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Essay review

Counterfactuals, causes and contingency in the history of science

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Darwin deleted, Peter Bowler. University of Chicago Press, Chicago, IL (2013). pp. 318, Price $30.00 cloth, ISBN: 9780226068671

Science as it could have been: Discussing the contingency/inevitability problem, Lena Soler, Emiliano Trizio, Andrew Pickering. University of Pittsburgh Press, Pittsburgh, PA (2015). pp. 472, Price $61.95 hardcover, ISBN: 9780822944454

Suppose that Charles Darwin had not written *On the Origin of Species*. Suppose that he had not been there to write it because on the voyage with the *Beagle*, he had gone overboard in a storm and drowned. In this scenario, would the history of evolutionary theory have looked anything like the actual history that we know? Would the concept of evolution by natural selection have emerged nevertheless? Or would thinking about evolution have taken a radically different path? Is the history of science contingent?

In *Darwin Deleted*, historian of science Peter Bowler sets out to answer these questions. He presents a counterfactual narrative of evolutionism from the mid-nineteenth to the early twentieth century, identifying Darwin as one of the "nodal points" in history at which a seemingly minor change of events could have set off an alternative trajectory. He describes the landscape of evolutionary thinking that would have emerged without Darwin, explores what shape the conflict between science and religion would have taken, and reflects on the relations between evolutionary thinking and the ideologies of social Darwinism, racism and the eugenics movement in both the actual and the counterfactual world. Bowler's narrative depicts both contingent and inevitable developments. It identifies those areas of scientific discourse where Darwin's absence would have made a difference, and those where it would have not.

But Bowler's understanding of the concepts of "contingency" and "inevitability" is slightly different from what most philosophers of science seem to have in mind when using these terms. *Science as it could have been* — edited by Léna Soler, Emiliano Trizio and Andrew Pickering — is the most comprehensive publication on the problem of contingency in science to date, and as such, it serves well to gauge philosophical opinions on the matter. The volume seeks not only to provide an overview of the current state of the debate, but also to clarify the central concepts and arguments involved.

In what follows, I bring together the philosophical discussion about contingency, and the counterfactual approach taken by Bowler. First, I describe the "comparative approach" to contingency taken by many philosophers of science. On this basis, I highlight differences to Bowler's historical concerns. I then show that Bowler, as well as some contributors to *Science as it could have been*, think of contingency and inevitability not in comparative, but in causal terms. I indicate how the "comparative" and the "causal approach" can be brought together and conclude with some reflections about the strengths and weaknesses of counterfactual histories à la Bowler.

1. The comparative approach

Science as it could have been assembles a plurality of philosophical perspectives and voices on the question of contingency in science. The contributions investigate the problem as it arises in various scientific disciplines, among them mathematics, physics, geology, and psychology. They situate the contingency issue with respect to related and often better-known philosophical debates and topics, such as scientific realism, social constructivism, scientific pluralism, experimental practices, natural laws, and ontology. They also offer sometimes diverging attempts to clarify the main concepts and positions. The plurality of approaches assembled in the book makes it somewhat difficult to find common ground between them. In this review, I focus on contributions that resonate well with Bowler's work, either because of stark differences from, or similarities to, his approach.

I begin with two contributions that provide a particularly clear understanding of what is at stake when philosophers of science argue about contingency. Léna Soler's dialogical reconstruction of "contingentist" and "inevitabilist" arguments (Chapter 1), and

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Emiliano Trizio's reflections on "contingentism" and scientific realism (Chapter 4). Both take as their starting point, Ian Hacking, who had described the question to which contingentists and inevitabilists give conflicting answers in the following way:

> If the results R of a scientific investigation are correct, would any investigation of roughly the same subject matter, if successful, at least implicitly contain or imply the same results? (Hacking, 2000, 61).

While the inevitabilist gives a positive answer, the contingentist holds that "there could be alternative non-equivalent but equally successful sciences" that yield results different from those of actual science (Hacking, 2000, 64). This way of delineating the positions at stake involves an act of imaginative comparison. I therefore call it the "comparative approach" to contingency. The basic move is to imagine a radically different alternative science and to compare it to our actual science. The contingentist, but not the inevitabilist, is willing to imagine this alternative science performing as successfully as our own.

Soler clearly thinks in comparative terms when analysing how the dialogical dynamics that unfold in the conflict between contingentists and inevitabilists drive them towards reflections about the relative merits of alternative sciences in their long-term development. She draws on Pickering's *Constructing Quarks* (1984) and Cushing's *Quantum Mechanics* (1994) to give a face to contingentist argumentative strategies. She finds Cushing's analysis of the history of the two empirically equivalent interpretations of quantum mechanics – the indeterministic Copenhagen interpretation and the causal, deterministic Bohm view – particularly illuminating. Not only does Cushing deal with actually existing rivals, rather than past or mere counterfactual alternatives, he also provides a clear explication of the comparative concepts of "incompatible alternative" and "equal success": the rivals are incompatible as far as ontological commitments are involved but as empirical equivalents they enjoy equal predictive success (pp. 68–69).

Soler observes that inevitabilists can challenge a contingentist claims based on Cushing's narrative by denying that the Copenhagen interpretation and Bohm's theory are genuine alternatives, treating them instead as different formulations of the same theory (pp. 71–72). In another contribution (Chapter 14), we come across a contingentist rejoinder: Jean-Marc Lévy-Leblond argues that even different theory formulations come with distinct conceptual and practical implications, and should hence be considered genuine alternatives. As Jean Paul Van Bendegem points out in Chapter 9, the general challenge for contingentism is as follows. There needs to be enough difference between two sciences or theories – his contribution deals with mathematics – for them to count as genuine alternatives. But the differences must not be so strong that the alternatives become incomparable (p. 227). The "comparative approach" thus involves an understanding of theory-individuation, as well as criteria of scientific success that allow for an evaluative comparison between alternatives.

The "comparative approach" also builds the background to Trizio's analysis of the relations between contingentism and scientific realism, and interestingly, Trizio draws on the same case studies as Soler does. He argues that inevitabilism can come in both realist and anti-realist forms. But while Gregory Radick had argued that realist-contingentist approaches to the history of science are conceivable as well (Radick, 2005, 23–25), according to Trizio, an elaborate version of preservative scientific realism is incompatible with contingentism (p. 142). In particular, the realist cannot allow the possibility of incompatible yet equally successful alternatives to those theoretical constituents that she is confident are (approximately) true and will be preserved in future successful science. The specific challenge that arises from contingentism is that the alternatives in question are thought to be not just logically, but also historically possible (p. 148).

In seeming conflict with this assessment, other contributions to *Science as it could have been* do allow realism and contingency to go together. But they usually moderate on contingentism, or on realism, or on both, for example when Ronald Giere seeks to make a "conditional realism" compatible with "reasonable contingency" (Chapter 7, p.188). Pickering's and Cushing's case studies are usually taken to entail much more radical forms of contingentism.

Talk about "reasonable" vs "radical" contingency claims raises the question of how to distinguish between contingentist views of different strengths, and how "strong" contingentism needs to be for there to be interesting debate. Harry Collins argues that we should reduce contingentism to the empirical claim that scientific communities have in fact entertained incompatible beliefs over short periods of time (Chapter 6). But for Soler, a controversial form of contingentism is more demanding. It requires not only the possibility of an alternative science that is incompatible yet equally valuable as ours, but also that the alternative science retains these features over the long haul (pp. 79–80).

With a rough overview over some of the issues that emerge in the context of the "comparative approach", we are now in a better position to highlight differences from Bowler.

2. A world without Darwin

Darwin Deleted lays out in great detail what an alternative history of science without Darwin would have looked like. Bowler argues that there would have been an evolutionary movement even without Darwin, but it would not have involved natural selection. In the absence of Darwin, non-selectionist alternatives – most importantly orthogenesis and Lamarckism – would have filled the gap. The transition to evolutionary thinking would have been less harsh, because Lamarckian progressivism and the developmentalist emphasis on inherent tendencies were less provocative from a theological perspective than natural selection's randomness. The main line of conflict would have run between developmentalism and adaptationism, with each receiving some degree of evidential support from developments in morphology, palaeontology and biogeography. With the advent of genetics, Lamarckianism would have come under pressure, prompting a search for alternative mechanisms of adaptation. In the early twentieth century, natural selection would have been discovered eventually, giving rise to a set of theories similar to the ones accepted today. What is the philosophical significance of this counterfactual story? Interestingly, Bowler's historical narrative is not particularly useful in the context of the "comparative approach".

First, his description of the alternate universe does not involve an account of theory-individuation. For one thing, Bowler does not present evolution by natural selection as strictly incompatible with its alternatives. He notes that Darwin allowed some space for the operation of Lamarckian mechanisms alongside natural selection. And he shows that pronounced "Darwinists" like Herbert Spencer and Ernst Haeckel drew significantly on Lamarckian and developmentalist ideas (pp. 130–133, 156–157, 222–223). His analysis suggests that what is compatible and what is not is not a logically predetermined feature, but subject to how theories are conceptualized and articulated in concrete contexts. Moreover, Bowler does not claim that the alternatives would have been equally successful as natural selection. There would have been differences regarding the timing and mode of theory acceptance, but it is not clear whether this would have made the alternatives more, less or equally successful as actual science, and according to which