



State of the field: Are the results of science contingent or inevitable?



Katherina Kinzel

Department of Philosophy, University of Vienna, Universitätsstraße 7, 1010 Vienna, Austria

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ABSTRACT

This paper presents a survey of the literature on the problem of contingency in science. The survey is structured around three challenges faced by current attempts at understanding the conflict between “contingentist” and “inevitabilist” interpretations of scientific knowledge and practice. First, the *challenge of definition*: it proves hard to define the positions that are at stake in a way that is both conceptually rigorous and does justice to the plethora of views on the issue. Second, the *challenge of distinction*: some features of the debate suggest that the contingency issue may not be sufficiently distinct from other philosophical debates to constitute a genuine, independent philosophical problem. And third, the *challenge of decidability*: it remains unclear whether and how the conflict could be settled on the basis of empirical evidence from the actual history of science. The paper argues that in order to make progress in the present debate, we need to distinguish more systematically between different expressions that claims about contingency and inevitability in science can take. To this end, it introduces a taxonomy of different contingency and inevitability claims. The taxonomy has the structure of an ordered quadruple. Each contingency and each inevitability claim contains an answer to the following four questions: (how) are alternatives to current science possible, what types of alternatives are we talking about, how should the alternatives be assessed, and how different are they from actual science?

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1. Introduction

Could the historical development of the sciences have led to alternative sciences? Say an alternative biology or physics invested in methods and practices different from those of our science, one that devised concepts and explanations incompatible with our actual scientific theories. Might we have come to accept alternative claims about the workings of nature? Indeed, might we have come to accept theories that furnish the world with different entities and causes than our best-confirmed scientific theories do? And if an alternative science had emerged historically, then could it, although radically different from our actual science, have become as successful in its explanations, predictions and technological applications as the biology and physics we know today? To put it briefly, are the results of successful science contingent?

Contingency is a central issue in the philosophy of general history. It also surfaces in a broad range of other academic fields, for example in sociology, economics, and moral and political philosophy (some examples from moral and political philosophy are Cottingham, 2008; Rorty, 1989; Williams, 2002; examples from economic and military history Cowley, 1999; Robert, 1964; Pomeranz, 2000). Over the last decades, contingency also developed into a central theme in the study of scientific knowledge and practice.¹ Sociologists of scientific knowledge presented historical

¹ There are debates about the historical contingency of science in the early twentieth century European tradition, especially in the respective later writings of Martin Heidegger, Edmund Husserl, and Ludwig Wittgenstein. Contingency is also a central concern in the French tradition of historical epistemology, in particular in the writings of Georges Canguilhem and Michel Foucault. In the Anglo-Saxon context, the problem of contingency in science was put on the agenda in the 1960s and 70s by Thomas Kuhn and Paul Feyerabend. An in-depth discussion of these different contributions is beyond the scope of this paper, which focuses primarily on more recent debates.

E-mail address: katherina.kinzel@univie.ac.at.

case studies that show scientific results to be decided upon in contingent social negotiation processes (Collins, 1985; Pickering, 1984; Pinch, 1986; Shapin & Schaffer, 1985). At the same time, the advent of microhistory in the history of science pushed “big picture”-narratives into the background. Close attention to the particular, the local and the contingent became a hallmark of good historiographical writing. More recently, ventures in counterfactual history explored possible or plausible alternative scientific trajectories (Bowler, 2008; Chang, 2012, 43–50; Radick, 2005).

In the philosophy of science too, contingency is an issue. Attacks on social constructivism pitted scientific reasoning against social causation, arguing that the proper operation of scientific rationality and methodology renders the outcomes of scientific debates much less contingent than sociologists believe them to be (Franklin, 1990, 1994; Laudan, 1981; Laudan, 1990). Scientific pluralists and perspectivalists take a more positive stance towards contingency, claiming that scientific progress can tolerate and perhaps even depends on the availability of multiple alternatives (Chang, 2012; Giere, 2006; Kellert, Longino, and Waters, 2006). And questions of contingency are also present in controversies regarding scientific realism and underdetermination (Cushing, 1994; Stanford, 2006).

But while contingency is implied in all these different sociological, historical and philosophical traditions, the concepts that are used in these debates often remain vague and intuitive. There exists only a small amount of systematic philosophical work that addresses the issue as an independent matter and that seeks to spell out in a rigorous manner what is at stake in claims concerning the contingency (or inevitability) of scientific processes and results.

“Contingentism” and “inevitabilism” made their first appearance as explicit philosophical positions in Ian Hacking’s *The Social Construction of What* (1999, 68–80), with further explication following a year later in a paper that asked: “How Inevitable are the Results of Successful Science?” (2000). The issue has since been explored in more detail in a symposium organized by Léna Soler, published in *History and Philosophy of Science* (Franklin, 2008; Sankey, 2008; Soler, 2008a, 2008b; Trizio, 2008), in a focus section of *Isis* dedicated to the role of counterfactuals in the history of science (Bowler, 2008; French, 2008; Fuller, 2008; Henry, 2008; Radick, 2008) and at a conference titled *Science as it Could Have Been*, held in 2009.² We can find some further explicit references to the contingency issue (Kidd, 2013, in press; Martin, 2013; Radick, 2003, 2005) but in general, systematic and conceptually rigorous literature on the problem is rare. Hence, we are confronted with a remarkable discrepancy between the large amount of sociological, historical and philosophical literature that raises vital questions concerning contingency in science on the one hand, and the small amount of philosophical work that is explicitly devoted to this issue on the other. In this paper, I present a survey of the existing work on contingency and inevitability in science. I structure my discussion around three types of challenge that emerge in the current discussions.

The first part of this paper deals with the *challenge of definition*. While “contingentism” and “inevitabilism” are sometimes referred to as if they constituted clearly delineated philosophical positions, many commentators are prepared to accept that there can be different types of contingency and inevitability in science. I show that it proves hard to describe the positions that are involved in a way that is conceptually rigorous while also doing justice to the plethora of existing views on the issue.

The second part analyses the *challenge of distinction*. There exist convincing arguments that the debate on contingency is logically independent of the scientific realism vs. anti-realism controversy. But as I will show, the debate is closely related to another long-standing and well-known philosophical dispute, namely that over what types of factors determine the emergence and acceptance of scientific results. It is thus unclear whether the contingency vs. inevitability debate constitutes an independent and distinct philosophical problem.

The third part of this paper is concerned with the *challenge of decidability*. It is often believed that case studies from the history of science warrant specific philosophical views on the contingency issue. However, many commentators also note that it may be difficult, if not impossible, to settle the conflict on the basis of historical evidence. As I will show, any amount of evidence accumulated in favor of one side of the conflict can be rejected by the rival side. How evidence from our actual history of science could settle the disagreement between contingentists and inevitabilists therefore remains an open question.

In the fourth part of this paper I offer some suggestions regarding what direction the debate should take in the future. I argue that in order to make progress in the present discussion, we need to distinguish more clearly between different contingency and inevitability claims. To this end, I present a taxonomy that has the structure of an ordered quadruple. My taxonomy reveals that each contingency and each inevitability claim contains answers to the following four questions: (how) are alternatives to current science possible, what types of alternatives are we talking about, how should the alternatives be assessed, and how different are they from actual science?

2. The challenge of definition

What is at stake in the debate between contingentist and inevitabilist interpretations of science? What exactly do the conflicting interpretations state and what is their disagreement about? At present, the most pronounced attempts to define the philosophical positions of “contingentism” and “inevitabilism” in a systematic manner come from Ian Hacking (1999, 2000) and Léna Soler (2008a, 2008b). Their strategies for arriving at a rigorous understanding of the issue differ markedly. While Hacking tries to circumscribe what it takes for contingentism and inevitabilism to be philosophically *meaningful*, Soler tries to capture what it takes for them to be *controversial*.

In the following I reconstruct Hacking’s and Soler’s reflections. Their approaches constitute important steps towards clarifying the present issue, but as I will show, both authors fail to do justice to the full variety of contingency and inevitability claims.

Hacking interprets the conflict as centering on the results of science.³ He formulates the question to which contingentists and inevitabilists are supposed to 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)

The inevitabilist gives an affirmative answer, whereas the contingentist thinks that “there could be alternative non-equivalent but equally successful sciences” (Hacking, 2000, 64). The notion

² In addition, an edited volume on contingency in science is soon to appear with Pittsburgh University Press (Soler, Trizio, and Pickering, in press). Léna Soler has kindly sent me the introduction to the volume, but I have not seen the individual contributions.

³ Here the notion of a result is construed broadly enough to cover both theories and experimentally established facts, yet narrowly enough to exclude the technological applications and the wider social consequences of science (Hacking, 2000, 59).

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