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Scientific Explanation

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Scientific Explanation

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Contents

1 Theories of Scientific Explanation	1
1.1 Introduction	1
1.2 Hempel's Models	1
1.2.1 The DN Model	1
1.2.2 The Value of Explanations	4
1.2.3 The IS Model	4
1.3 Problems for Hempel's Models	7
1.3.1 Accidental Generalisations	7
1.3.2 Irrelevant Premises	7
1.3.3 Asymmetry	8
1.4 Strategies for Solving the Problems	9
1.4.1 Causal Derivations	9
1.4.2 Positive Causal Factors	10
1.4.3 Positive and Negative Causal Factors	10
1.4.4 Unificationism	11
1.4.5 The Causal-Mechanical Model	12
1.4.6 Overview	12
1.5 Philip Kitcher's Unification Account of Explanation	13
1.5.1 The Idea of Unification	13
1.5.2 Argument Patterns	13
1.5.3 Four Factors of Unifying Power	14
1.5.4 Explanations Versus Non-Explanatory Arguments	16
1.6 Wesley Salmon's Causal-Mechanical Model of Explanation	17
1.6.1 Etiological and Constitutive Explanations	17
1.6.2 Causal Interactions	17
1.6.3 Causal Processes	20
1.6.4 Examples of Causal-Mechanical Explanations	22
1.7 Summary and Preview	23
References	23
2 How to Study Scientific Explanation?	25
2.1 Introduction	25
2.2 Rudolf Carnap on Explication	25

2.3	Carl Hempel's Working-Method	27
2.3.1	The First Stage: Explication	27
2.3.2	Descriptive and Normative Claims	28
2.3.3	Hempel's Failures	29
2.4	Philip Kitcher's Working-Method	30
2.4.1	Kitcher Versus Hempel	30
2.4.2	Kitcher's Positive Descriptive Claim	31
2.4.3	Kitcher's Normative Claim	32
2.5	Wesley Salmon's Working Method	32
2.6	A Pragmatic Approach to Studying Scientific Explanations	33
2.6.1	Context-Dependent Normative Claims	33
2.6.2	Context-Dependent Descriptive Claims	34
2.6.3	Epistemic Interests	35
2.6.4	Methodological Neutrality Versus Methodological Commitment	35
2.6.5	Pragmatic Approach Versus Pragmatic Theory	36
2.7	Conclusion	37
	References	37
3	A Toolbox for Describing and Evaluating Explanatory Practices	39
3.1	Introduction	39
3.2	Types of Explanation-Seeking Questions	40
3.2.1	Explanations of Particular Facts Versus Explanations of Regularities	40
3.2.2	Questions About Particular Facts	40
3.2.3	Questions About Regularities	42
3.3	Possible Formats of Answers to Why-Questions About Plain Facts	43
3.3.1	Introduction	43
3.3.2	The CDN Format	44
3.3.3	The PCR Format	46
3.3.4	The PNC Format	47
3.3.5	The Etiological Format	48
3.3.6	Variations on Previously Described Formats	49
3.4	Possible Formats of Answers to Contrastive Why-Questions	50
3.4.1	Introduction: Woodward's Desideratum	50
3.4.2	From Reality to Alternative Scenarios	51
3.4.3	From an Ideal Scenario to Reality	51
3.4.4	Real Contrasts	52
3.5	Possible Formats of Answers to Resemblance Why-Questions	53
3.5.1	Introduction	53
3.5.2	Top-Down Unification	53
3.5.3	Bottom-Up Unification	55
3.6	Possible Formats of Explanations of Regularities	56
3.6.1	Introduction	56
3.6.2	Covering Law Explanations of Regularities	57
3.6.3	Mechanistic Explanations of Capacities	58

- 3.6.4 Explanation by Aggregation 61
- 3.7 Evaluating Explanatory Practices 62
 - 3.7.1 Introduction 62
 - 3.7.2 Explanation-Seeking Questions and Epistemic Interests 63
 - 3.7.3 The Appropriate Format of an Explanation 64
 - 3.7.4 Explanations and Levels of Reality 65
 - 3.7.5 Abstraction and Amount of Detail in Explanations 65
 - 3.7.6 Irrelevant Preferences and Mistaken Exclusions 68
- References 68

4 Examples of Descriptions and Evaluations of Explanatory

- Practices 71**
 - 4.1 Introduction 71
 - 4.2 Richard Feynman on the Challenger Disaster 72
 - 4.2.1 Introduction 72
 - 4.2.2 An Etiological Explanation 72
 - 4.2.3 A Contrastive Etiological Explanation 73
 - 4.2.4 Summary and Some Brief Evaluative Remarks 74
 - 4.3 Explanations in Dynamical Cognitive Science 75
 - 4.3.1 Introduction 75
 - 4.3.2 Walmsley’s Claim 75
 - 4.3.3 Causal Explanations 76
 - 4.3.4 Non-Deductive Explanations 77
 - 4.3.5 Conclusion 78
 - 4.4 Intentional Explanations of Actions 78
 - 4.4.1 Introduction 78
 - 4.4.2 Explanation-Seeking Questions About Actions 79
 - 4.4.3 A Case Study 80
 - 4.4.4 Conclusion 81
 - 4.5 Pigeon Navigation 81
 - 4.5.1 Introduction 81
 - 4.5.2 The Explanations 82
 - 4.5.3 Properties of the Explanations 83
 - 4.5.4 Evaluation of the Explanatory Practice 83
 - 4.6 The Cuban Missile Crisis 84
 - 4.6.1 Introduction 84
 - 4.6.2 Allison’s Models 85
 - 4.6.3 Explanations at the Appropriate Levels of Reality in the Cuban Missile Crisis 87
 - 4.7 The Efficiency of Propaganda 88
 - 4.8 Proximate Versus Remote Causes 89
 - 4.8.1 The Close-Grain Preference 89
 - 4.8.2 An Imaginary Case of Cholera 90
 - 4.9 Where to Find More Examples? 91
 - References 92

Introduction

When scientists investigate why things happen, they aim at giving explanations. This practice of scientists can be analyzed by philosophers of science. In fact, there is a long tradition—which started in the second half of the twentieth century—of philosophical analysis of scientific explanation. Our motivation for writing this book is double. On the one hand, we think that the way in which philosophers of science have studied scientific explanation during most of this period, is flawed. We think it is important that new generations of philosophers of science see what went wrong in the past, so that they can avoid similar problems. Second, through our joint work on explanations in the social and in the biomedical sciences, we have gradually developed an alternative approach. This positive alternative has never been fully spelled out and never been presented in a systematic way: it is scattered among many papers published in several philosophy of science journals. Moreover, in these papers the focus lies on implementing the alternative approach, rather than on presenting and defending it. The latter will be done in this book.

Given this motivation, our first aim is to clarify what philosophers of explanation were doing and to show what went wrong in the past. [Chapters 1](#) and [2](#) are devoted to this task. The title of the first chapter is *Theories of Scientific Explanation*. In this chapter, we first summarize the ideas of Carl Hempel, the godfather of this subdomain of the philosophy of science. Then we present the problems that other philosophers have raised in connection with Hempel's theory of explanation. Subsequently, we clarify how most of the major research traditions in the field that have emerged after Hempel, can be seen as different reactions to these problems. Finally, we discuss two such traditions (Philip Kitcher's unification approach and Wesley Salmon's causal-mechanical model) in more detail. This chapter does not give a complete overview. We give enough material so that the reader can grasp what these key players were doing (what their aims were, how they argued, ...). The elements presented in [Chap. 1](#) enable the reader to understand our criticism in [Chap. 2](#).

The second chapter is entitled *How to Study Scientific Explanation?* Building on what is said in [Chap. 1](#), this chapter investigates the working method of three important philosophers of explanation: Carl Hempel, Philip Kitcher, and Wesley Salmon. We argue that they do three things: (i) construct an explication in the sense of Rudolf Carnap, which then is used as a tool to make (ii) descriptive and

(iii) normative claims about the explanatory practice of scientists. We show that convincing arguments for the normative and descriptive claims are missing and that this should not come as a surprise, given the bold nature of their claims. At the end of this chapter we propose our alternative which we call the “pragmatic approach to scientific explanation.” We clarify briefly what this approach consists in. Among other things, it involves more modest descriptive and normative claims than the traditional ones.

Our second aim is to elaborate and defend our alternative approach. We do this in [Chaps. 3 and 4](#). In the third chapter, which is entitled *A Toolbox for Describing and Evaluating Explanatory Practices*, we develop a philosophical toolbox which contains different formats for explanation-seeking questions, different formats for explanations, and also what we call clusters of evaluative questions. The formats are tools for describing explanatory practices, but also for evaluating them (you cannot evaluate without knowing what is going on). The clusters of evaluative questions are of course tools for evaluating explanatory practices. In the last chapter, entitled *Examples of Descriptions and Evaluations of Explanatory Practices*, we provide illustrations of most parts of the toolbox. This chapter has an argumentative function (it shows that the toolbox is useful and that the pragmatic approach is viable) but also a paradigmatic function: it shows how the approach works, so other philosophers can apply it to their area of interest, if they are convinced of its fruitfulness.

We hope that our book will be useful for various audiences. It can be used as a textbook for intermediate philosophy of science courses. However, the way the book is set up also makes it an excellent study and research guide for advanced (M.A. and Ph.D.) students that work on the topic of scientific explanation. Finally, it is a handy source and reference book for senior researchers in the field of scientific explanations and—more generally—for all philosophers of science.

Chapter 1

Theories of Scientific Explanation

1.1 Introduction

In this chapter we first summarize the ideas of Carl Hempel, the godfather of this subdomain of the philosophy of science (Sect. 1.2). Then we present the problems that other philosophers have raised in connection with Hempel's theory of explanation (Sect. 1.3). Subsequently, we clarify how the major research traditions in the field that have emerged after Hempel, can be seen as different reactions to these problems (Sect. 1.4). Finally, we discuss two of these reactions in more detail. Philip Kitcher's unification account in Sect. 1.5 and Wesley Salmon's causal-mechanical account in Sect. 1.6.

This chapter gives the reader insights into some of the most important steps in the development of the domain till 1990. More recent developments (e.g. the work of James Woodward, Michael Strevens and the mechanistic approach) are treated in Chap. 3. But even for the period before 1990 we do not aim at completeness. For instance, the work of Bas van Fraassen is also discussed in Chap. 3, not here. The reason for this is that Chap. 2 plays a pivotal role in this book: we criticise the work of Hempel, Kitcher and Salmon at a meta-level and propose an alternative approach which is elaborated in Chaps. 3 and 4. Our criticism in Chap. 2 cannot be understood without knowledge of what these three philosophers have written on explanation. So we focus on their work. The work of other philosophers is saved for later: we try to integrate important insights into the toolbox we develop in Chap. 3.

1.2 Hempel's Models

1.2.1 *The DN Model*

We start with some definitions and terminology. According to Hempel, an explanation consists of an explanandum E (a description of the phenomenon to be