

# Title: Explanation, Causality, and Unification\*

Alexander Gebharder · Gerhard Schurz

Düsseldorf Center for Logic and Philosophy of Science (DCLPS)

**Keywords:** explanation; causality; unification.

To provide explanations is one of the essential goals of scientific research. Scientific explanations bear a close relation to at least two further scientific concepts equally important for the sciences, viz. causality and unification. On the one hand, explanations typically provide causes for their respective explanandum phenomena, and thus, also knowledge about how one can manipulate or control one's environment in a way that serves one's purposes. On the other hand, scientific explanations typically subsume a multitude of different events under a manageable amount of general principles, which, among other things, provides us with an understanding of the world we are living in.

In November 2011, we organized a workshop with the title *Explanation, Causality, and Unification* at the Heinrich Heine University Düsseldorf, which was funded by Deutsche Forschungsgemeinschaft (DFG), research unit *Causation | Laws | Dispositions | Explanation* (FOR 1063). The main goal of this workshop was to bring together experienced as well as young researchers with a specialization in one or more of the three topics mentioned in the workshop's title to present and discuss their work as well as the connection between explanation, causality, and unification. But also issues concerning conceptual questions of the explication of these concepts, issues concerning problems and results that arise from these concepts' application to specific scientific disciplines, and questions about how these concepts relate to other concepts relevant to the sciences, such as expectation, law, reduction, etc., were of interest.

We are very happy to present a collection of five papers which resulted from presentations and critical discussions at the workshop in the monographic section of this issue of *Theoria*. The first paper (pp. xxx-xxx) is Stathis Psillos' "Regularities, Natural Patterns and Laws of Nature." The paper starts by posing the question of why there is regularity in nature. The author argues that (contrary to what rationalists typically claim) no powers or necessary connections are required as enforcers of regularity. From an empiricist point of view regularity enforcers are not needed at all. As an

---

\* This is a draft. The final version is published under the following bibliographical data: Gebharder, A., & Schurz, G. (2014). Explanation, causality, and unification [Introduction]. *Theoria*, 29(1), 5-7. doi:10.1086/674206

alternative, he sketches an empiricist metaphysics of robust and objective laws of nature based on the notion of natural patterns, whose relation to regularities is then analyzed in mereological terms.

In “Scientific Practice and Necessary Connections,” which is the second paper (pp. xxx-xxx) in this collection, Andreas Hüttemann introduces a new problem for those Humeans who believe that the future is not yet determined. He argues that such “open-future-Humeans” cannot explain what he calls the “recalcitrance of nature,” i.e., the fact that nature is such that any attempt to bring about certain situations, e.g., a violation of the Maxwell-equations, is doomed to failure. He then argues that the best available explanation for the “recalcitrance of nature” is not provided by an empiricist Humean metaphysics, but by a metaphysics that features necessary connections.

The third paper (pp. xxx-xxx), “The Role of Unification in Micro-Explanations of Physical Laws” by Erik Weber and Merel Lefevere, focuses on the micro-explanation of physical laws. The authors introduce and discuss two specific examples of physical laws and their respective micro-explanations, viz. (i) the phenomenon that the mercury level first drops and then rises in mercury thermometers which are rapidly immersed in hot water, and (ii) the ideal gas law. On the basis of these two examples and their findings, the authors argue that unification, though not a goal of explanation, is still an explanatory virtue, because unification typically results in higher explanatory power in the Woodwardian sense that explanations involving unification usually provide more answers to what-if-things-had-been-different questions.

In his “Unification and Explanation: Explanation as a Prototype Concept,” which is the fourth paper (pp. xxx-xxx) in this monographic section, Gerhard Schurz investigates unification as an explanatory virtue. After giving a brief sketch of the Schurz-Lambert account of unification, the author critically discusses several objections to this account made by Weber and van Dyck, Gijsbers, and de Regt. As a last step, the author argues that causation, nomic expectability, and unification typically go hand in hand with explanation. But neither is it the case that a single one of these three concepts is necessary, nor that all three together are sufficient for explanation. He concludes that explanation should be understood as a prototype concept containing causation, nomic expectability, and unification.

The fifth and last paper (pp. xxx-xxx) in this collection is Victor Gijsbers’ “Unification as a Measure of Natural Classification.” The author is mostly interested in scientific understanding without explanation. The paper starts by explaining Duhem’s notion of natural classification, which seems to be a good candidate for providing some kind of non-explanatory understanding. Then five desiderata a measure for the naturalness of classifications would have to meet are introduced and discussed. As a last step, the author argues that an amended version of the Schurz-Lambert account of unification fits these five desiderata, and thus, provides adequate means for a measure of the naturalness of classifications.

We would like to thank the researchers who gave a talk at the workshop, in particular, Michael Baumgartner, Lorenzo Casini, Victor Gijbbers, Andreas Hüttemann, Kevin Kelly, Theo Kuipers, Margaret Morrison, Stathis Psillos, Henk de Regt, Matti Sintonen, Erik Weber, and Jon Williamson, as well as the other attendees of the workshop whose valuable contributions to the general discussion made the event such a success. Further thanks go to the authors who contributed to this special issue for their interesting work, to the reviewers for their helpful comments, and also to the *Theoria* editors José Antonio Díez Calzada, Valeriano Iranzo, and David Teira for the pleasant collaboration and their support in editing this monographic section.

**Alexander Gebharter** is a research fellow at the Düsseldorf Center for Logic and Philosophy of Science (DCLPS). His research focus lies on causation, but also on related topics such as mechanisms, causal modeling, explanation and prediction, theoretical terms, and empirical content.

**Address:** Düsseldorf Center for Logic and Philosophy of Science (DCLPS), Heinrich Heine University Düsseldorf, Universitätsstraße 1, 40225 Düsseldorf, Germany. E-mail: alexander.gebharter@phil.hhu.de

**Gerhard Schurz** is full professor of philosophy at the University of Düsseldorf and director of the Düsseldorf Center for Logic and Philosophy of Science (DCLPS). He was associated professor at the University of Salzburg and visiting professor at the University of California at Irvine and at Yale University. His research areas cover philosophy of science, logic, epistemology and cognitive science, and meta-ethics. He is author of more than 100 publications in international Journals. Book publications among others: *The Is-Ought Problem* (Kluwer 1997), *Einführung in die Wissenschaftstheorie* (Wissenschaftliche Buchgesellschaft, 3rd edition 2011), *Philosophy of Science: A Unified Approach* (Routledge 2014).

**Address:** Düsseldorf Center for Logic and Philosophy of Science (DCLPS), Heinrich Heine University Düsseldorf, Universitätsstraße 1, 40225 Düsseldorf, Germany. E-mail: Gerhard.schurz@phil.hhu.de