for another day: there is a limit to how much a single paper can do. Our aim in this section was simply to show that understanding the nature and role of frameworks in history reveals the subtle nature of historical disagreement. Let's move to our second upshot.

4.2   The History & Philosophy of Science

It has been recently suggested that the (apparent) failure of the history of science and the philosophy of science to integrate has been due to deep-seated differences in the metaphysics underwriting the two projects (Kuukkanen 2016). Where philosophers look for the 'essence' of science and its episodes, historians see each episode as unique, contingent and variable. On our account, such a disagreement can be stripped of metaphysical commitments, and seen instead as simply a set of different frameworks. (And indeed, *qua* philosophers we personally often aim not to provide unitary accounts of science.) Roughly speaking, philosophers often seek to unify *explananda*, while historians often seek to contrast them. While these are two different projects, their products are fruitfully integrated, and there is bountiful space to occupy between the two apparent extremes (see also Scholl and Raz 2016). That is, we don't think these differences are good not to integrate history and philosophy of science.

To illustrate this point, let's reconsider two accounts of Newton's early optical work discussed earlier: Jalobeanu's investigation of the 'Baconianism' of Newton's first optical paper and Newman's investigation of Newton's debt to 17th-century chymistry. Jalobeanu identifies

features of the Baconian method of natural history in Newton's paper, interpreting the work as closely related to Boyle's and Hooke's methodological positions. However, she nowhere argues for influence, writing:

> It is important to note that the focus of this historical and philosophical reconstruction is not primarily to establish historical influence. Newton owned a copy of Bacon's *Historia densi et rari* and most probably read it. The experiment I am going to discuss is dog-eared in his copy. However, as with many other experimental natural philosophers of the late seventeenth-century, Newton reflected critically and creatively on Bacon, and developed his own particular brand of Baconian natural history (Jalobeanu 2014, 42).

In other words, Jalobeanu is not interested in establishing the Baconian influence on Newton's methodology. Rather, she assumes that, in one way or another, Newton was influenced by Bacon (most likely via multiple paths—directly from Bacon's works, and indirectly via the work of Boyle, Hooke and others). She further argues that reading his early paper as a contribution to the debate over the purpose and methods of Baconian experimental philosophy in the early 1670s sheds light on some early criticisms of the paper.

Newman, in contrast, is guided by questions of origin and influence. He finds that the chymical notions of analysis and synthesis, first encountered in Newton's reading of Boyle, were "immensely fruitful models in Newton's mind that allowed him to reason out processes ranging from the realm of optics to […] Newton's 'theory of everything'" (Newman 2016, 464).

We've already discussed Newman and Jalobeanu as having different frameworks: given their different contrast/comparison classes it is likely reasonable to adopt an ecumenical attitude to their differences. But note how they are different. Where both have explicitly historical questions in mind, these questions play out in quite different ways. Newman is interested in showing how particular individuals influenced one another's thought. His project requires fine-grained historical analysis including, for instance, close readings of student notebooks: sources which Jalobeanu claims are unnecessary for her approach. She, instead (at least in this instance) is interested in how Baconianism, considered as a fairly abstract set of principles, ideas and scientific strategies, shifted over the course of its life. Where Newman tells a tale tracing how various lines of intellectual influence converge into the development of Newton's theories, Jalobeanu abstracts from the influence to instead describe *Baconianism*. Likely, the former will be considered more historical and the latter, more philosophical. But we hope that this short contrast is sufficient to suggest that, while there are a wide range of possible perspectives (that is, frameworks), some of which will look more historical and some, more philosophical, trying to decide—strictly speaking—where the dividing lines are would be a mistake. At best, such

questions reinforce arbitrary disciplinary boundaries by creating a dichotomy out of a continuum; and worse, it may hinder progress by encouraging scholars to cling dogmatically to the small set of frameworks favoured by their discipline, missing other, potentially illuminating perspectives.

The relationship between history of science and philosophy of science has been a—or perhaps *the*—central methodological question in HPS. In light of our discussion of frameworks, it seems to us that this question rests on a false dichotomy: just what makes something philosophical as opposed to historical? Undoubtedly, historians and philosophers undergo different training, and often have different research interests. The philosopher might prefer different frameworks—different indexes and explanatory expectations—to an historian, and some philosophical work might not involve historical reflection (see Van Dyke Forthcoming) and indeed some historical work might only involve local indexes and highly contextual expectations. However, we see no good reason for clustering at either end of these continua. It is not simply that philosophy and history have things to offer one another, but that in many contexts there is no distinction to be made between them. Although we can reasonably identify certain types of indexes, expectations, and contrast/comparison classes as more often the domain of historians of science, and others as more often the domain of philosophers of science, there is an enormous amount of space in the middle. And this, we suspect, is where much of the most fruitful and interesting work is to be done.

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i For recent examples see (Chang 2011), and the papers collected in (Hendry and Kidd 2016, Laerke, Smith, and Schliesser 2013). There are many similarities between our view and Forland's recent book (Førland 2017), although that is focused on historiography more broadly, as opposed to the relationship between history and philosophy of science; similarly Potochnik makes similar points, but focuses on the nature of science (Potochnik 2017).

ii See, for instance, Carol Cleland's discussions of experimental and historical science (Cleland 2002) and (Currie and Turner 2016).

iii The contrast is sometimes cashed out in terms of 'genetic' versus 'nomothetic' explanation (see, for instance, McCullagh 2002). Some historians (e.g. Stone 1979) have contrasted narrative and explanation—focusing on how historians narrativize rather than how they explain. We admit bafflement as to what the distinction is supposed to amount to, and concur with Førland's claim that narratives are explanations (Førland 2004). Further work on narrative explanation relevant here includes Danto (1965), Roth (forthcoming), as well as the debates between Hempel (1942), Dray (1957) and Gallie (1959).

iv Undoubtedly, understanding events as types plays an important epistemic role in, for instance, establishing the power of the postulated causes in the explanation—we don't deny that regularities matter to history—rather, we are making a claim about the explanatory role such regularities play: in many historical explanations, it is not the laws or regularities which carry the explanatory load.

v Note that this could involve a kind of unification. Indeed, on the very last page of (Hull 1975), Hull seems to gesture towards some distinctively historical kind of unification. However, we don't think that unification is the primary focus of historical explanation.

vi These distinctions are from (Mitchell 1997).

vii Note that there is nothing distinctively historical about our conception of frameworks. The historicity of the framework is set by the historical focus of the index, explanatory expectations and contrast/comparison class. Our schema may well have application outside of historical scholarship, but this is beyond the scope of our paper.

viii We take Danto's discussions of 'temporal structures' (Danto 1962) to play a similar role.

ix For discussion of Railton's views, see (Førland 2004, Salmon 2006, Railton 1981).

x Different philosophers and historians carve up causation in different ways (e.g. Hall 2004), while others consider non-causal features to be explanatory. We don't take ourselves to make any commitments on this here.

xi Indeed, such narratives have a variety of important epistemic roles in historical reconstruction (see Currie and Sterelny 2017, Currie 2016).

xii There is a useful contrast between Railton's view and how we see historical explanation. Railton, focused as he is on the physical sciences, sees the goal of explanation as identifying organizing principles: a mature science has a body of theory under which a variety of phenomena can be fit (see also Kitcher 1981). This kind of view clashes with the historian's interest in the unique. Unification, then, is not always a strength of an historical explanation. Specifically, adding further information—more salient, relevant information—can obscure the explanation we want (see Strevens 2008, chapter 7 for a similar point).

xiii Although see (Sterelny 1996) on biology and (Grantham 1999) and (Currie 2014) on paleobiology.

xiv Although how we might sift noise from signal is a complex question which we lack space to tackle here.

xv http://www.newtonproject.ox.ac.uk/

xvi For a summary, see (Schickore 2011).

xvii For systematic approaches see (Currie 2015, Scholl and Raz 2016).

xviii We don't take Chang's 'concrete' and 'abstract' to be the right way of dividing the philosophical from the historical (although perhaps philosophical training better equips one for abstract tasks, and historical for concrete ones).

xix For a similar account focused on medieval examples, see (Van Dyke Forthcoming).

xx Van Fraassen provides a particular clear discussion of contrast and comparison sets (van Fraassen 1980).

xxi Note that we are not interested in settling this dispute or taking a position on it here. We are interested in this case purely for what it can tell us about historical disagreement.

xxii The Otago School, led by Peter Anstey, runs the blog, *Early Modern Experimental Philosophy* (https://blogs.otago.ac.nz/emxphi/). The Otago School is so-called because the project originated at the University of Otago in New Zealand.

xxiii This situation might turn out to be roughly analogous to the one Hasok Chang describes (Chang 2012). Chang (chapter 5) argues for what he calls *extreme normative epistemic pluralism*: roughly the thought that the benefits of maintaining multiple epistemic value systems and perspectives is worth resisting consensus. Where we make space for such a plurality of research programs, Chang outright denies "the common intuition that there could only be one right answer to a scientific question, and that one science has answered a question definitely its verdict is final" (Chang 2012, 254).

xxiv See (Walsh and Currie 2015b) for a discussion of how the ESD and RED generate different narratives.

xxv Kuukkanen is optimistic regarding this capacity (Kuukkanen 2016), Kinzel is less so (Kinzel 2016), and we're even more pessimistic, as we admit below.