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Nature and history : towards a hermeneutic philosophy of historiography of science

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Citation

Bouterse, J. (2016, February 25). *Nature and history : towards a hermeneutic philosophy of historiography of science*. Retrieved from <https://hdl.handle.net/1887/38041>

Version: Corrected Publisher's Version

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Note: To cite this publication please use the final published version (if applicable).

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Title: Nature and history : towards a hermeneutic philosophy of historiography of science

Issue Date: 2016-02-25

Chapter 2: Contingentism and Inevitabilism in History of Science

2.1 The Question

A major question that, in one form or another, occupies scholars of scientific change is whether the actual history they study is the only possible one, or whether different histories were possible.⁴⁰ This question is often seen through the prism of the debate about contingency and inevitability in the history of science.

My aim in this chapter is to reflect upon the meaning of this question specifically within the context of a philosophy of historiography of science, which means that somewhat different considerations come into play than discussions of this question within the context of philosophy of science. Notably, one traditional problem immediately retreats from focus, namely the question whether an alternative development of science could have led to something as epistemically *successful* as actual science – which in Ian Hacking’s classical formulation of the contingentism-inevitabilism polarity and most authoritative later discussions is the main question.⁴¹

My premise is that historians of science are interested not primarily in judging epistemic success, but in explaining why science developed as it did. This does not mean that questions about objectivity or justification can be avoided in this explanation, but it means that they are not what is at stake at the outset. Our question is in what sense it is possible to say that science could have developed differently, not in what sense it is possible to say that a different science could have been as successful as actual science. This may seem like dodging precisely the philosophically interesting questions – everybody can easily imagine much less sophisticated alternatives to the current state of knowledge to have occurred, for example if external factors had made sure that human civilization never left the bronze age.⁴² However, I want to show that this question can be understood in such a way that we can align different historiographical approaches to different answers to it.

In particular, I will argue that inevitabilist positions have a strong affinity with the idea that the content of science can be explained only by reference to the world that science itself seeks to describe and explain.

⁴⁰ E.g. Hull (1988, 2).

⁴¹ Hacking (2000a, 58-61); Soler (2008a; 2008b, 230-231).

⁴² Martin (2013, 925); Fuller (2011, 568).

2.2 Contingency and Indeterminacy

As a first step, we need to realize that what is at stake in the contingentism-inevitabilism debate cannot be captured in terms of the distinction between indeterminism and determinism, and is in fact almost completely independent of it.⁴³ One can be an inevitabilist while adhering to some kind of indeterminism, or a contingentist while holding fast to the regulative ideal of determinism.⁴⁴

Of course, this means that contingentism is not by definition identical to indeterminism or inevitabilism to determinism.⁴⁵ By determinism I mean the belief that any state of reality is compatible with only one state of reality at a later time.⁴⁶ Indeterminism is a denial of this; the belief that at least some states of reality are compatible with multiple states at some later time. Graphically represented:⁴⁷

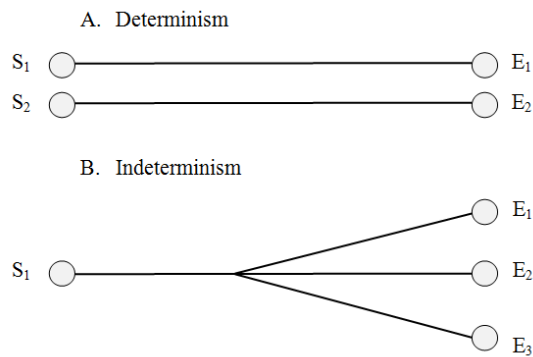


Figure 1: Determinism versus indeterminism

In the deterministic set of worlds A, being on a point on a timeline means inevitably to be on a specific other point later; different outcomes require different conditions. In the indeterministic world B, different outcomes are compatible with the same starting point.

Now, for our current purposes it is crucial that we may be interested in other aspects of possible timelines than their determinacy. Notably, we may be interested in

⁴³ Contrary to Martin (2013, 926), who sees indeterminism as a strong version of what he calls unpredictability contingency.

⁴⁴ Cf. Adcock (2007); see also Nagel (1960) on determinism as a regulative principle for science, including history, and Loewer (2008, esp. 331-334) for a critical evaluation of the idea that determinism has become obsolete because of quantum mechanics.

⁴⁵ Ben-Menahem 2009.

⁴⁶ Cf. Dennett (2003, 25). This definition is less strict than that of Earman (1986, 12-14), who says that those worlds are deterministic which are identical at any time, are identical at all times.

⁴⁷ In the timelines used as illustration here, the horizontal dimension represents time; the vertical dimension indicates likeness – that is to say, points that coincide in time differ more when they are further away from each other. This particular illustration is practically identical to that in Beatty (2006, 340).

whether possible timelines converge or diverge from each other. Figure 2 represents two qualitatively different but both deterministic sets of timelines:

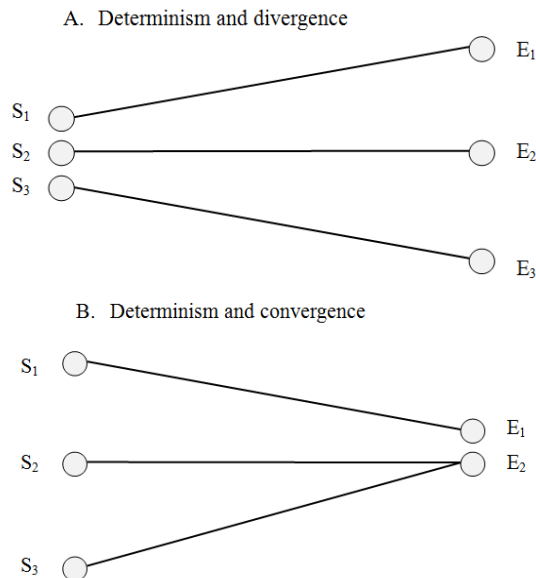


Figure 2: Divergence and convergence in deterministic sets of worlds

In the set of possible timelines A, end-states are more sensitive to the initial conditions than in the set of possible timelines B. Even if from the perspective of one timeline, things are as inevitable in A as in B, doing counterfactual history in set A will lead to different conclusions than in set B: in A, after all, a slight difference in initial conditions would have led to a comparatively large difference in end-states, and in B it is the other way round. (I consider leading to identical situations to be an option as well.)⁴⁸

In one indeterministic world, possible timelines are bound to diverge at some point – because they are identical in the beginning and non-identical later – but it is conceivable both that they will converge again, and that they will diverge further from each other (figure 3):

⁴⁸ Ben-Menahem (2009) defines contingency in this way, in terms of sensitivity to initial conditions.

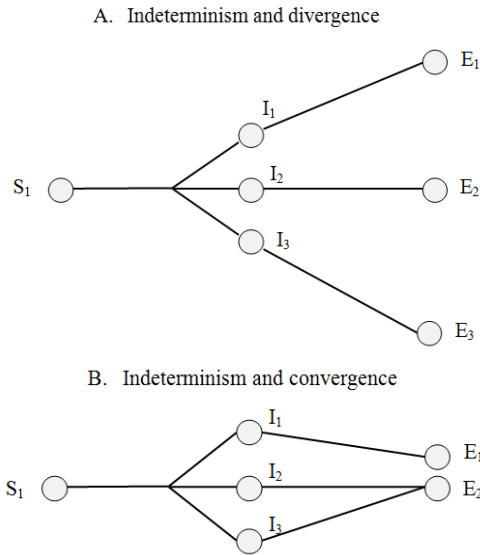


Figure 3: indeterministic divergence and convergence

When we ask the question whether we were bound to end up where now are, we are not asking whether we live in an indeterministic world, but whether the causal processes in our world work in such a way that all or most of the different path that were possible converge towards where we actually ended up.

2.3 Contingency as Path-Dependent Historical Possibility

Next, we need to see that we can meaningfully talk about historical possibility not only in indeterministic worlds, but in deterministic worlds as well. In a deterministic world, after all, there is objectively no possibility: even if the Laplacian demon could give a true answer to the question what would have been different if a certain aspect of the initial situation had been different, he cannot convince himself that things actually could have been different. Historians usually want their counterfactuals to depend not on hypothetical miracles but on what I will call ‘historical possibilities’.⁴⁹ It may seem that these exist only in indeterministic worlds.

However, it is important here that we differ from the Laplacian demon in that our knowledge of causally relevant factors in history is always finite, and all our claims concerning them are inherently dependent on abstraction and selection. Many of our knowledge claims are compatible with a multitude of states of reality, and span a range of relatively close possible worlds.⁵⁰ For instance, our knowledge of the macroscopic fact that there was an assassination attempt on an Austro-Hungarian archduke in 1914 does not fix

⁴⁹ Cf. Reiss (2009, 718-722); for history of science, French (2008, e.g. 575).

⁵⁰ Cf. also Berry (2009).

precisely which world we live in, and it is therefore itself consistent with multiple different outcomes – importantly, both survival and death of the victim.

It may be that deterministic worlds that were close to each other at this point (to the point that they are hardly distinguishable) have diverged further apart from each other depending on the outcome of this assassination attempt.⁵¹ That is, we can believe both that we live in a deterministic world and that it is meaningful to state that Franz Ferdinand could have survived and the First World War might have been avoided.⁵² We can equally well believe that the First World War was both determined *and* inevitable in this stronger sense – it also happened in close worlds in which Franz Ferdinand did not die.

I define contingentism and inevitabilism as theses about the extent to which historically possible alternative paths in history diverge or converge. ‘Historical possibility’ here means that the occurrence of an alternative is not forbidden by what is implied by our historical descriptions – thus, for instance, survival of Franz Ferdinand on 28 June 1914 is not forbidden by the fact that he was the victim of an assassination attempt on that day. On the other hand, the fact that Franz Ferdinand did die forbids that he could lead the Austrian-Hungarian armies in the First World War. Whatever is forbidden by some historical knowledge in combination with background knowledge is an anachronism with respect to that knowledge (see section 3.3), what is not forbidden by this knowledge is historically possible.

Historical possibility and the corresponding notion of anachronism are distinguished from other kinds of possibility by the fact that its boundaries are dependent on historical time and place. Caesar both crossing the Rubicon at a given moment in 49BC and not crossing the Rubicon then is impossible, but it is a logical impossibility. Caesar flying over the Rubicon by his own strength is a biological or physical impossibility – that is, it is forbidden by our knowledge of the physical environment and the human body, not by our knowledge of the specific context of ancient Rome. Caesar wearing a watch is logically and physically possible: there is nothing we know about watches that implies that they could not function in 49BC, or be worn by Caesar. However, it is forbidden by our knowledge of a specific time and context, namely that of ancient Rome.

The convergence and divergence of historically possible paths can be related to the notion of path dependence, a term used in economics to denote processes whose dynamics do not guarantee convergence to a “unique, globally stable equilibrium configuration”;⁵³ processes, that is, to which “history matters”.⁵⁴

⁵¹ Loewer (2008, 334-336)

⁵² Cf. Dennett (1984) on the difference between deterministic and fatalistic worlds; cf. also Taylor and Dennett (2002) and Dennett (2003, 63-95, which also contains another assassination-related example).

⁵³ David (2007, 97).

⁵⁴ David (2007, 92). See Vergne (2010) on the relation between path dependence and randomness.

There are some connotations to the usage of this term in economic discourse that I should want to avoid. First, its usual relation to lack of change.⁵⁵ I assume that science is subject to historical processes of change in any historically possible scenario. Second, its association with notions of efficiency; mechanisms of path dependence, such as increasing returns or lock-in, explain why sub-optimal institutions survive.⁵⁶ Setting aside the question whether this is useful even in economics,⁵⁷ it is hard to translate this aspect of path dependence to history of science, not just in practice but in principle: it presupposes that we can assess the relative efficiency of our existing science and a possible alternative. Whereas we can, in principle, assess this difference when it comes to technologies actually in use and their conceivable alternatives, it seems paradoxical to do so for our systems of knowledge. For instance, even if we believe that it was possible for phlogiston theory to have developed into a (in some sense that would need to be specified) more efficient chemistry than Lavoisier's chemistry, it is paradoxical to agree upon the superiority of the alternative without adopting it.⁵⁸

Taking this into account, the notion of path dependence is very useful: it awakens us to the possibility that the likelihood of something happening is influenced by what happens before.⁵⁹ It seems to me that a general contingency thesis with respect to the history of science is well described as the belief that the likelihood of particular later stages in the history of science depends to a large extent upon things that happened before that could well have gone otherwise, so that the content of science in the year 2065 is much more fixed now (in 2015) than it was in 1915, for instance, since a lot of alternative diverging paths that were still possible in 1915 have not been taken. As John Beatty and Isabel Carrera write, "when a particular future depends on a particular past that was not bound to happen, but did, history matters."⁶⁰

The inevitabilist, on the other hand, believes that there were no or relatively few historically possible alternatives in 1915 that would not have converged to roughly our current state by now – either because very few alternatives were historically possible, or because the dynamics of science leads these alternatives to converge in the end.

⁵⁵ Boas (2007, 35-37); Crouch and Farrell (2004, 5-6).

⁵⁶ Page (2006, 90); Boas (2007, 35-37); Crouch and Farrell (2004, 5-6).

⁵⁷ For an insightful criticism of this (esp. concerning the relationship drawn between path dependence and market failure by Liebowitz and Margolis (1995), who on the basis of this relationship claim that there can be no path dependence in economics) see David (2000, 8-12). Cf. Boas (2007, 38n8) on path dependence in political science.

⁵⁸ Chang (2012, 42-50, 62-65). Chang claims that phlogiston theory has been prematurely abandoned and its survival would have 'accelerated' developments in chemistry and physics (65). Consistent with what I am claiming here, Chang goes on to argue that phlogiston theory is and ought to be a part of modern chemistry as well. Cf. also Stanford (2006, 3-26) on unconceived alternatives.

⁵⁹ Crouch and Farrell (2004, 12).

⁶⁰ Beatty and Carrera (2011, 495).

2.4 Contingency, Historical Explanation, and the World

This distinction between contingentism and inevitabilism leads us to a hypothesis concerning the different status they will ascribe to the external world. If the inevitabilist maintains that historical developments do not make a difference to the content of science, she will most likely claim that this content is in the end decided by the world outside history. The contingentist, on the other hand, will usually say that the makeup of nature does not fix the eventual content of science, but that additional *explanantes* are needed, contingent upon histories that could have been otherwise.

This means that there is no necessary trade-off between contingency and explicability, as there is between indeterminacy and explicability. Contingentism in history of science is rather a statement about the insufficiency of *ahistorical* explanations: saying that the development of the concept of quarks is contingent means that an ahistorical explanation, such as the actual existence of quarks in nature, does not suffice, for there is a lot of relevant historical knowledge consistent with the existence of quarks under which it is possible that science would not come to contain quark physics.⁶¹ The inevitabilist would make the opposing claim that all or almost all worlds that contain quarks and modern physics will eventually contain a quark concept. Importantly, neither the inevitabilist nor the contingentist needs to believe that the concept of quark is not determined; they disagree only about what it is determined by.

I will illustrate this interpretation of the contingency-inevitability polarity by a few historiographical examples. When Bruno Latour seeks to understand how Pasteur and the Pasteurians were accepted, he says that “the first rule of method common to history and the sociology of science is to convince ourselves that this was not necessary.”⁶² He elaborates:

it might have been said – it ought to have been said – that this handful of scientists was precisely no more than a handful. It might – and ought – to have been said that they were ‘only theoreticians shut away in their laboratories, without contact with the outside world.’ This was not said. Why?⁶³

Latour says here that it was not inevitable that Pasteurianism was accepted; it could have been ignored. He goes on to provide an extensive account of the groups that Pasteur was able to enlist thanks to his various movements, and of his ability thereby to involve larger movements in his own. Latour’s denial of inevitability does not amount to a denial of explicability; he seems to claim not that Pasteur’s success was not *determined*, but rather that

⁶¹ There are, of course, other points of departure conceivable than a belief in quarks: a belief in the non-existence of quarks for example, agnosticism about quarks, or the opinion that the question of the existence or non-existence of quarks is meaningless. The point here is that *even* if one assents to the existence of quarks, these quarks do not necessarily and sufficiently explain the existence of belief in quarks.

⁶² Latour (1993b, 61).

⁶³ Latour (1993b, 61).

it was not *inevitably* linked to the content of Pasteurianism. It was possible for the history of science to look differently even after Pasteur's doctrines were conceived of, and recognizing this is important because it creates room for all the other factors involved in the success of Pasteurianism.

Jim Endersby, in a study of the Victorian Darwinian Joseph Hooker, says that:

once we examine the details of Hooker's career and compare them with those of his contemporaries, it becomes clear that there was nothing inevitable about the changes he participated in. [...] I shall also show that there was nothing predictable about Hooker's embrace of Darwinism, which was supposedly the common, secularizing ideology of the scientific professionalizers. Indeed, I shall argue that Hooker's acceptance of Darwinism was more complex and ambiguous than has hitherto been recognized.⁶⁴

Here, too, the denial of inevitability is not a denial of determinacy, but a rhetorical move to make room for additional *explanantes*, by saying that straightforward, law-like relations between phenomena (for instance, between scientific professionalizers and Darwinism) actually disappear in the complexity of the historical narrative.⁶⁵

I will zoom in closer on my last example: Steven Shapin and Simon Schaffer's declaration in *Leviathan and the air-pump* that:

we want to show that there was nothing self-evident or inevitable about the series of historical judgments which yielded a natural philosophical consensus in favour of the experimental programme⁶⁶

Shapin and Schaffer, too, continue with a book-long account that in the end leaves the reader with the satisfied feeling that the triumph of experimental science actually falls comfortably within the limited range of outcomes consistent with the social and political context of Restoration England. They certainly do not want to claim that this constellation randomly favored Boyle's natural philosophy rather than Hobbes, and they sum up their beliefs in quite deterministic language in the final chapter: "he who has the most, and the most powerful, allies wins."⁶⁷

The point is not that Boyle's triumph is inexplicable, but that there is no ahistorical entity or fact such as the possibility of a vacuum which by itself determined the outcome of the debate. The allies that Boyle had, and his assumed rightness, must themselves be considered to be historical products.⁶⁸ Boyle's victory is determined – thus inevitable – in a world in which we take into account all the forces that were in play in Restoration England,

⁶⁴ Endersby (2008, 5-6).

⁶⁵ Cf. also Kracauer (1969, 27-44).

⁶⁶ Shapin and Schaffer (1985, 13).

⁶⁷ Shapin and Schaffer (1985, 243).

⁶⁸ Shapin and Schaffer (1985, 14).

but this polity could have been different; and the fact that the fate of Boyle's science depended on that polity and not (just) on nature means that it is right to say that it was not historically inevitable.

I hope to have done justice to what Shapin and Schaffer are saying while rephrasing their thesis to fit my definition of contingentism and inevitabilism in the history of science. It seems to me that they are committed to the statement that things could have been different now, in the sense that a chain of historically possible events exists (starting from the 17th century) which leads to a significantly different science which looks less like Boyle's. Inevitabilists are committed to the inverse statement, that there is no chain of historically possible events that would have led to a significantly different science in the end. The crucial semantic issue in each individual case is what counts as 'historically possible' (and as 'significantly different'); the crucial substantive issue is whether anything that could be agreed to be historically possible would indeed have led to a significantly different science.

We have not established that inevitabilism can be grounded only by the external world (we will discuss this further in chapter 4), but controversy about historical possibility and the divergence and convergence of possible histories will inescapably involve questions about the causal importance of different factors in history. Contingency claims are made with this rhetorical goal in mind: to show the insufficiency of other explanations, and replace these by a superior one.⁶⁹ Thus, the causal role of the world in history of science is of direct relevance for the contingency-inevitability polarity.

2.4 The Special Position of History of Science

Historians usually work with macroscopic, culture-laden entities and facts – such as Austro-Hungarian archdukes and assassination attempts – whose interrelations display a large measure of subjective indeterminacy. Though they can usually readily admit the influence of non-cultural 'natural' factors, there are reasons why this may be more complicated in the case of history of science.

Often, descriptions of historical events in terms other than those of mainstream general history do not compete with this history for explanatory relevance: for instance, we can zoom in on the medical details of the assault on Franz Ferdinand without thereby jeopardizing the possibility to attribute his death to social, political or ideological causes. In this case, medical and political-historical explanations do not compete. In other cases, they may compete; for example, Jared Diamond's claim that (among other things) diseases to which European conquerors were but American indigenous peoples were not immune explain Western dominance in the modern era is made in explicit competition with cultural explanations of Western dominance.⁷⁰

⁶⁹ On this, see Henry (2008) and Sankey (2008) – Sankey believes that inevitabilism and realism are strongly connected.

⁷⁰ Diamond (2005, 405-425).

In addition to this, the historiography of science has a specific problem that other branches of history do not, because it studies specific cultural entities, which are supposed to have a necessary relation to certain natural entities. Usually, historical contingentism as defined above is not in opposition to scientific claims that there are known necessary relations between the entities that populate our universe. However, a tension arises if we claim that our knowledge of those necessary relations is contingent. After all, the following three claims cannot all be true:

- [1] Scientific theories are historical entities
- [2] Historical entities are historically contingent
- [3] Scientific theories have a uniform and necessary relation to the non-historically contingent things they describe.

One way to solve this is to deny [1]: to deny that scientific theories are genuinely historical entities in the sense implied by [2]. This is the position that Steven Weinberg takes, when he says that the laws of nature as known by science are:

culture-free and they are permanent [...] in their final form, in which cultural influences are refined away. I will even use the dangerous words ‘nothing but’: aside from inessentials like the mathematical notation we use, the laws of physics as we understand them now are nothing but a description of reality.⁷¹

Based on his view that science reflects the world, Weinberg’s view of physics in particular is highly inevitabilist: he believes that physics

is moving toward a fixed point [...] a theory that, when finally reached, will be a permanent part of our knowledge of the world. Then our work as elementary particle physicists is done, and will become nothing but history.⁷²

This confirms that a plausible argument for the inevitabilist is to say that there is a necessary relation between a feature of nature and a feature of some cultural products (namely finished science), while the contingentist will have to maintain that this relation is path-dependent.

I want to emphasize that I consider the inevitabilist position to be a logically valid one. It is not clear to me, however, how scientific theories can pass from a culture-laden to a culture-free state; how cultural influences are ‘refined away’ (we will discuss Weinberg further in section 3.2). Contrary to Weinberg, I see no reason not to regard scientific theories as cultural products, but their being cultural does not itself preclude their being determined partly (and even significantly) by nature.

⁷¹ Weinberg (1996, 136).

⁷² Weinberg (1996, 137).

There is not even necessarily a question of truth here: a definite truth-relation is only one of the ways in which the world may determine the shape of cultural products, and moreover, there may be multiple non-contradicting and true theories about this world. Inversely, natural phenomena may be necessary causes of some untrue beliefs. Most importantly, it is unclear where 'truth' enters the chain of causality leading to scientific theories, except as a principle or value in the minds of the scientists.

I repeat that historiographically speaking, the interesting question is not whether scientific theories are true or justified or whether different ones could have been as true or justified. Rather, it is about the ways in which nature plays a *causal* role in determining the cultural products that are scientific theories. Can these products be simply reduced to nature (which would imply commitment to [3] and to inevitabilism), are they determined by something other than nature (which means rejecting [3] and creating space for contingentism), or is there some kind of complex interplay, and if so, is there any identifiable pattern in the way nature plays its part in this interplay? Can the world 'resist' certain scientific theories under certain circumstances, and how?⁷³

Conceptualizing the ways in which the world or nature may co-determine some cultural products is a legitimate question for history of science. This, however, requires the conceptual space that this chapter has sought to make. Importantly, it requires the recognition that contingentism – the legitimate default position for historians, since it maximizes the importance of historical knowledge – does not imply that nature cannot be a necessary cause of a certain scientific theory.

⁷³ Trizio (2008, 253-256) observes that there are several histories of geographical discoveries conceivable but that given the actual distribution of land over the globe, the results of these histories still (in a certain sense inevitably) tend to converge. He asks the question whether the same would hold for high-level hypotheses and theories in physics, and if not, what the differences are that point to contingentism in those areas – for example, that geographical discoverers did not create a new ontology but only added individual entities.

2.6 Conclusions

The two main points argued in this chapter are:

- 1) Controversies between contingentism and inevitabilism in history of science are best understood as different views on the extent to which historically possible alternative paths tend to converge towards similar or identical later states. Contingentists believe that science is relatively path dependent, whereas inevitabilists believe it is not.
- 2) Inevitabilism has an affinity with the view that the content of science is eventually explained only by what the world is like.

Chapter 4 continues the second point. The relation between contingentism and the role the world can play in our historical explanations is much more complicated, since it involves both the causal question what precisely the role of the world is, and the question whether our beliefs about nature can shed light at all upon possible histories that do not contain those beliefs.