

Preface

The birth of quantum theory is one of the most impressive examples of scientific revolution. What makes this historical episode fascinating is that the breakthrough originated from a ‘classical’ research program that progressively accumulated conceptual and experimental tensions up to the point of generating a ‘non-classical’ outcome. The progressiveness, however, does not make the historical reconstruction any simpler. The tight interplay of highly technical issues belonging to fields as diverse as electromagnetism, thermodynamics, and combinatorics is a serious hindrance for many historians to the extent that a full account of this interplay remains a desideratum.

Such an account is not solely interesting for the historian of physics. Indeed, what follows can be viewed as a study in the epistemological problem of theory assemblage. Traditional epistemology tends to regard a scientific theory as a given that can be confirmed, falsified, modified, or overthrown by a new one. But very little has been hitherto said on the process that brings a theory into being. The case of quantum theory gives us an almost unique opportunity to investigate how progressively a new conception acquires a shape, how flexibly this shape is adapted to new insights, and, eventually, how dramatically it can change. For this reason, my approach is organized in order to spell out the morphology, the epistemic architecture, and the conceptual resources that form the building of Planck’s theory. Only through a comparative analysis of these elements is it possible to understand how Planck’s theory could embody the tensions at the border of different areas of knowledge.

Initially, Planck envisioned his theory as an integration between thermodynamics and electromagnetism. Within these two areas of knowledge, however, he was referring to specific theoretical sub-traditions that distinguished his program from those of his contemporaries. As the program unfolded, Planck had to take up new mathematical and conceptual techniques from kinetic theory and adapt them to his program. This is again an epistemologically interesting process that affects the structure of the theory and its capacity to respond to external challenges. Furthermore, the introduction of new resources and techniques does not automatically entail their integration into the program. Instead, Planck wanted to maintain the original bulk of his idea: to provide an explanation of the equilibrium within the cavity radiation that would stress the strict irreversibility of the equilibration

process. The combination of Planck's explanatory constraints and the techniques he increasingly admitted made his theory less and less flexible, until, eventually, this process isolated some parts of Planck's theory from the rest of physical knowledge. I argue that the quantum, the revolutionary and ultimately uncalled-for upshot of Planck's theory, was initially in epistemic isolation within the web of his conceptual and mathematical resources. Only later, after the careful analysis of scholars such as Einstein, Ehrenfest, Lorentz, and Jeans, it acquired a revolutionary epistemic status.

This work is the achievement of my 15-year-long interest in Planck's radiation theory. It is the third book I dedicate to Planck and most likely the last one. I began this journey humbly benefitting from the advice of a great scholar, my Ph.D. supervisor Evandro Agazzi, and I finished it eagerly stealing from the wisdom of another great scholar, Jürgen Renn. As a matter of fact, Jürgen was the first and most indefatigable supporter of this project, at times even more indefatigable than I. The intermediate stations of this long trip have been punctuated by many other colleagues and friends whose thoughts, remarks, suggestions, questions, and criticisms, permeate these pages. Nadia Robotti imparted a passion for history of physics and encouraged patient work on the papers. Some of our afternoon discussions at the Physics Department of the University of Genoa still stick in my mind and always will. I had the luck and the honor to be part of the History of Quantum Project of the Max Planck Institute for the History of Science. I partook in the pioneering effort to write a different kind of history of the quantum revolution, and I am indebted to that exciting research environment more than words can convey. I thank Alexander Blum, Arianna Borrelli, Bretislav Friedrich, Clayton Gearhart, Dieter Hoffman, Shaul Katzir, Martin Jähner, Michel Janssen, Ed Jerkowitz, Christian Joas, Marta Jordi, Christoph Lehner, Daniela Monaldi, Jaume Navarro, and Arne Schirrmacher for all their contributions to my research. I also thank Allan Needell for our discussions on Planck's combinatorial procedure. Matteo Valleriani granted me his friendship, which is more valuable than any intellectual insight I can possibly obtain. My work has been supported by several institutions, among which I want to thank particularly the Library of the Max Planck Institute for the History of Science (Berlin), the Archive for the History of the Max Planck Society, the Hayden Library and the Library Storage Annex at the Massachusetts Institute of Technology, and the Centre d'Història de la Ciència of the Universitat Autònoma de Barcelona. I have discussed some of the ideas of this book at the conference *Continuity and Discontinuity in the Physical Sciences since the Enlightenment* (American Institute of Physics, July 2011), at the & HPS4 meeting (Athens, March 2012), and at the *Lectio Commandiniana* (Urbino, April 2013); I am indebted to the participants of those events for the interesting discussions that followed the lectures. Now that I have finished these pages, on a bitterly cold Sunday afternoon, I realize that this slim book is a rather inadequate representation of such a long intertwining of careers, personal relations, intellectual exchanges, enthusiasm, and passions. Once again, the journey was more important than the destination.

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The Bumpy Road

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Badino, M.

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