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What is truth?

A new philosophy of the sciences and the humanities

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Contents

8 *Rationality*

Introduction

The sciences of the 21st century are in need of a new philosophy of science, and this book represents my best attempt to provide one. Compared with, say, the early 1980s, the sciences have changed almost beyond recognition. Disciplinary boundaries have become blurred, certainly with regard to content, if not always institutionally. The distinctions that previously existed between many natural sciences and technology have been obliterated. The steady but relentless surge of "research methods" in the university curricula is having an impact on the way that the sciences are conducted, which is often but not always beneficial.

This book's perspective is informed by the following precepts:

1. The natural sciences, the social sciences, and the humanities are given equal emphasis. No one discipline is given more prominence than another in terms of scientific or scholarly rationality.
2. The philosophy of science should be studied within the more general contexts of the history of philosophy and the history of the sciences.
3. The philosophy of science should provide reflections on the practices of the sciences. Wherever possible, I shall use real-life scientific examples and engage in dialogues with the "research methods" as taught in various academic fields.
4. Much has happened in the philosophy of science since Karl Popper and Thomas Kuhn, who for decades were the "staple" of so many philosophy of science courses. While acknowledging the importance of Popper and Kuhn, this book aims to move beyond the ideas of these thinkers and contribute to the development of "post-Kuhnian" philosophy of science.
5. A thematic approach prevails — that is, the "styles" of science as developed by the historian of science Alistair Crombie and the philosopher of science Ian Hacking. Crombie and Hacking confined their work to the natural sciences. For the first time in the growing literature on the styles, this book acknowledges the important place of the humanities and the social sciences.

The reader should not feel obliged to accept the specific philosophical claims of the styles approach. Its main merit lies in providing a novel perspective on how to establish interdisciplinary links between various fields of science and the humanities, and between currents in philosophy that are not usually brought together. A style is a category, and a category is the result of abstraction. An honest category maker should respect the peculiarities and idiosyncrasies of the items grouped within any category, and should not reduce them to an allegedly shared essential character trait.

Yet a more precise indication of what the styles approach is about is in order. It was Crombie who proposed this approach around 1980, at first only to selected audiences. He identified six styles: [1] postulation and the ancient search for principles and methods; [2] the experimental style; [3] hypothetical modelling; [4] taxonomy; [5] probabilistic and statistical analysis; [6] historical derivation: the genetic method. Crombie did not derive the six styles from an a-priori scheme, for good reasons. His voluminous work on the styles, *Styles of Scientific Thinking in the European Tradition*, was not published until 1994, but the idea of the styles had been endorsed by Hacking almost as soon as Crombie had proposed them. This would help Hacking to establish himself as one of the most important "post-Kuhnian" philosophers of science, especially through his books on the experimental style (*Representing and Intervening*, 1983) and the statistical style (*The Taming of Chance*, 1990). Hacking's most recent book (*Why is there Philosophy of Mathematics at All?*, 2014) deals with the postulational style in mathematics. I shall make many references to Hacking's work throughout this book (and will discuss his take on the styles approach in more detail in the concluding chapter). However, despite the very high quality of Hacking's work, he succeeded only to a limited extent in conveying the full breadth of the styles approach in the philosophy of science community. This is why this book also purports to be a scholarly contribution to the philosophy of science. My own *Styles of Knowing* (Pittsburgh, 2011) is an essay on the history of the sciences, and for that reason is more closely linked to Crombie's work than to that of Hacking. However, it proved imperative to broaden Crombie's almost exclusively "history of ideas" approach into a more inclusive cultural history and an orientation towards the material practices of the sciences inspired by science and technology studies.

What, then, is the difference between the styles approach and "traditional" philosophy of science? In a word, it lumps and it splits. Ways of approaching science that were previously seen as unimportant, because they were considered to be either merely scientific preliminaries (such as the categorizations achieved by the taxonomic style) or supporting methodologies (such as the experimental and statistical styles), are now included. It is illuminating to see different styles treated as rationalities that stand by themselves. Karl Popper struggled to provide an adequate account of how Darwinian evolutionary theory should be classified. That problem has now been solved.

Another feature of the styles approach is the separation of classical postulation from hypothetical modelling. The former has its roots in antiquity, and is restored here in doing justice to its aspirations. The price paid by classical postulation is that it now occupies only a small place in the tableau of modern science. How this came to be is discussed in Chapter 8. By far the most important feature of the styles approach is that experimental rationality (and practice) has become a style of its own. For Popper, the experiment was thoroughly wedded to theoretical science, or hypothetical modelling. Now its own "logic" has been ascertained.

We shall discuss the styles not just as "stand-alone" styles, but also in their interactions. Only occasionally do styles appear to be difficult to reconcile. It is far more often the case that scientists and scholars work in more than one style. However, especially in these cases, the styles approach will turn out to be a very useful analytical instrument.

Although styles may be found in combination, each style has its own criteria for truth (and falsity), as Hacking has reminded us. Philosophers and laymen who hold that truth does not exist are guilty of lazy thinking. But neither is there only one truth. Truth is in the plural (there are as many truths as there are styles). Depending on the style, truth may be local or temporary. However, we cannot manage without the notion of truth.

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Analytical Table of Contents

CHAPTER 1 — *Theory*

Chapter 1 tells the story of western philosophy and science, from Plato to Newton. The views of Plato and Aristotle on natural philosophy were challenged from approximately 1100 onward, in particular by Al-Ghazali, Maimonides, Etienne Tempier (Bishop of Paris), and Duns Scotus. They criticized Aristotle for being too exclusively focused on the necessity for a rational world order, and they suggested that instead the world order could have been different from what it appears to be. The result was more daring theoretical speculation and empirical investigation. The case of Descartes shows that it has not been easy for natural philosophy to dispense with the intuitive certainty of necessary truth. Yet hypothetical modelling and the use of metaphors and analogies led to great scientific productivity. It will be shown that an unlikely analogy was the source of Newton's gravitational theory.

CHAPTER 2 — *Experiment*

The experiment in science is given its well-deserved status of an independent rationality. The traditional view that the sole function of an experiment is to test a theory is no longer viable. The real achievement of an experiment is to produce a stable phenomenon. The experiment's claim to truth rests mainly on the correct application of procedures. This chapter relies on the analyses of experimental rationality by Ian Hacking, Hans Radder, and Nancy Cartwright, among others. The work of Bruno Latour, Harry Collins, and Andrew Pickering, which leans towards anthropology and social studies of science, is also taken into consideration.

CHAPTER 3 — *Observation*

The hypothetical-analogical style of science — by far the most important method of scientific theorizing — is analyzed from the vantage point of "observation", a classic philosophical problem. The first part of this chapter discusses some canonical authors of modern philosophy, namely Locke, Hume, and Kant. The latter's "Copernican Revolution" is discussed — in other words, how the human mind establishes causality in nature's workings. The second part of the chapter deals with the important 20th-century figures in philosophy of science, namely Karl Popper, Thomas Kuhn, and a few others. These philosophers all put theory first, while acknowledging its fallibility, and they designed or analyzed various strategies to allow for this.

CHAPTER 4 — *Data*

When there are many observations, and when those observations are obtained by means of measuring equipment, we usually speak about "data", especially in this age of "big data." According to the philosophers discussed in Chapter 3, the epistemic status of the theories that frame the observations is "intersubjective." However, there are other philosophers who, when dealing with large databases, hope to encounter an "objective nature." Such was the situation in philosophy in the 19th century. It now looks as if history is repeating itself. Around 1800, an "avalanche of numbers", seemingly coming out of the blue, helped to establish the statistical style of science. Since around 1990, statistics has been on the rise in the practice of the sciences, with the social sciences being an important case in point. To many, the experiment carries a promise of "objectivity." However, it is the return of the classical-deductive style of science that is the most remarkable development in the new taste for objectivity. Philosophers and scientists are not literally returning to Plato and Aristotle, but there is enough kinship in style for us to be able to speak of a comeback. We shall discuss logical positivism, and its renewed relevance for today, in this light. Some typically 21st-century sciences, such as information science and global warming simulation models, will also be discussed from this perspective.

CHAPTER 5 — *Text*

Data come in many guises. For instance, in the humanities they exist in the form of "text" — or better still, "texts" — for which a context is identified. This chapter purports to show that there is an important relationship between how a student of the humanities identifies a specific context and how in the rest of the sciences a hypothesis is selected that best explains the data. More than 100 years ago, Wilhelm Dilthey highlighted the similarity between hermeneutics in the humanities and the way in which Kepler practiced data interpretation in astronomy. The second half of this chapter discusses two forms of hermeneutics, namely the now classical hermeneutics of Dilthey and Gadamer, among others, and the new hermeneutics of Derrida, called "deconstruction." Similarities between Derrida's work and the work of Walter Benjamin and Theodor Adorno will also be discussed.

CHAPTER 6 — *Society*

Chapter 6 offers an exploration of the social sciences, most importantly sociology, with the aim of demonstrating that they feature all six styles of scientific reasoning. We focus on the experimental style (which in the social sciences mainly appears in the guise of the quasi-experimental style), the taxonomic style (which is instrumental in concept formation, through the creation of categories), and the hypothetical-analogical style. The latter style is the subject of the second part of the chapter. We shall look at the various paradigms in sociology, including Durkheim's functionalism, the post-functionalist theories of Luhmann and Lyotard, the "field" of Bourdieu, and network theories in their various manifestations, including Latour's actor-network theory. The sociological paradigms will be "unpacked" by placing their metaphorical content center stage.

CHAPTER 7 — *History*

Modern history is only 200 years old, and is thus contemporary with the birth of Darwinian evolutionary theory. Chapter 7 will examine their conceptual relationship (while steering clear of Spencer's social Darwinism). Naturally, the writing of history dates back much further. We shall analyze the work of Thucydides, Tacitus, Leibniz, and Edward Gibbon, and demonstrate that these older forms of history do not belong to the modern historical-evolutionary style. The classical-deductive style in particular was a standard for historians throughout many ages, while in the 18th century the "logic of history" was found in taxonomic or hypothetical-analogical rationality. In the final section of the chapter, we shall look for new paradigms in the writing of history.

CHAPTER 8 — *Rationality*

Chapter 8 concludes the book by reflecting on the idea of styles of scientific rationality. Critical reactions to the styles concept will be discussed. We shall also ask why the classical-deductive style holds a special place among the six styles. Historically this style has been endowed with the very idea of rationality. We shall discuss why this is so, and compare the concept of rationality found in Plato with ancient Chinese rationality. Last but not least, we shall approach the idea of rationality through the work of the French anthropologist Philippe Descola.

I

Theory

The human mind imposes itself on things by means of its concepts, like a sculptor shaping a statue out of stone.

PIERRE ABÉLARD (1124)[1]

1.1
Prologue

The French physicist Jean-Baptiste Perrin was awarded the Nobel Prize in 1926 for proving the existence of atoms (in 1909).[2] One might be surprised that such proof had not been provided earlier, but in fact there was still room for doubt until Perrin's experiments. The German chemist Wilhelm Ostwald promoted "energetics", aiming to make energy the foundation of the whole of physics. Energy would replace matter, and hence also the atoms that had never been observed, as a foundational concept. For different reasons to those of Ostwald, three other eminent scientists — Jacobus van 't Hoff, Max Planck, and Pierre Duhem — also did not subscribe to the atomistic theories that were prevalent at that time.

Perrin's experiments had involved observation of a seemingly trivial phenomenon. Almost 100 years earlier, in the summer of 1827, the Scottish botanist Robert Brown had been using his microscope to examine pollen grains suspended in water. These tiny particles were moving in a random, erratic manner with no apparent cause. Brown ascertained that the movement was not due to their living plant origin, as tiny metallic particles moved in the same way. Over time, various explanations were postulated for this so-called "Brownian movement", until Albert Einstein persuasively argued that the movement of the pollen grains was caused by constant collisions with randomly moving, invisible water molecules. One might suppose that all the collisions between a pollen grain and the infinitely smaller water molecules around it would cancel each other out. However, at any moment in time a number of water molecules may simultaneously hit a pollen grain from one side, and none from the other. Perrin provided support for Einstein's hypothesis with cleverly designed experiments and a very precise statistical model.[3]

Ostwald also became convinced by this hypothesis. Yet his energetics had been more than a theory on the nature of matter to rival atomism. There was a philosophical position behind it, namely restriction to those phenomena that can effectively be observed in nature or in the laboratory. This philosophical position is called "phenomenalism." Over the course of the 19th century, energy had come to be known in different forms — heat, steam energy, electrical energy, chemical energy, and so on — and it had been established that one form of energy can be converted into another. Ostwald also proposed that matter should be viewed as a *manifestation* of energy.

Ostwald's hypotheses did not have many adherents. In 1898, Ernest Rutherford identified two different forms of radioactive radiation — alpha and beta radiation. Soon afterwards it became clear that two different types of particle must be involved. This had already convinced many physicists of the existence of atoms. Moreover, several theories that assumed the existence of atoms had been around for some time, including the chemical atomic theory of John Dalton (1803), and the so-called kinetic theory of gases proposed by Rudolf Clausius and James Clerk Maxwell. Around the mid-19th century, Clausius and Maxwell had developed models of gas as a collection of elastic spheres that collide both with one another and with the walls of the gas container. Many years earlier, René Descartes and Isaac Newton had proposed their atomic theories, and long before them were the theories from antiquity. However, no one had ever provided direct proof of the existence of atoms. Instead, theories of atoms could be viewed as useful intellectual models only.

Perrin, too, did not observe atoms or water molecules directly, but only "saw" them indirectly. Hardened sceptics might argue that there could be an alternative explanation for Brownian movement. Yet even if it had been possible to provide a different explanation, this would have had to compete with the extremely close conformity between Perrin's model and the results of his measurements. The theory of energetics had already been somewhat weakened by the theory of relativity, so it was not too surprising that Ostwald admitted defeat. After Perrin, the atomic theory started to receive such wide-ranging support that it was inevitable that the existence of atoms, molecules, and electrons (Rutherford's beta radiation) would eventually become universally accepted.