Niels Bohr on Causal Explanation

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Introduction

Bertrand Russell thought that causation was a folk concept that had no place in a fundamental description of the world.

> *The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm. (Russell, 1913, p 12)*

Introduction

Niels Bohr thought that physics provides occasion to clarify and sharpen our most fundamental concepts.

> *The significance of physical science for philosophy does not merely lie in the steady increase of our experience of inanimate matter, but above all in the opportunity of testing the foundation and scope of some of our most elementary concepts. (Bohr, 1958, p 308)*

Philosophical background to Bohr's stance

Rationalism versus Empiricism

- The Law of Causality = The Principle of Sufficient Reason: Nothing happens without a cause
- David Hume (1711–1776) argued that "C causes E" cannot mean anything more than events of type E have tended, in our experience, to be followed by events of type E.
- Immanuel Kant (1724–1804) argued that the PSR is valid in the realm of experience.

Høffding on causality

- Hume is mistaken in thinking that “thing” is unproblematic while “cause” is problematic.
- It’s impossible to prove or disprove the law of causality.
- Regulative ideal

Peculiarities of Bohr's view

- Continuity
- Conservation laws
- Causal concepts are indispensable for the human experience of the world. (Høffding had pointed out that our concepts evolved under pressure to act.)

Growing pains for causality

- Rutherford's worry about Bohr's atomic model
- BKS
- Beta decay

Causality as a heuristic for discovery

Complementarity as a generalization of the principle of causality

- Bohr: The discovery of QM settles (for now) the validity of the conservation principles.
- Several of Bohr's later articles focus on the concept of causality.

Space time co-ordination and dynamical conservation laws may be considered as two complementary aspects of ordinary causality which in this field exclude one another to a certain extent, although neither of them has lost its intrinsic validity. (Bohr, 1932, p 376).

Causality as an idealization

- No system is truly closed (cf. Høffding); no particle is truly free from all external forces.

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