

Counterfactual Histories of Science and the Contingency Thesis

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Abstract Within the debate on the inevitability versus contingency of science for which Hacking's writings (The social construction of what? Harvard University Press, Cambridge, 1999; *Philos Sci* 67:S58–S71; 2000) have provided the basic terminology, the devising of counterfactual histories of science is widely assumed by champions of the contingency thesis to be an effective way to challenge the inevitability thesis. However, relatively little attention has been devoted to the problem of how to defend counterfactual history of science against the criticism that it is too speculative an endeavor to be worth bothering with—the same critique traditionally levelled against the use of counterfactuals in general history. In this paper, we review the defense of counterfactuals put forward by their advocates within general history. According to such defense—which emphasizes the essential role of counterfactuals within explanations—good counterfactual scenarios need to exhibit the right kind of plausibility, characterized as continuity between said scenarios and what historians know about the world. As our discussion shows, the same requirement needs to be satisfied by good counterfactual histories of science. However, as we mention in the concluding part of the paper, there is at least one concern raised by counterfactual history of science as used to support the contingency thesis for which the defense based on the plausibility of the counterfactual scenarios does not seem to offer easy solutions.

1 Introduction

Ian Hacking's writings (1999, 2000) concerning the question of whether the results of successful science are inevitable or contingent have provided the basic terminology for the debate between so-called *inevitalists*, on the one hand, and so-called *contingentists*, on the other hand (see Soler 2008, 2015; Martin 2013;

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Kinzel 2015 for recent overviews). Contingentists maintain that history of science may well have taken a path leading to some alternative S' , S'' , S''' , etc., to our current science S : this is the *contingency thesis*, typically defended by devising—or at least, invoking the possibility to devise—alternative histories of science. Such alternative, counterfactual histories are populated by theories alleged to be as successful as the ones currently embraced by scientists, which according to the *inevitability thesis* are unavoidable stages in the development of science. The more plausible the envisaged counterfactual histories, the contingentists' reasoning seems to go, so much the worse for inevitabilists: if putting forward credible alternatives is actually feasible, then the inevitability thesis will lose quite a bit of its *prima facie* appeal.

Champions of the inevitability thesis find such contrary-to-fact speculations far from compelling. For after all, they ask, how can one ascertain what consequences would have followed, had things gone differently at some juncture in the history of science? Counterfactual history of science then faces the same criticisms levelled at the use of counterfactuals within general history. In what follows, we shall review the defense of counterfactuals put forward by their advocates within general history. According to such defense—which emphasizes the essential role of counterfactuals within explanations—good counterfactual scenarios need to exhibit the right kind of plausibility, characterized as continuity between said scenarios and what historians know about the world. As our discussion will show, the same requirement needs to be satisfied by good counterfactual histories of science.

We shall proceed as follows. In Sect. 2, after some introductory remarks on the current state of the debate on the inevitability versus contingency of science, we shall focus on some essential features of counterfactual history of science as used to support the contingency thesis. In Sect. 3, we shall deal with the defense of counterfactuals within general history devised by advocates of what is variously referred to as “alternative history,” “alternate history,” ““what if?” history,” “allo-history,” and “counterfactualism,” and emphasize the role of counterfactuals within explanatory models. In Sect. 4, some examples of counterfactual histories of science, highlighting the importance of the plausibility of the counterfactual scenarios and relating such plausibility to the viability of the models put forward by counterfactual historians, will be discussed. In Sect. 5, we shall conclude by indicating one concern raised by the use of counterfactual history of science in support of the contingency thesis for which the above defense of counterfactuals does not offer easy solutions.

2 Inevitability, Contingency, Counterfactual Histories

In order to clarify both the scope of the inevitability versus contingency of science debate and the aim of the present paper, it will be useful to start our discussion with a few preliminary remarks.

First, Hacking's writings have to a large degree shaped the most recent debate: among other things they provide, as mentioned above, the very labels used to designate the opposing camps and their respective claims.¹ Nevertheless, the issue of the inevitability versus contingency of the results of successful science is anything but unknown to twentieth century philosophy of science. For instance, in *The Structure of Scientific Revolutions* (1962/1970) Thomas Kuhn famously characterized paradigms as rival sets of hypotheses competing to win the support of a scientific community. As one of the most well-known practitioners of counterfactual history of science recently put it, according to Kuhn's theory of science, "several of the rivals may have the ability to function effectively and contingent circumstances may influence the outcome of the debate" (Bowler 2013, pp. 26–27) between advocates of competing paradigms. To mention but one more example, the later Paul Feyerabend devoted sustained efforts to a wide-ranging criticism of realism, in which considerations pertaining to the vagaries of historical developments play a central role. In a 1989 paper tellingly entitled "Realism and the historicity of knowledge," later collected in his posthumous, unfinished *Conquest of Abundance* (1999), Feyerabend railed against what he viewed as a key tenet of realism, i.e., the separability assumption, which he formulated as follows:

what has been found in [a] idiosyncratic and culture-dependent way (and is therefore formulated and explained in idiosyncratic, ad hoc, and culture-dependent terms) *exists* independently of the circumstances of its discovery. In other words, we can cut the way from the results without losing the result (1999, p. 133).²

Relatedly, as Sankey (2008) and Kidd (2011, 2016) have pointed out, not only the specific developmental paths followed by individual sciences, but also the very emergence of science as such can be viewed as a phenomenon resulting from various contingencies (an issue to which Heidegger, Husserl, and Wittgenstein, among others, devoted quite some attention). Only recently, however, has the explicit discussion of counterfactual history become one focus of the reflection on the inevitability versus contingency of science.³

Secondly, the two conflicting claims around which the inevitability versus contingency debate revolves can be—and sometimes have indeed been—stated in very general and somewhat stark terms. For instance, an often-mentioned champion

¹Although in what follows we shall stick to the "inevitability versus contingency" couple and cognate expressions, some terminological variations in the relevant literature are worth mentioning: for instance, French (2008, p. 572) contrasts "contingentists" with "necessitarians," Henry (2008, p. 552) "contextualists" with "positivists," and Fuller (2008, p. 577) "underdeterminism" with "overdeterminism."

²Hacking is of course well aware of such antecedents, discussed at length in his analysis of the debate on social construction (1999). For Feyerabend's take on the contingency of science, see especially Kidd (2016, Sect. 5); for his criticism of the separability assumption, see Tambolo (2014).

³See especially the texts mentioned in Footnote 1, which together with Radick (2008) and Bowler (2008) feature in a focus, published in *Isis*, devoted to "Counterfactuals and the Historian of Science."

of the inevitability thesis once commented: “If we ever discover intelligent creatures on some distant planet and translate their scientific works, we will find that we and they have discovered the same [fundamental physical] laws” (Steve Weinberg, quoted in Hacking 2000, p. S66). This phrasing of the inevitability thesis conveys the idea that the results of our science are unavoidable stops along the way to an “imagined end-run science” (ibid., p. S60) of which, according to die-hard inevitabilists, they provide a preview of sorts. An equally strong version of the contingency thesis can be formulated by borrowing Gould’s (1989) terminology: nothing is inevitable in the development of a properly conducted physical investigation of the world; therefore, were it possible to “replay the tape” of history of science, the path taken by the scientific enterprise would most likely differ very significantly from the actual historical record.

As the debate proceeds, however, intermediate positions between the above extreme versions of the inevitability and contingency theses are acquiring more and more prominence. This is certainly related to the awareness that science can be viewed as inevitable (contingent) along different dimensions: the social and cultural conditions in which scientific inquiry takes place; the methods that happen to be used by researchers; the evidence available to scientific communities; the standards used to appraise theories; the concepts providing the framework for experiments; etc. In other words, the contingentists’ claims concerning the empirical success of putative alternatives to the theories that our scientific communities currently embrace cover only one dimension of the inevitability versus contingency of science issue—although arguably the most important one. Consequently, it has been suggested, in order for the notion of the inevitability (contingency) of science to be a useful analytical tool, the inevitability thesis and the contingency thesis ought to be unpacked into various *inevitability theses* or *claims* and *contingency theses* or *claims*, respectively (see Martin 2013; Kinzel 2015, esp. Section 5; and Soler 2015).

Here we shall not aim at doing justice to the nuances of the debate, for which in the years to come the recently published collection *Science as It Could Have Been* (Soler et al. 2015) will certainly be the mandatory reference. More modestly, we shall focus on one argumentative strategy often deployed—and even more often assumed to be readily deployable, should the need arise—in support of the contingency thesis. The strategy consists in claiming that, although the historical record attests that things went in a certain way, they may well have gone differently. Therefore, today we may well find ourselves championing a science S' which, different from our current science S , would be made of theories enjoying the same amount of empirical success as the ones that we now embrace. In rough outline, then, the strategy used to defend the contingency thesis consists of three steps: (i) some presumably crucial juncture in the past of science, at which things might have gone differently, is identified; (ii) the counterfactual speculation is put forward that, had things indeed gone differently, a different development would have followed; (iii) depending on the author putting forward the counterfactual speculation,

such different development is described in more or less detail (sometimes, it is just evoked as a possibility).⁴

Unsurprisingly, champions of the inevitability thesis find such speculations less than compelling. Indeed, alternative histories of science face basically the same objections raised against counterfactual speculations in general history, famously dismissed as “a parlour-game with might-have-beens” (Carr 1961, p. 97) by eminent historians. In the next section, some of the arguments that champions of counterfactual history have put forward in defense of their endeavors will be reviewed.

3 Counterfactuals, Idealized Models and Historical Explanations

It comes as no surprise that counterfactual speculations have attracted quite a lot of criticism from practicing historians: reconstruction of the past as it actually happened, after all, figures prominently in their job description.⁵

One major concern that the devising of alternative pasts typically raises has to do with the very subject matter of counterfactual history. A counterfactual history starts with the identification of a certain juncture in the past at which things—allegedly—might have gone differently, so that the subsequent events might have unfolded in a different way. But given that at such crucial juncture things went exactly as we know they went, the critics ask, is it not the case that the individual who claims that they might have gone differently, thus bringing about different developments, is just projecting her own prejudices on the past? To put it differently: is it not the case that the narrative resulting from a counterfactual approach teaches us more on the historian writing it than on the reconstructed past? The very same criticism can of course be raised against *any* reconstruction of the past; nevertheless, critics of counterfactual history point out, the concern is clearly more pressing in the case of narratives hinging on the choice to assume the past to have been different from how we know it was.

Indeed, as emphasized by Gavriel Rosenfeld among others, “presentist motives” (2002, p. 90) are far from extraneous to the genre of alternate history. In this connection, Rosenfeld argues at length that some typical correlations obtain between the way in which proponents of counterfactual histories view the present and the way in which they recount the past. For instance, in *nightmare scenarios*,

⁴Note that advocates of the contingency thesis do not suggest that one can devise a full-fledged alternative to our science: in view of the long-term collective investments of time, efforts, ingenuity, and resources involved in the emergence of anything as complex as our current body of scientific knowledge, this is an impossible task (see especially Trizio 2008; Kidd 2016).

⁵For a recent critical survey of alternate history, see Evans (2014), which provides the reader with plenty of references to explore the genre. Rosenfeld (2014) and Sunstein (forthcoming), among others, offer critical assessments of Evans’ opinionated survey.

the conjured up past compares unfavorably to the real historical record, so that the present is vindicated; while in what Rosenfeld calls *fantasy scenarios*, the alternative past is depicted as superior to the real historical record in order to support the writer's critique of the present.

In spite of the overtly political agendas that often underlie alternative histories, practitioners and defenders of counterfactual history have forcefully argued that its primary goal is not that of criticizing or praising the past but, rather, that of understanding it better. To mention but one example, the editors of the collection *Unmaking the West: 'What-If' Scenarios that Rewrite World History* insist that "not all counterfactual thought experiments are equally subjective and therefore equally speculative" (Tetlock et al. 2006, p. 9). The alternative histories devised in the chapters of their collection, they claim, aim at changing the questions around which the debate on the rise of the West has traditionally revolved. When the question that triggers historical inquiry is counterfactual (e.g., "Why did alternative developments fail to occur?") instead of factual (e.g., "Why did a certain event happen?"), they emphasize, "history looks different" (ibid., p. 5). This is of crucial importance for anyone "interested in the cognitive processes of observing and drawing causal lessons from history as in the historical record itself" (ibid.). To this end, Tetlock, Lebow, and Parker claim, a counterfactual approach is especially useful because it reminds one of the

many intricately interconnected assumptions scholars need to make to justify claims about the inevitable or improbable rise and fall of civilizations. We see enormous intellectual value—perhaps, indeed, the greatest service counterfactual historians can render—in unearthing the labyrinthine logical complexity of "what-if" assumptions underpinning the often all too confident claims about why the West, and not one of the rest, rose to global hegemony (ibid., p. 9).

Note that, according to Tetlock, Lebow and Parker, shedding light on the historians' implicit assumptions is not the only advantage of a counterfactual approach, and consequently, they go on to provide an in-depth discussion of the various benefits—and challenges—of counterfactual history (on which see also, e.g., Tetlock and Belkin 1996; Lebow 2000; Yerxa 2008). Here, however, we shall not follow the details of their account. For our present purposes, what matters is that the passages quoted above point the reader to a thesis that is emphatically embraced by all defenders of alternative history: the thesis that there is a very close link—one that cannot be severed—between counterfactuals and historical explanations. Indeed, champions of counterfactuals take them to be ubiquitous in historical research, since they are no less than a "by-product of any historical statement that implies causality" (Kaye 2010, p. 38). More specifically, the idea is that whenever a causal claim of the kind "x caused y" is asserted by the historian who attempts to explain a certain event, the corresponding counterfactual "Had it not been the case that x, it would not have been the case that y" is simultaneously endorsed, albeit only implicitly. According to their advocates, counterfactuals are thus a fundamental ingredient of the explanatory practice of any historian—even of those who officially dismiss counterfactual history as "history-fiction."

That counterfactuals somehow feature in causal explanations is certainly not an exotic view: as Ronald Giere, for one, put it, “[t]o understand a causal system is to know at least some counterfactuals about that system” (Giere 2015, p. 192). In the case of non-experimental disciplines such as history, however, the point is of special interest. Since the researcher cannot replay the tape of history at will,

one can hardly discuss the relative importance of causes without engaging in some kind of thought experiment where one removes successively and separately each of the causes in question and evaluates what difference the absence of this cause would have made to the phenomenon in question (Elster 1978, p. 176).⁶

On Elster’s account, then, counterfactuals lend crucial support to researchers dealing with the task to estimate, in spite of the scarcity of evidence, the impact of a certain presumed cause on the observed effect that constitutes the object of inquiry. Although Elster himself does not use the notion of model, we may say that the importance of counterfactuals for historians depends on their being a key component of explanatory models. Just like in the natural sciences, the researchers investigating a historical phenomenon can be viewed as proposing an *idealized model* of it, that is, “a deliberate simplification of something complicated with the objective of making it more tractable” (Frigg and Hartmann 2012). Of the countless elements constituting historical reality, only some—assumed to be causally relevant for the historical outcome under inquiry—feature in the model, while others are entirely disregarded.⁷ Allowing as they do the manipulation of one or more of the elements featuring in the idealized model, counterfactuals make it possible to study the relationships among the elements within the model. Of course, just like in the natural sciences, model building is subject to constraints, and the idealized model used to investigate a historical phenomenon cannot be manipulated at will, thereby licensing any counterfactual scenario that one could possibly come up with. Quite on the contrary, as our discussion here and in Sect. 4 will clarify, a key constraint on counterfactual scenarios, both in general history and in history of science, is their plausibility.

Unsurprisingly, counterfactuals in history can be defended by means of various arguments. Nolan (2013), for instance, has recently enumerated no less than eight different reasons why practicing historians should care about them, and Tetlock and Belkin have emphasized how counterfactual speculations serve a variety of distinct—although clearly related—theoretical purposes, “from hypothesis generation to hypothesis testing, from historical understanding to theory extension” (1996, p. 16). Nevertheless, it is hard to exaggerate the importance that defenders of

⁶The tradition that characterizes counterfactuals in historical explanations as thought experiments dates back to Weber’s 1905 essay “Objective Possibility and Adequate Causation in Historical Explanation,” published in English in Weber (1949). I wish to thank Marco Buzzoni for pointing this out to me.

⁷As Frigg and Hartmann (2012) put it, idealized models characterized in this way instantiate the so-called “Aristotelian idealization, which amounts to ‘stripping away,’ in our imagination, all properties from a concrete object that we believe are not relevant to the problem at hand. This allows us to focus on a limited set of properties in isolation.”

counterfactuals in history attach to their connection with causal explanations: counterfactuals, causal claims, and historical explanations are, in Johannes Bulhof's words, "three sides of the same strange three-sided coin; you cannot have one without the other two" (1999, p. 147).

In most cases, such enthusiastic embrace of counterfactual speculations goes hand in hand with the acute awareness that not all of them are equal. And although the difference between sound alternative history on the one hand and history-fiction on the other hand is not easily spelled out in the abstract, advocates of counterfactual history have tried to lay down some best practice rules and guidelines. Tetlock and Belkin (1996, pp. 16–31), for instance, proposed a number of criteria for assessing the "legitimacy, plausibility, and insightfulness" of counterfactual speculations, with the aim "to initiate a sustained conversation [...] on what should count as a compelling counterfactual argument" (ibid., p. 17). Martin Bunzl's paper "Counterfactual History: a User's Guide" (2004) is one major contribution to such conversation. As we shall see in the remaining of the present section, Bunzl proposes a solution not only to the problem of telling sound from unsound counterfactuals, but also to that of linking counterfactuals to evidence. The latter problem is no less important than the former. In fact, critics of counterfactual history point out that, since there is no way to ascertain what would have happened, had things gone differently at some juncture in the past, there is simply no point in asking such questions. By definition, the critics insist, contrary-to-fact reasoning does not belong to the domain of proper historical inquiry, which is aimed at establishing what claims concerning the past the available evidence licenses.

Now in a counterfactual conditional—such as, for instance, "Had Adolf Hitler died in the trenches during World War I, no attempt at a final solution of the so-called *Judenfrage* would have been carried out by the German government during the 1940s"—the antecedent is, of course, false. Those asserting the counterfactual then have to deal with an obvious question: how can one tell what would have happened, had Hitler died in the trenches during World War I? More generally: on what basis can one claim that the consequent of a counterfactual follows from its antecedent? When can a counterfactual conditional be asserted? Bunzl forcefully argues that sound counterfactual reasoning "can be grounded" (ibid., p. 845). In fact, sound counterfactual conditionals are *plausible* ones, which "bear certain evidential markings that we can learn to read" (ibid., p. 849). More specifically, a sound counterfactual conditional can be brought into contact with evidence—if only indirectly—in such a way that its appraisal becomes feasible. This requires one to view the plausibility of the counterfactual as depending not only on the plausibility of the antecedent, but also on the *plausibility of the counterfactual inference*, i.e., the inference that the consequent of the counterfactual follows from the antecedent. On Bunzl's account, in order for such an inference to be plausible, it must be derivable from the conjunction of the antecedent with appropriate background conditions. Among such appropriate conditions, Bunzl lists "established theoretical and statistical generalizations" (ibid., p. 849), possessing the property of projectability, with which the counterfactual conditional has to be

consistent.⁸ The example in the next paragraph, proposed by Bunzl himself, illustrates the point quite clearly.

Historian Albert Gunns has explained the collapse of the Tacoma Narrows bridge—blown down by winds of 42 miles per hour in 1940, shortly after the construction was completed—as the consequence of poor design. In fact, budgetary constraints led to the design of a two-lane deck, narrower and lighter than the decks of other contemporary suspension bridges that never exhibited the problems that put a premature end to the life of the Tacoma Narrows bridge. Normal design practice, Gunns argues, would have dictated the building of a roadbed more than two lanes wide, which “*would had resulted in a deck that was heavier and more rigid and therefore less susceptible to aerodynamic effects*” (Gunns, quoted by Bunzl 2004, p. 850). Gunns counterfactually claims that, had the prescriptions of normal bridge design practice been followed, the bridge would not have collapsed. The plausibility of the counterfactual conditional asserted by Gunns, Bunzl suggests, depends on the plausibility of the laws of mechanics from which (in conjunction with the antecedent) the consequent can be derived.⁹ Since such laws are considered as plausible because of their positive instantiations, the counterfactual conditional is connected to the evidence, if only indirectly, via the laws involved.

The above example admittedly concerns the residual case in which a historian can “borrow” from other disciplines the laws that ground the counterfactual conditional, and therefore make the counterfactual inference plausible. However, Bunzl insists, his defense of counterfactuals in history can be readily extended to cases in which no such laws are available. In these cases, Bunzl hastens to add, “considerations of rationality stand in for them” (ibid., p. 852). Here we shall not follow Bunzl’s discussion of such cases in depth. What needs to be emphasized is that on his account, when historians assess causal claims, they deploy the standards of judgment endorsed by their professional community; the very same standards are invoked, although “to a different purpose” (ibid., p. 855), when counterfactual claims are assessed. In short, there are various ways to ground counterfactuals, and one ought not to be misled by the fact that the laws and theories deployed by historians are, in most cases, “what philosophers call ‘folk theories’” (ibid.).¹⁰ The crucial point, Bunzl insists, is that sound counterfactuals can be grounded based on generalizations—very often low-level ones, and subject to exceptions—that express

⁸These remarks raise the well-known problems faced by the consequentialist approach to counterfactuals, such as, for instance, the delimitation of the set of background conditions, which Bunzl seems to sidestep. Here, however, we are not concerned with the viability of Bunzl’s avowal of counterfactual history; rather, we discuss it at some length because it is one of the most thorough attempts to spell out the solution to the problem of telling sound from unsound counterfactuals in the case of general history.

⁹This specific counterfactual explanation is rendered intuitively even more plausible by the fact that, when the bridge was reconstructed, it had a roadbed with four lanes, and it never suffered from the problems that led to the collapse of the first Tacoma Narrows bridge (Bunzl 2004, p. 851).

¹⁰This point was famously made by Hempel in his paper “The Function of General Laws in History” (1942).

our beliefs concerning how things go under normal circumstances, or in most cases, and therefore help us to assess how things would have gone, had some circumstances been different.

As hinted above, Bunzl's paper is only one of the contributions to the ongoing discussion on the identification of compelling counterfactual arguments. Unsurprisingly, champions of counterfactuals in history are not a school characterized by unanimity, and there is a continuing disagreement among them concerning how exactly one should spell out the insight concerning the connection between causal claims and counterfactuals. For instance, Nolan (2013, esp. Sect. 2) has challenged Tetlock and Belkin's (1996) and Lebow's (2000) characterization of such connection, and has insisted on the well-known difficulties faced by the consequentialist approach to counterfactuals deployed by Bunzl, as well as by the attempts to analyze causation in terms of counterfactuals.

There is, however, a crucial point of agreement, concerning the fact that the judgments that historians make when trying to ground a counterfactual claim are *continuous* with the ones that they make when trying to justify causal claims. As Nolan (2013, p. 329) put it:

Provided our ordinary competent reasoning about causation employs counterfactuals, and especially if it does so in a way that cannot be codified easily and is not by explicit algorithms, then a historian relying on that capacity should not also reject reasoning using counterfactuals, on pain of their principles not lining up with their practice. I think this is the best way to argue that the close links between causal and counterfactual judgments mean that historians interested in causation (and most, if not all, should be) should not reject a role for counterfactuals in historical reasoning.

To briefly sum up our discussion in the present section, defenders of counterfactuals in general history take them to be an essential ingredient of historical explanations. Despite their disagreements over the best way to characterize the connection between counterfactuals, causal claims, and historical explanations, and over the best way to tell sound counterfactual speculations from wild flights of fancy, advocates of counterfactuals in history maintain that contrary-to-fact speculations lend themselves to rational scrutiny. The crucial insight here is that, in order for this to happen, counterfactuals need to exhibit the right kind of *plausibility*: the historians' more or less "implicit sense of what is likely to have depended on what" (ibid., p. 328) allows them to discriminate between good and bad candidate counterfactuals. Therefore, although general, formal criteria for spotting sound counterfactual speculations are anything but easy to come by, the bottom line of the defense of counterfactuals in general history can be couched in terms of the *counterfactuals' consistency with what historians know about the world*. It is the historians' admittedly partial and imperfect knowledge of how the world works, and of how historical actors typically behave in this world, that allows them to recognize sound counterfactuals. As the examples discussed in the next section illustrate, the plausibility of the alternative scenarios is a crucial feature also in the case of counterfactual histories of science.

4 On the Uses of Counterfactual History of Science

Just like counterfactual speculations in general history, not all counterfactual histories of science are equal. For instance, they may greatly differ from one another with respect to the kind of divergences from the historical record that they postulate. One may imagine an alternative history in which Charles Darwin dies prematurely and is therefore unable to put forward the theory of evolution by natural selection, but one of his contemporaries—say, Alfred Russel Wallace—readily replaces him as the first proponent of the idea. This would certainly qualify as a counterfactual history of science, since as we know, *On the Origin of Species* was published in 1859 and Darwin died in 1882, aged 73, but in such a scenario, his premature death would be quite inconsequential for the trajectory followed by scientific inquiry. From the point of view of the inevitability versus contingency of science debate, a much more interesting counterfactual history would be one in which Darwin does not feature and his premature death does make a difference to the ensuing development of biology. Historian of science Peter J. Bowler has conjured up one such counterfactual history.

In *Darwin Deleted: Imagining a World Without Darwin* (2013), Bowler devises a counterfactual world characterized by the fact that Darwin prematurely dies in 1832. In Bowler’s narrative, however, none of the contemporaries comes up with the exact same idea: competing theories of evolution are put forward (as they were in actual history of science), but natural selection is not “in the air.” Natural selection, Bowler insists, “was by no means an inevitable expression of mid-nineteenth-century thought,” and in that historical moment only Darwin, by virtue of his unique, “right combination of interests” (*ibid.*, p. 31), could formulate it. In this Darwinless world,

it would have taken until the early twentieth century for the theory of natural selection to come to the attention of most biologists. Evolution would have emerged; *science would be composed by roughly the same battery of theories we have today, but the complex would have been assembled in a different way.* In our world, evolutionary developmental biology had to challenge the simpleminded gene-centered Darwinism of the 1960s to generate a more sophisticated paradigm. In the non-Darwinian world, the developmental model would have been dominant throughout and would have been modified to accommodate the idea of selection in mid-twentieth century (*ibid.*, p. 9, emphasis added).

It should be noted that Bowler is not particularly interested in the inevitability versus contingency of science debate as such: he openly admits that his investigations in counterfactual history of biology chiefly stem from the desire to defend Darwin’s theory by refuting “the claim that the theory of natural selection inspired the various forms of social Darwinism” (*ibid.*, p. 10). According to him, the crucial point that his counterfactual narrative helps to establish is that, had Darwin not published *On the Origin of Species*, “racism and various ideologies of individual and national struggle would have flourished just the same” (*ibid.*, pp. 10–11), their justification being derived from other theories of evolution. In any case, Bowler’s counterfactual history has a clear contingentist flavor: the alteration of the historical

record at a crucial juncture leads to a science that is (if only slightly) different from the one that we currently embrace.

For our present purposes, what matters is that Bowler's counterfactual history is not a wild, unrestrained flight of fancy. In this regard, he insists that "the viability of the counterfactual world can be substantiated by hard facts," since "we have enough evidence from our own world to show that the alternative could work" (*ibid.*, p. 30). Indeed, the historical record tells us what the rivals to natural selection were, and we know for a fact that such rivals were viable, since they were widely accepted by scientists before the triumph of Darwin's theory.

These remarks suggest that just like in general history, within history of science good counterfactual speculations need to exhibit the right kind of plausibility. In Bowler's case, decades of scholarly engagement with nineteenth century science provide the historian with in-depth knowledge of the institutional setting in which scientific inquiry was conducted, the evidence that was available to the scientific community, the alternatives to natural selection that researchers pursued, the personalities and the interests of the scientists involved, etc. Based on his extensive knowledge of the actual world, and his "sense of what is likely to have depended on what" (Nolan 2013, p. 328), Bowler can not only defend Darwin's theory, but also *explain* Darwin's uniqueness, making a strong case for the claim that had it not been for Darwin, natural selection would have entered the scene much later. In other words, Bowler created a very rich idealized explanatory model, in which a lot of relevant information is included. His Darwinless world is such that the elements featuring within the model are under the control of the researcher, who can therefore manipulate them in a fine-grained way, within the limits imposed by the constraint of plausibility. Needless to say, opinions differ concerning the acceptability of various aspects of Bowler's elaborate account of a world without Darwin.¹¹ Nevertheless, as Tetlock, Lebow, and Parker remarked, "not all counterfactual thought experiments are equally subjective and therefore equally speculative" (2006, p. 9); Bowler's book, it seems to us, nicely illustrates the point with respect to the case of counterfactual history of science.

In the introduction to the symposium entitled "Counterfactuals and the Historian of Science," published in *Isis*, Gregory Radick commented that "remarkably little systematic attention" (2008, p. 548) has been devoted to counterfactual history of science. More recently, Léna Soler remarked that "counterfactual thinking *about science*" and its history, as opposed to the use of counterfactuals within science, "remains an underdeveloped activity" (2015, p. 9). Our lengthy discussion in Sect. 3, together with the above summary of Bowler's ventures in a Darwinless world, ought to be viewed as an attempt to contribute, if modestly, to the most recent attempts to engage in such an activity.

To the best of our knowledge, only cursory remarks concerning the similarities between the use of counterfactuals in general history and the use of counterfactuals

¹¹See, e.g., the review symposium of *Darwin Deleted*, featuring Alan C. Love, Robert J. Richards, and Bowler himself (Love et al. 2015).

in history of science are to be found in the relevant literature. We should nevertheless mention that the first example of alternative history discussed in the present section, in which the explanatory role of counterfactuals is emphasized, is far from exhausting the range of uses to which counterfactual history of science has been put, both within and without the inevitability versus contingency of science debate.¹² Indeed, the examples discussed in the following make it clear that counterfactual history of science has often played *a critical, as opposed to an explanatory, role*, so that occasionally, the motive underlying the deployment of counterfactual histories of science has been an “if only,” instead of a “what if” question. Accordingly, alternative histories have been deployed not only in order to challenge the inevitability thesis and the interpretation of the success of scientific theories typically associated with it (that is, scientific realism, or at least some versions of it). As we shall see in a moment, alternative histories are also a tool used to criticize both the epistemic authority with which science is credited and the social order allegedly going hand in hand with it.

The works of some famous feminist scholars provide examples of this latter use. In *The Death of Nature* (1980), historian Carolyn Merchant has claimed that, had the social milieu in which Western science emerged been different, the ensuing trajectory followed by scientific inquiry would have been significantly different. Her work may therefore be viewed as providing a historical backing to the claims put forward by physicist Evelyn Fox Keller, who in a number of papers collected in *Reflections on Gender and Science* forcefully argued that “were more women to engage in science, a different science might emerge” (Keller 1985, p. 76).¹³

Within an analysis of the attitudes towards counterfactuals characterizing historians of science of different philosophical persuasions, John Henry has discussed the case of such “sweeping changes” (2008, p. 557) as a cultural background completely different from that in which Western science arose and developed. In Henry’s view, despite the efforts of Fox Keller, Merchant, and other feminist historians and philosophers of science, “it is by no means clear what [the] alternative, and supposedly very different, feminist science would look like” (2008, pp. 558–559). Henry hastens to add that this does not reflect on the central claims of their philosophical agendas, which do not stand or fall with the soundness of counterfactual speculations. Whatever the case, for our present purposes it is important to emphasize that when counterfactual history of science is deployed in a critical role, the counterfactual scenario needs to exhibit the same kind of plausibility that is required when counterfactual history of science is used, as in the *Darwin Deleted* example discussed above, for explanatory purposes. As Soler put it, “what confers plausibility to a counterfactual scientific narrative is its ‘close connection’ to the actual history of science” (2015, p. 10).

¹²I wish to thank two anonymous reviewers for pressing me to address this issue.

¹³Admittedly, neither Fox Keller nor Merchant explicitly deploy full-blown counterfactual narratives, which they nevertheless plainly evoke.

The notion of “close connection” is of course vague, and different authors disagree on the plausibility of specific instances of counterfactual history of science. In any case, when wide-ranging differences—such as a completely different cultural background—between the actual historical record and the counterfactual narrative are postulated, the resulting scenario is very likely to be impervious to assessments concerning its plausibility (on this, see among others Kinzel 2015, p. 61). For instance, one may ask whether a science emerging from a set of completely different initial conditions would be an investigation of roughly the same phenomena that constitute the subject matter of our current science. In fact, in order for an alternative to our science to qualify as an alternative, it has to deal with the same material with which our science deals: as Trizio vividly put it, “there is little epistemological interest in comparing what our science says about planets with what one might have ended up thinking about viruses” (2015, p. 130). Given a very different developmental history, it is certainly legitimate to postulate a very different outcome, but it is of crucial importance being able to specify, exactly, different in what respects. Wide-ranging differences in the initial conditions make it very difficult to speculate on the trajectory that an alternative science would follow, and such alternative may well end up being simply incommensurable with our current science.

To put the point differently, we may say that wide-ranging differences such as those postulated by Merchant often lead to underdescribed idealized models. In a well-designed idealized model, the researcher can control the elements constituting it, which lend themselves to a fine-grained manipulation allowing one to study their relationships. When wide-ranging differences in the initial conditions are postulated, and the model is not supplemented with relevant information constraining it, at most coarse-grained manipulations of the elements within the model are possible, so that the researcher’s control over it is relinquished. Compare such cases with the scenario conjured up in *Darwin Deleted*. In Bowler’s model, every other element being equal and under the control of the researcher, Darwin’s premature death leads to a counterfactual scenario whose plausibility can be assessed, due to the fact that it is constrained by relevant information, that is, the historian’s knowledge of a specific phase of the history of biology. As the reader will recall, the continuity between counterfactual scenarios and what historians know about the world is the bottom line of the defense of counterfactuals within general history. Analogously, the plausibility of a counterfactual history of science can be characterized in terms of its continuity with what historians know about the world. Such continuity, we suggest, is quite difficult to attain in the case of underdescribed idealized models.

Coming now back more specifically to the inevitability versus contingency of science debate, it is far from surprising that counterfactual history of science has been repeatedly used in order to challenge scientific realism. Perhaps the first author to discuss at some length the connections between the various positions that, in principle, can be defended within the debate, Radick has shown that the two couples inevitabilism-realism and contingentism-antirealism “by no means exhaust” (2005, p. 24) the space of possibilities. In a similar vein, Howard Sankey has argued that “scientific realism has no evident implications with regard to the inevitability of

science” (2008, p. 259). Nevertheless, it is a fact that realists tend to group around the inevitability thesis, while antirealists tend to favor the contingency thesis. Indeed, one of the most celebrated examples of history of science emphasizing contingency, James Cushing’s *Quantum Mechanics. Historical Contingency and the Copenhagen Interpretation* (1994), to which we shall now briefly turn, has a distinctively antirealist flavor.

Famously, in 1952 physicist David Bohm put forward a version of quantum mechanics which, empirically equivalent to the so-called “Copenhagen interpretation”—since the 1920s, the standard version of the theory—is nevertheless incompatible with it from the ontological point of view. According to Cushing, given that the two versions of the theory make the same predictions, the fact that the Copenhagen interpretation became the standard version of quantum mechanics crucially depends on the vagaries of historical development. In fact, based on a detailed examination of the relevant period of the history of physics, Cushing claims that Bohm’s version of the theory may well have been devised during the 1920s. However, nobody came up with it at the right point in time, and consequently, the Copenhagen interpretation acquired its status of a standard irrespectively of the merits of Bohmian mechanics, which came to the scene much too late to ever manage to win a comparable support among physicists. In Cushing’s reconstruction, then, the order in which ideas are introduced within a scientific debate can decisively influence its outcome: had Bohm’s version of the theory come first, history might have unfolded differently, and today the majority of scientists may well be championing Bohmian mechanics as their favorite interpretation of quantum mechanics.

Cushing’s narrative, revolving around the role of historical contingency, exhibits an immediate connection to a classic argument against scientific realism, namely, the underdetermination thesis: two competing theories are empirically indistinguishable, and yet posit incompatible underlying ontologies, so that one is left wondering which one of them is true. Besides such connection with the dispute over the merits of realism, what makes Cushing’s work of particular interest for the inevitability versus contingency debate is that, as Trizio (2015, p. 129) points out, his case for the possible triumph of Bohm’s interpretation of quantum mechanics satisfies a number of demanding constraints, which ensure the plausibility of the counterfactual scenario. First of all, the subject matter dealt with by the theory prevailing in the alternative history of science is the same as that dealt with by the actually prevailing theory. Secondly, Bohm’s interpretation of quantum mechanics is as successful as the Copenhagen interpretation. Thirdly, there is a fundamental, irreconcilable disagreement between the two theories. Not unlike Bowler, Cushing created a very rich idealized model, in which a lot of relevant information, providing the necessary constraints on the counterfactual scenario, is included. The crucial element within the model—“the temporal order of events that actually took place in the mind of a handful of researchers” (ibid, p. 134)—is clearly under the control of the historian, and can be manipulated in a fine-grained manner. This counterfactual narrative therefore provides a very effective way to defend the contingency thesis, and to argue that the path followed by scientific inquiry can be

influenced by a variety of factors, including the theoretical idiosyncrasies of the researchers involved in the development of a specific field.

Counterfactual history of science covers an extended and uneven territory. Such territory borders on the one side with actual history of science and on the other side with merely logical possibilities, and includes “scenarios that would only slightly differ from our actual history of science, and more creative science fiction (for instance involving twin-earth-like planets or alien beings as the subjects of science)” (Soler 2015, p. 10). As our discussion illustrates, the same kind of plausibility that characterizes good counterfactual speculations within general history will be of great help in navigating the territory of counterfactual history of science.

5 Concluding Remarks

In this paper, we suggested that the plausibility of the devised alternative scenarios is as important in the defense of counterfactual history of science as it is in the defense of counterfactuals within general history. Nevertheless, at least one worry raised by counterfactual history of science as used to support the contingency thesis needs to be briefly mentioned here.

The issue can be introduced by considering Ian Hasketh’s (2014) thoughtful review of Bowler’s book. In the opening chapter of *Darwin Deleted*, Bowler argues that the contingency of the past means that apparently irrelevant events may lead to unintended, unpredictable, and wide-ranging consequences, and explicitly refers to Gould’s claim that, were it possible to replay the tape of life, the outcome would very likely be completely different, due to the intervening contingencies affecting evolutionary history. Nevertheless, Hasketh points out, “there is nothing entirely random or unpredictable or accidental” (ibid., p. 301) in how the events in Bowler’s counterfactual history unfold, except for Darwin’s premature death, after which no further contingencies play a role within the narrative. Bowler himself suggests that his story “follows a more natural sequence of discovery” (2013, p. 279) than that followed by actual history of science, which was “disturbed” by the appearance of Darwin’s theory of natural selection.¹⁴ In brief, Bowler’s narrative ends up with a science that is slightly different from ours, but in which natural selection *does* feature. However, as Hasketh remarks, if contingency is taken seriously, then it cannot be used at the beginning of the counterfactual history and ignored at later stages of development: “a truly contingent narrative can only follow a definable course until the next contingency arises” (2014, p. 302; on this, see also Ben-Menahem 1997).

It seems to us that Hasketh’s remark generalizes and, as historian Allan Megill nicely put it, “contingency is not a train one can get on and off at will” (quoted in

¹⁴A short paper by Bowler, anticipating the themes of the book, is tellingly entitled: “What Darwin Disturbed. The Biology that Might Have Been” (2008).

Hasketh 2014, p. 302). In other words, contingency may well end up with undermining counterfactual history of science as used to support the contingency thesis. In fact, after the first alteration in the historical record is introduced, why should one believe that there will be no further alterations, leading the resulting narrative farther and farther away from the historical record? This possibility may be viewed as completely unproblematic, since it is precisely the hardcore of contingentism. Nevertheless, such possibility should worry contingentists wishing to use counterfactual history of science to defend the contingency thesis. In fact, the farther one gets from the historical record, the more difficult it becomes to constrain the counterfactual scenario in such a way as to ensure its plausibility. When contingency is embraced, how can one rule out narratives leading to scenarios that cannot be rationally assessed?

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