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Article

From Symbiosis to Specialization: A Historiographical Analysis and Methodological Proposition for Integrated History and Philosophy of Science

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Abstract:

The relationship between history of science and philosophy of science, which constitutes the field of history and philosophy of science (HPS), has undergone significant transformations. This paper presents a dual analysis of this evolution. Firstly, it provides a brief historiographical review of the shifting dynamics between the two sides of the aisle. Secondly, it employs a bibliometric analysis of scholarly databases – Dimensions and OpenAlex – to map the field's contemporary landscape. The findings reveal two dominant trends: the proliferation of the case study method and a marked increase in academic specialization into sub-fields (e.g., HP of Physics, HP of Biology). Finally, this paper proposes a methodological framework, the “epistemic gradient”, which reframes the relationship between historical particularism and philosophical generalism, offering a practical model for conducting integrated HPS research.

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Introduction: The Enduring Question of Integration

As a field, history and philosophy of science (HPS) represents a dynamic and disputed intellectual enterprise, despite its central premises – that a historical understanding of science can inform philosophical inquiry, and that philosophical frameworks can illuminate historical developments – being rather clear and, *prima facie*, uncontroversial.

Nonetheless, the relationship between the two parent disciplines has not been one of consistent and symmetrical collaboration. It has passed through distinct phases: an early period of asymmetric symbiosis where history largely served philosophical or pedagogical ends, usually establishing a background for a particular approach; a pivotal “Kuhnian moment” that both institutionalized and fragmented the field. In its contemporary phase, this paper argues that HPS has since entered a new phase, one defined by two powerful

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trends: the ascendancy of the case study as a dominant research methodology and the concurrent fragmentation of the field into highly specialized sub-disciplines.

This contemporary landscape presents new features that shall be discussed. This paper addresses the current situation by proceeding in three parts. Firstly, it provides a brief historiographical account of the shifting relationship between history and philosophy of science to contextualize HPS as an intellectual project. Secondly, it presents a quantitative and critical assessment of the contemporary field, using bibliometric data to substantiate the claims regarding case studies and specialization. Finally, drawing on an analysis of research practice, it proposes a novel methodological framework – the “epistemic gradient” – as a practical tool for navigating the complexities of modern integrated HPS research.

A History of Asymmetric Relations

(a) The beginning of HPS

The use of history as tools to introduce or justify scientific concepts has a long pedigree. From Archimedes’ *Eureka* to Newton’s apple, the history of a given topic (say, mechanics) is generally used to introduce the subject at hand. That is why textbooks in physics usually use anecdotes to illustrate or introduce an important concept, notion, or experiment. However, using history to introduce something is older than just textbook writing. To instantiate, it was used by Antoine Lavoisier (1743-1794) when he published his earlier studies of gases. In that occasion, he supplemented the account of his research with the recent history of research in the subject. Herman Boerhaave (1668-1738), for example, introduced chemistry to his students with the help of a brief history of the field² (Christie 1990). This means historiography of science was guided by the scientific research at hand to introduce and justify the subject in question. Therefore, its usage was more pedagogical, built to establish a lineage and a backdrop for a scientific work.

During the Enlightenment, as a harbinger of things to come, history – or, more precisely, historiography – of science was increasingly summoned to clarify, illustrate, and craft philosophical arguments. This is clear when we look at Adam Smith’s *Essays on philosophical subjects*. His *Essays* were published posthumously in 1795 by the hands of his friends and literary executors, Joseph Black (1728-1799) and James Hutton (1726-1797). In it, Adam Smith (1723-1790) – philosopher and one of the founders of modern economic thought – illustrates his philosophical inquiry with an account on the history of astronomy. The first chapter is named “The principles which lead and direct philosophical enquiries: illustrated by the history of astronomy”. The title gives it away. His objective is philosophical – why and how philosophical (and scientific) inquiries happen³ – and his historical account is a way to discuss and illustrate his points. His explanation turns quasi-psychological. Most notably, he discusses sentiments, such as wonder, that arise when something unexpected is seen. In such a case, “imagination and memory exert themselves to no purpose, and in vain look around all their classes of ideas in order to find one under which it [the novelty] may be arranged” (Smith 1795, 13). As Black and Hutton noted:

² In most cases, such as Archimedes and Newton, the historiography of science underneath it is at best *whiggish* and presents a distorted view of science; at worst, they are simply false (Martins 2000; 2006). Nonetheless, these uses should not be analyzed by today’s historiographical standards; they should be interpreted as a construction of an imagined past – “a fanciful genealogy of itself” – of a discipline (Wilson 2017, 814).

³ For a description and a critical analysis of Adam Smith’s philosophical idea here, see Cleaver 1989.

The Author, at the end of his *Essay*, left some Notes and Memorandums, from which it appears, that he considered this last part of his History of Astronomy as imperfect, and needing several additions. The Editors, however, chose rather to publish than to suppress it. It must be viewed, not as a History or Account of Sir Isaac Newton's Astronomy, but chiefly as an additional illustration of those Principles in the Human Mind which Mr. Smith has pointed out to be the universal motives of Philosophical Researches. (Smith 1795, 93)

Therefore, his use of history of science is philosophy-oriented. This pattern of history serving philosophy continued into the 19th century with greater systematicity. William Whewell's (1794-1866) monumental *The history of inductive sciences* is a cornerstone of this tradition. Whewell described scientific progress using the history of science. His focus was on a rational reconstruction of science; where his effort aimed to distill a timeless logic of discovery from the historical record and, consequently, often de-emphasized diachronic considerations and the specific and contingent contexts of the past (Christie 1990). These early configurations, from Lavoisier to Whewell, established a recurring pattern of an asymmetric relationship in which the particularities of history were often subsumed by the general ambitions of science or philosophy.

(b) The Kuhnian Moment: Integration and Divergence

The modern institutional form of HPS owes its existence in large part to Thomas Samuel Kuhn's (1922-1996) *The structure of scientific revolutions*, published originally in 1962. Kuhn's book represented a profound shift. Unlike Whewell, Kuhn was deeply concerned with being diachronic, seeking to understand past science in its own terms without anachronistically imposing modern questions and concepts. Yet, the conceptual toolkit he developed to achieve this – paradigm, normal science, crisis, incommensurability – was forged with philosophical influences (notably, the later Wittgenstein and Quine) and prompted philosophical discussions about their definitions and usages⁴.

The structure was, thus, a deeply hybrid work, creating a shared object of inquiry that neither historians nor philosophers of science could ignore. For instance, in 1969, a conference titled *Historical and philosophical perspectives of science* was held at the University of Minnesota. However, this marriage was one of convenience; it was doomed to fail (Zammito 2004, 95-96). In fact, Kuhn's work was a contentious point in this round of interaction and, therefore, the integration of modern HPS is born as a Chimera because Kuhn's *Structure* was read differently by different groups. Philosophers debated his concepts in light of a relativistic debate, while historians saw it as a possible resolution to the internalist versus externalist rivalry – the debate on whether changes and developments in science were due to intellectual factors (internalist position) or broader societal, cultural, and economic factors (externalist position).

Therefore, Kuhn's role to the history of HPS is, as Golinski summarized, “paradoxical” (2012, 13). As he summarized: “Kuhn's book [*The structure of scientific revolutions*] encouraged historians and philosophers of science to stop talking to one another, because it lent itself to quite divergent interpretations in the two disciplinary communities” (Golinski 2012, 13-14).

They saw their object of study – science – in different ways. Kuhn himself saw HPS as a problematic endeavor, urging the disciplines – history of science and philosophy of science – to keep a safe distance from each other (Kuhn 1977, 20). By the beginning of the 1990s, the

⁴ One could cite many references on this; the most important one in this context is the book *Criticism and the Growth of Knowledge*, published in 1970.

“link between history of science and mainstream philosophy of science became significantly attenuated” (Zammito 2004, 111). By the late 1980s, the relationship had become deeply strained. In a well-known 1989 reflection, the philosopher Larry Laudan lamented that

Studies is now, as it was in 1969, virtually the only general journal which encourages historians of science to grapple with issues concerning the methodological and conceptual foundations of the sciences. But the melancholy fact of the matter is that, more by default than by design, philosophers have taken on an increasing share of the responsibility for doing conceptually-based history of science, a fact that erstwhile historians like Kuhn are quick to acknowledge and that many historians of science (e.g. L. P. Williams or Erwin Hiebert) are quick to deplore. Nor is there anything new in that. Duhem, Mach, Whewell, Meyerson, Burt, Strong and a host of others long ago realized that philosophers of science cannot wait for, nor should they expect, historians of science to do their work for them. (Laudan 1989, 12-13)

The Kuhnian moment, which had promised a fruitful integration, had paradoxically catalyzed a period of disciplinary separation and mutual skepticism.

The Contemporary Landscape of HPS: A Bibliometric Assessment

In the wake of this divergence, HPS did not disappear but rather reconfigured itself. The journal *Perspectives on Science*, for example, sought to bridge this gap. It was launched in 1992 with the express purpose of “serving as a venue for philosophy, history and sociology of science, as well as scholarship combining and bridging these specializations” (Howard 2011, 65). Out of this period of reconfiguration, two dominant features have come to characterize the current landscape: the methodological ascendancy of the case study and the structural fragmentation of the field into specialized sub-disciplines. A bibliometric analysis of scholarly output confirms these trends, as I shall demonstrate below.

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(a) The Ascendancy of the Case Study

The case study – an in-depth examination of a specific and usually well-bounded historical episode – has become the de facto methodology for much of the work produced under the HPS banner in recent times⁵. This methodological turn, however, brought with it what Pitt (2001) termed the “dilemma of case studies”. The dilemma posits that any given case study is either a biased selection chosen to confirm a pre-existing theory (begging the question) or an unjustified generalization from a single instance (a naïve induction). As he concluded:

[w]e don’t know what a case study is – if we shift to a problematic [a specified domain or some specified topic] we open up a can of worms – problems are embedded in historical contexts, but selecting the right context without begging the question isn’t obvious. On the other hand, if we assume that concepts associated with philosophical analyses of science have some sort of atemporality, we violate legitimate historiographical concerns. (Pitt 2001, 381)

⁵ The change in HPS to more historicist approaches after the Cold War was discussed in Howard 2011, 55-74. Among the many possible reasons for “philosophy’s new embrace of history”, Howard points that it “was partly a matter of new philosophical projects discovering again that descriptive historical scholarship could function in an evidentiary manner with respect even to systematic philosophical claims with putatively normative import” (Howard 2011, 65-66).

Burian (2001) challenges Pitt's critique, arguing that case studies are valuable to historians and philosophers when approached from the "bottom-up". In this view, case studies should not serve merely to test pre-existing general frameworks, but rather to construct new philosophical concepts. Burian contends that this approach yields a deeper understanding of science than the limited heuristic role assigned by Pitt: "properly deployed, they [case studies] can yield deeper understanding of science than alternative methods and that they ought to play a greater role in philosophy of science than the mainly heuristic one to which he [Pitt] relegates them" (Burian 2001, 384). This distinction parallels Pietsch's (2016) classification of "predictive" versus "abstracting" studies. While predictive studies aim to generalize findings to similar instances, abstracting studies focus on deriving concepts and laws through structural analysis. However, unlike Burian, Pietsch does not consider one method inherently superior; he simply notes that abstracting studies – such as Kuhn's framework for scientific revolutions – are more prevalent in HPS literature.

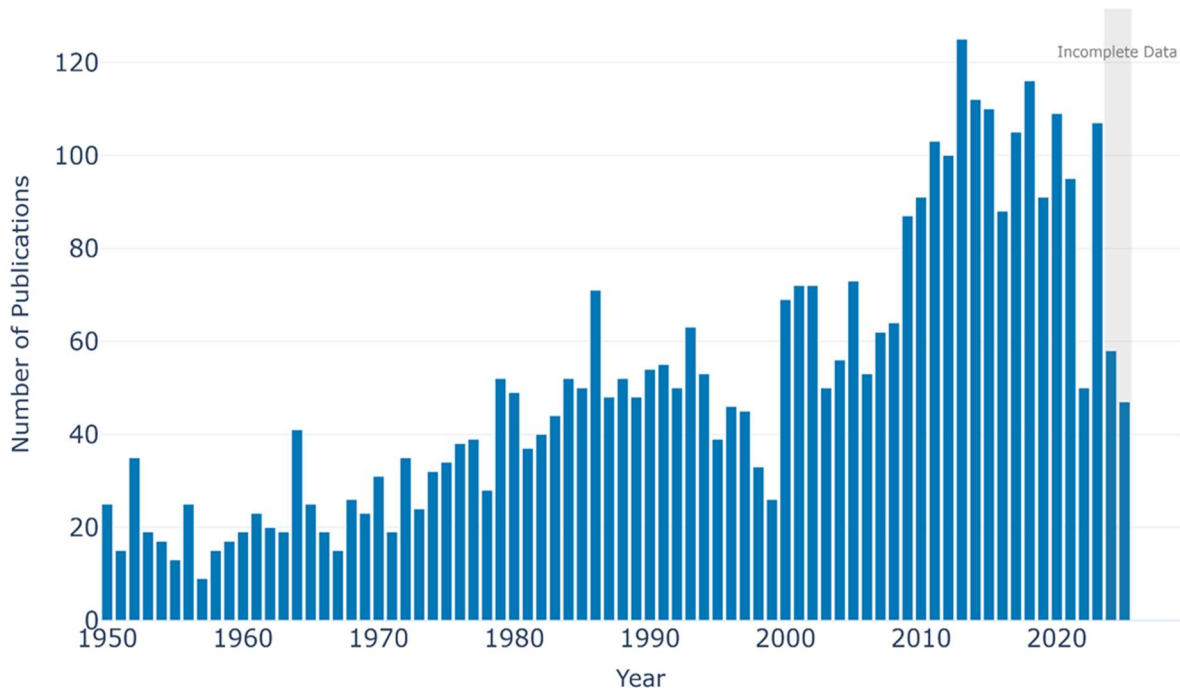
The work of Hasok Chang (2012) provides a compelling example of this bottom-up, abstracting approach. As he explains in his 2012 article, he has shown how he crafted philosophical concepts (epistemic iteration and epistemic pluralism) after feeling the failures of the frameworks he had been using when researching two case studies (the history of thermometry and the Chemical Revolution)⁶. It is worth pointing out that the aforementioned references agree that philosophical conceptualizations based on historical case studies should only be thought out as "middle-range epistemologies" (or mesoscale epistemologies). That is, it is a local (regionalized) philosophical framework, not a general and all-encompassing one.

The dominance of the case study approach can be quantified. An analysis of scholarly publications cataloged in OpenAlex – which is a free and open database of scholarly works, researchers, institutions, and journals launched by the non-profit organization OurResearch – under the topic of "History and Philosophy of Science" reveal a growth in HPS-related works since 1950. In it, the volume of journal articles and books on the subject has risen, although the tide changed after 2010, leaving the subject at a plateau. The years 2024 and 2025 should be taken with skepticism since recent works may naturally take a long time to be properly added to the database.

⁶ This led him to rebuild the coherentist framework in philosophy of science. He went from foundationalism to its rival – coherentism – and, later, to his own reformulation of the latter. This cyclical and iterative aspect of HPS research was explicated and defended as a methodological approach to HPS work by Scholl and Räs (2016).

Figure 1: A search on OpenAlex database on the field of study category for “History and Philosophy of Science”. Search was made on December 14, 2025.

HPS Publications Over Time (OpenAlex)



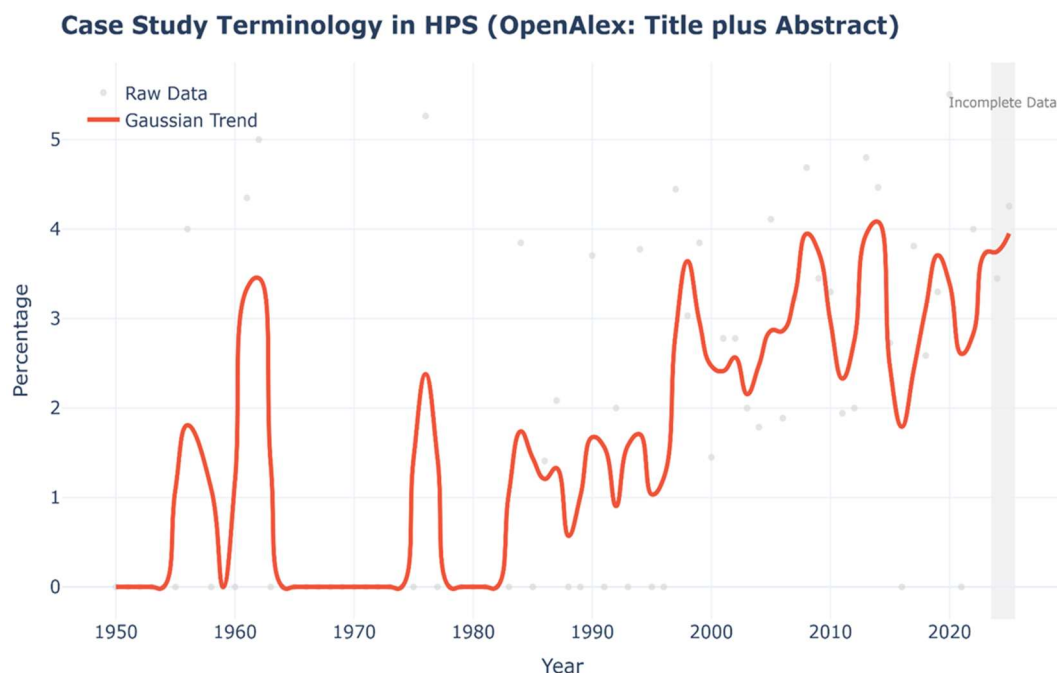
The years 2024 and 2025 should be taken with skepticism;
therefore, I added a gray shade to point this out.

Figure (1) shows that HPS research grew but it has reached stagnation after 2010. This plateau confirms Arabatzis and Schickore’s (2012) assessment that, despite concerns on the cold relation between history of science and philosophy of science, an integrated HPS – with its plethora of methods and discussions – won’t simply vanish.

With the total number of HPS publications in hand, our search can scan every document’s title and abstract for specific words and phrases and calculate the percentage. Searching every document for the expressions “case study”, “case-study”, “case studies”, and “case-studies” shows a growing trend of focus on case studies type of HPS research. In this query, we have added the expression “historical episode” and its plural form⁷. We took a 3-year Gaussian smoothed average and calculated the percentage of “case study” works in HPS; the result is Figure (2). We can, thus, visualize the share of HPS publications with the “case study” expression with the data from OpenAlex.

⁷ These expressions are similar, although I agree with Chang (2012) that “historical episode” is a clearer expression because it shows that historical conclusions endowed with a philosophical framework is usually a variation of the abstract philosophical concepts used instead of a mere (and isolated) instantiation of concepts and ideas. Thus, “historical episode” should be the standard jargon.

Figure 2: The share of HPS publications with the “case study” expression or equivalent within the data used to produce Figure (1), according to the OpenAlex database.
Search was made on December 14, 2025.



The red curve represents a Gaussian smoothed trend ($\sigma=1$) with a window of 3 years⁸ to highlight the underlying historical trajectory of case study terminology while minimizing short-term fluctuations. With this, we can have a better look at how case studies are proliferating in HPS.

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We can see that case studies seem to have taken a foothold on HPS in general. The turbulence in this data is due to the low numbers in both counts, making the noise almost as high as the sound. Furthermore, this result is probably underestimating the total share of actual case studies, since a lot of works in HPS surrounding the biggest topics in the field (such as Newton’s natural philosophy or Galileo’s reasoning, for example) usually do not call themselves a “case study” despite possibly being one⁹. Nonetheless, the major challenge in Figure (2) is OpenAlex’s small number of HPS publications, as one can attest looking at Figure (1). Fortunately, in Figure (4), we reached a smoother graph for HPS publications related to case studies using the Dimension database. With it, our general conclusion taken from Figure (2) – that case studies are on the rise in HPS – holds water.

(b) The Fragmentation into Specializations: The History and Philosophy of the Sciences

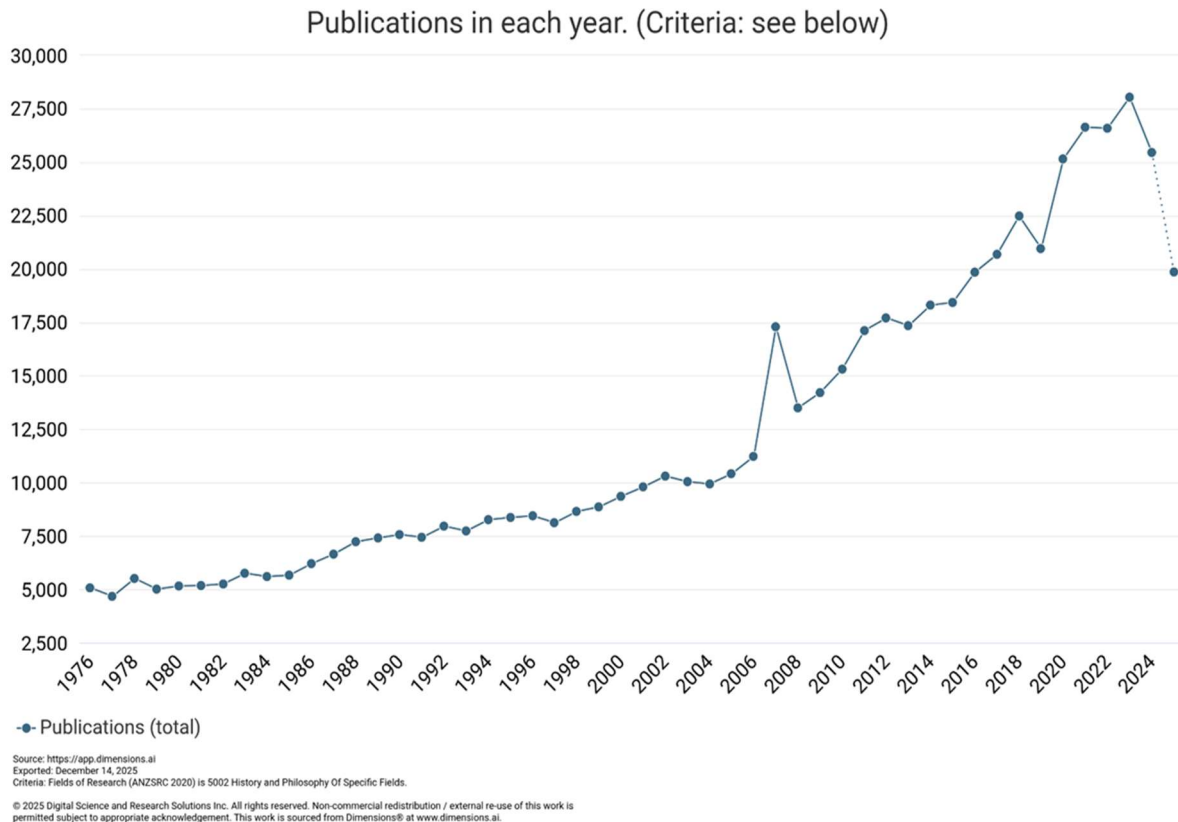
Running parallel to the rise of the case study is a trend toward increasing academic specialization. The broad field of HPS is progressively fracturing into a collection of distinct sub-fields, each focused on a specific scientific discipline.

⁸ Centered on the year in the middle; thus, the window of 2020 up to 2022 is centered and plotted in 2021. The borders suffer a renormalization, making it more responsive to fluctuations.

⁹ There are also miscounts in the opposite direction. A few HPS articles have discussed the validity and usage of case studies in HPS without actually being a case study work on HPS (some of them, like Chang [2012], were cited in this article). The query can’t distinguish such a nuance.

If we analyze data from another database, the Dimensions database, we can observe that HPS has moved toward specialized topics; that is, constrained to specific scientific fields and academic niches. Figure (3) indicates that searching the Dimensions database for the topic of “History and Philosophy of Specific Fields” shows that the number of publications per year soared recently¹⁰, despite the stagnating number of publications on HPS in the same period according to Figure (1). Thus, Figure (3) indicates academic specialization.

Figure 3: Number of publications per year, as recorded in the Dimensions database.
[Available at: <https://app.dimensions.ai/discover/publication>].
Search was made on December 14, 2025.



The blue line indicates number of publications between 1976 and 2025. The result indicates academic specialization within HPS, although their data should be taken with reservations, as explained below.

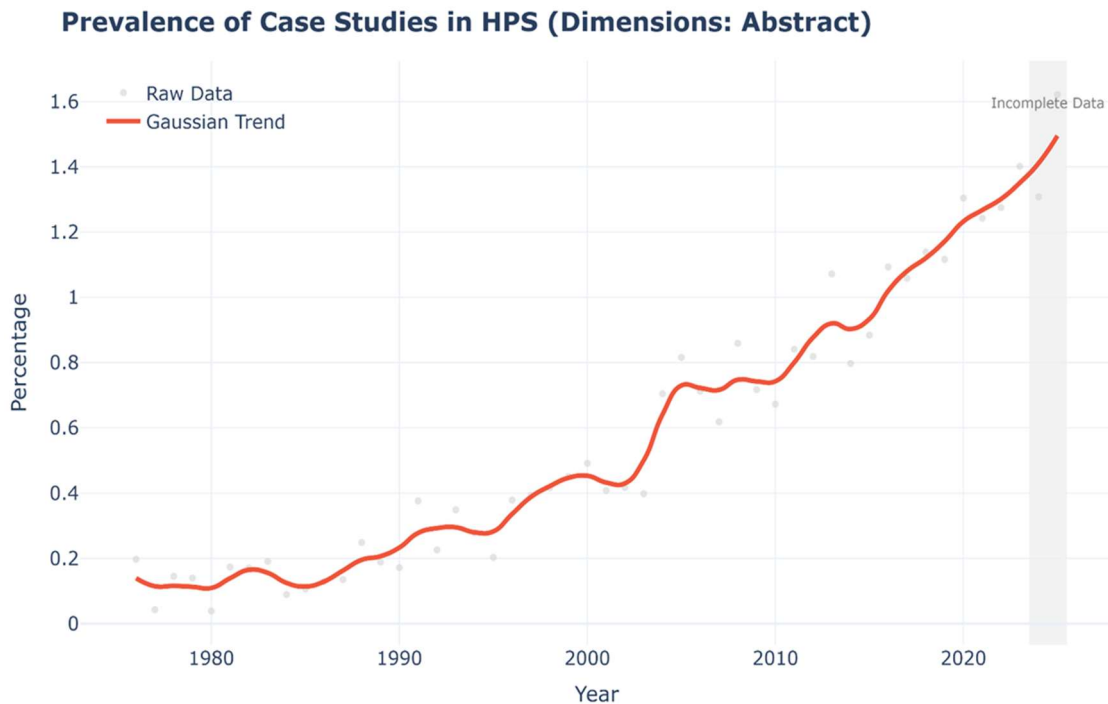
The last two years have been dashed because they should be taken with skepticism due to an increase in incomplete data.

However, the Dimensions database result should be seen with skepticism. Their category of “History and Philosophy of Specific Fields”, labeled 5002 in their website, is based on an umbrella of fields. Their set is composed of: History and philosophy of engineering and technology; History and philosophy of law and justice; History and philosophy of medicine; History and philosophy of science; History and philosophy of the humanities; History and philosophy of the social sciences; History of ideas; History of philosophy; and History and philosophy of specific fields not elsewhere classified. This group is based on the Australian

¹⁰ The Dimensions database does not have a “History and Philosophy of Science” category without adding specialized niches, unfortunately.

and New Zealand Standard Research Classification (ANZSRC)¹¹. Therefore, one should be wary of Figure (3) and the conclusion it leads to. Using the Dimensions database, which, if we compare Figures (1) and (3), gives many more HPS-related publications than OpenAlex, we can also check the percentage of “case study” works within HPS by probing their abstracts.

Figure 4: Number of case study works in the HPS query in the Dimensions database.
Search was made on December 14, 2025.



The years 2024 and 2025 should be seen with skepticism due to incomplete data in the database.

As the Dimensions database shows in Figure (4), the share of case studies in HPS has only increased. It seems that almost 2% of all HPS¹² is related to case studies. And the trend is upwards with no signs of slowing down or plateauing. Our perception based on Figure (2) seems to be true – case study is a rising approach. Or, at the very least, we can affirm that calling a work a “case study” has become more normalized, which is the hedgiest claim one can make with the data presented.

Moreover, all data related to case studies should be taken with a conceptual grain of salt since there is no proper grand definition of what a case study inquiry is. Wolfgang Pietsch (2016, 51) summarized a set of criteria to identify a case study. It examines “an episode in considerable detail and take into account the context in which it happened”. Note that the difference between the phenomenon to be researched and its context are not clearly distinguishable. Furthermore, they consider a “large number of variables”, and they examine the phenomenon from a “variety of perspectives and with a variety of methods”, resulting in a “heterogeneous data structure [that is, a complex historical narrative]”. Last but not least, they try to answer questions such as “what is this a case of?”. These criteria may not

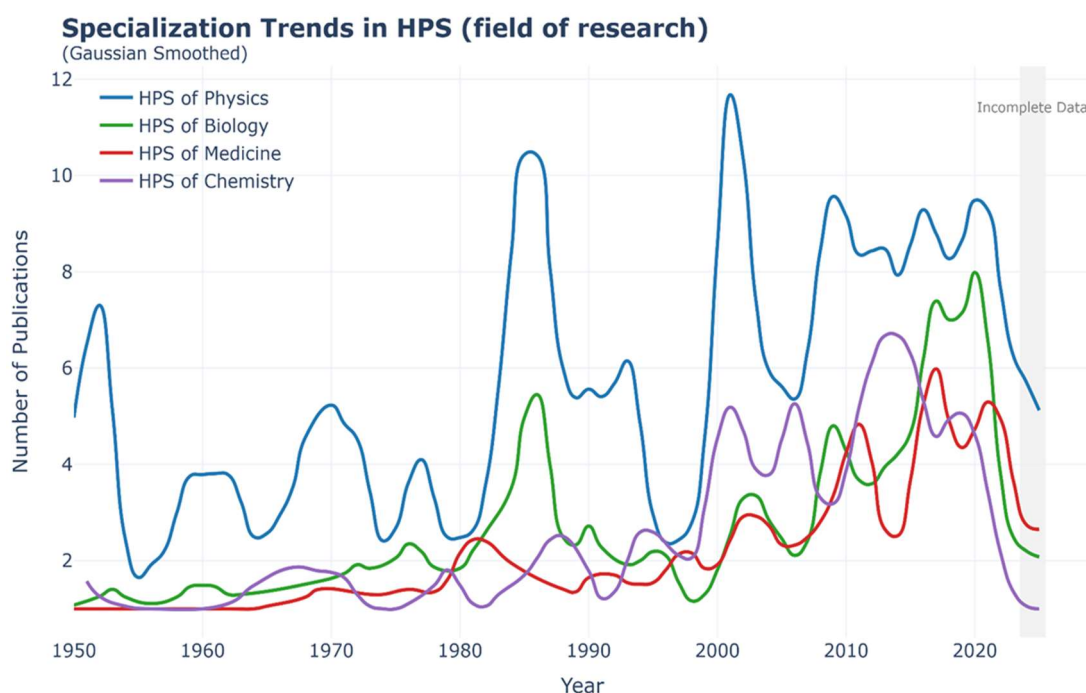
¹¹ For more on this category as it is defined by the ANZSRC, see Australian and New Zealand Standard Research Classification (ANZSRC) 2025.

¹²As defined by Dimensions; as we saw it, their definition is broad.

be either necessary or sufficient. In other words, some case studies may vary from this and still be reasonably categorized as case study works¹³. Thus, the best one can do quantitatively is to proxy the number of case studies by how many published academic documents use such expression (and its grammatical variations), without forgetting that this is at best a decent-but-naïve approach, even when the database is reliable. In summary, despite shortcomings in this methodology, case studies do appear to have become a steadily more present line of research within HPS.

Moreover, granular and compelling evidence for academic specialization comes from the OpenAlex database. One can run conjugated queries for different concepts such as “History and Philosophy of Science” plus “Physics”, HPS plus “Medicine”, HPS plus “Chemistry”, and HPS plus “physics” (all searches were made on December 14, 2025). When OpenAlex indexes a paper, an AI algorithm reads the title, abstract, and – crucially – the citations and journal venue. Based on this, it tags the paper with specific “Concepts” ID. All one needs is to search for articles in which HPS’s ID overlaps with other areas, such as physics, building proxy quantification for History and Philosophy of Physics (a 3-year Gaussian smoothed average was calculated, just like in the case study analysis of Figures [2] and [4]). One will notice a rise in publications in all of them. It’s the rise of “History and Philosophy of the Sciences”. Note that we should ignore the end of the lines because database may lag behind in publication retrieval.

Figure 5: A 3-year Gaussian smoothed average of the number of publications, according to the OpenAlex database.
Search was made on December 14, 2025.



The result indicates academic specialization within HPS. Notice that history and philosophy of physics and history and philosophy of biology seem to be the winners in this race, as one would expect. Once again, the data for 2024 and 2025 should be taken with skepticism due to the database lag in

¹³ For a didactic division of types of case studies and a discussion on the limits of over-reliance on case study claims and methods (i.e., blindness to parameters that can only be seen globally), see Galison 2016, 155–170.

publication retrieval. The borders suffer renormalization in the Gaussian smoothing process, making them more responsive to fluctuations; therefore, the descend after 2020 is probably a response to incomplete data, not evidence for academic demise.

These data point seems to confirm a fundamental structural shift we observed in Figure (3): the emergence of a collection of distinct “HP of the Sciences” in place of a more unified HPS. This specialization allows for deeper engagement with the technical content and specific conceptual issues of each science; and it may reinforce (positively) the rise of case studies.

Two trends – the localism of the case study and the fragmentation into specializations – exist in a state of unexamined tension. New fields could provide room for transversal philosophy-building, avoiding the pitfalls of excessive case studies. However, they could become self-contained niches, with their own localized case studies and almost no interaction with the other niches of HPS or to more global frameworks in their own niche. In any case, the field of HPS should bridge its parts through an internal struggle, one in which a methodology and/or philosophical framework may help bond. This brings us to the next section.

A Methodological Proposition: From a Disciplinary Gap to an Epistemic Gradient

Given a landscape characterized by case studies and specialization, how can researchers conduct work that is both historically grounded and philosophically ambitious? The solution lies not in abandoning the trends of contemporary HPS, but in developing more explicit and robust methodologies for navigating them. This section proposes such a methodology, abstracting from the practice of HPS research that the author accumulated to offer a generalizable framework for integration.

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(a) Reconciling the Particular and the General: The Core Challenge

The fundamental tension in HPS research stems from the differing aims of its constituent disciplines. As Caneva (2012) has noted, historians typically focus on particular and concrete events; that is, particular theories, concepts, researchers/natural philosophers and moments. Meanwhile, philosophers aim for general and abstract frameworks. This creates a “language barrier”. A historian must balance the language of their historical actors with modern vocabulary, while a philosopher may freely critique a scientist’s use of a term like “explanation” as philosophically imprecise (Bueno and French 2018).

This clash is acutely felt when a researcher attempts to apply a general philosophical framework to a specific historical case. For example, in a study of the 18th century mathematization of electrostatics, a researcher might employ Bueno, Colyvan, and French’s “inferential conception” of the application of mathematics in the sciences (Bueno and Colyvan 2011; Bueno and French 2018). This is a powerful, general framework designed to apply to all instances of mathematics in the sciences. However, the researcher’s goal is to understand the particular factors at play in the mathematized work of a specific figure like Charles Coulomb. The general framework may conflict with historical evidence, such as when the framework posits that mathematics alone plays no explanatory role, while the historical actor clearly believed they were offering mathematical explanations for physical phenomena. This is the core challenge: how to make the general and the particular interact with one another without damaging either.

(b) The Epistemic Gradient and the Fine-Tuning Method in Practice

A practical methodology for overcoming this challenge can be articulated through a set of operational principles. These principles, derived from the concrete process of conducting integrated research, offer a replicable approach.

- 1 **Principled scope reduction:** When applying a broad philosophical framework, it is rarely necessary or desirable to import the entire theoretical apparatus. The researcher must engage in a process of “trimming branches” – deliberately selecting only those philosophical arguments and concepts that are directly relevant to the historical questions at hand. In the study of mathematization, for example, complex debates about mathematical realism might be justifiably set aside to maintain focus on the role of mathematics in scientific explanation. This is an exercise in choice, guided by the specific goals of the historical inquiry.
- 2 **Objective-oriented inquiry:** Philosophical questions often breed more philosophical questions in a “Matryoshka effect”. A question about explanation can lead to questions about understanding, which can lead to questions about cognition. To avoid infinite regress, the pursuit of these philosophical rabbit holes must be guided by clear historical objectives. The goal is not to solve the philosophical problem in its entirety, but to pursue it only insofar as to secure or clarify the historical analysis, or to render arguments unassailable. For instance, a historian needs to know what constitutes a scientific explanation only to the extent that it allows them to confidently identify and analyze instances (and types, perhaps) of explanation(s) in their sources.
- 3 **Transparent positioning:** When a conflict arises between the language and/or concepts of the historical actors and the philosophical framework, the researcher should make a choice and explicitly justify it. This is particularly crucial when dealing with the “language barrier”. If historical actors describe their work as “mathematically explaining” a phenomenon, while the chosen philosophical framework deems this expression invalid, the researcher should not simply ignore the conflict. A historian in HPS, thus, navigates through two languages: that of the historical actors, to avoid anachronistic distortions; and the present nomenclature and vocabulary, which cannot be overridden since history is for the living. This is what Caneva (2012, 53) calls “Bohrian complementarity”. The solution is to adopt a position – for instance, siding with the historical actors’ terminology for the sake of diachronic analysis – and to transparently acknowledge and explain this choice in such a way that respects both historical and philosophical concerns. Another alternative is to de-historicize part of the analysis, dividing it into two fronts. One is the historicized explanation: following the actor’s explanation and diachronically contextualizing its novelties and peculiar properties. Later, the historian can revisit it with the help of its philosophical framework, discussing it more philosophically.

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These operational principles suggest a new way of conceptualizing the relationship between history and philosophy. The difference is not a static “gap” to be bridged, but an *epistemic gradient* that can be actively navigated. Research can move along a continuum from the highly particular and concrete (the traditional domain of history) to the highly general and abstract (the traditional domain of philosophy). Similarly, this transit may help one circumvent the pitfalls of case study works, bonding the narrative, the arguments and the conclusions from specific to general in a way that (hopefully) satisfies Galison’s (2016) concerns.



This navigation can be described as a “*fine-tuning*” method. A researcher begins with a deep, diachronic analysis of a particular case. Philosophical tools are then introduced and “fine-tuned” to make sense of the specific historical material. Through this iterative process, which aligns with the methodologies described by Chang (2012) and Scholl and Rätz (2016), concepts can be developed that move up the gradient from particular to general (and from concrete to abstract).

The ultimate goal of this method is to create robust middle-range epistemologies – theories and concepts that are philosophically sophisticated but remain grounded in and accountable to detailed historical evidence. This approach embraces both the depth of the case study and the conceptual power of philosophy, providing a path forward for a truly integrated HPS, one in which case studies can be bridged into non-local arguments, characteristics and conclusions. Hacking’s *styles of reasoning* can be seen as one such approach, although less focused on practical properties and more focused on over-arching epistemologies, overflying middle-range approaches (Hacking 2004a, 2004b, 2012; Bueno 2012).

Conclusions

The intellectual project of HPS has evolved from an asymmetric relationship, through a period of paradoxical integration and divergence, to its current configuration, which is strongly characterized by the methodologies of the case study and the structure of academic specialization. This paper has traced this historiographical arc and, through a bibliometric analysis, provided quantitative evidence for the contours of the contemporary field. The prevalence of localism and fragmentation presents the central methodological aspect for today’s HPS researchers.

In response, this paper has articulated the epistemic gradient method as a practical and theoretically-grounded framework for conducting integrated research. By reconceptualizing the relationship between the historical particular and the philosophical general as a navigable continuum rather than an unbridgeable gap, this method offers a way to harness the strengths of current trends. It provides a means to build middle-range epistemologies that are both historically rich and philosophically insightful. Arguably, these middle-range epistemologies may help us circumvent the limits of localism discussed by Galison (2016). Although it should be noted that such a method may not be able to address academic specialization, which should be seen not as a problem but as a natural feature of today’s academic market.

The future of HPS will likely see further integration with emerging fields, such as the computational “science of science”, cognitive science, and data science. As the toolbox for studying science expands, the need for rigorous, transversal methodologies that can connect detailed historical work with broader theoretical questions will only become more acute. The epistemic gradient is offered as one such tool, designed to foster a more integrated, robust and progressive future for the study of history and philosophy of science.

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