Types of Explanation

Why-Questions I: Why does this particular instance of the pattern appear?

Why-Questions II: Why is it that there is a pattern that remains stable under various changes?

We can explain (in sense II) why such patterns are to be expected if we can show that many of the multitudes of details that are different in each instance do not matter.

Levels of Explanation

In many instances, the explanations of physical phenomena based on microscopic details provided by “fundamental” theories are incomplete. Such cases require that we ignore microscopic details and focus on a phenomenological account; this is accomplished, mathematically, by asymptotic reasoning.

The critical behavior of a fluid is best characterized by its order parameter:

$$\Psi = \rho_{\text{liq}} - \rho_{\text{vap}} \sim \frac{|T - T_c|^\beta}{T_c}$$

$\beta$ is the same for many fluids and magnets. It is universal.

Discrete and continuous representations of physical media:

Breaking Drops

Droplets always break with the same shape. Moreover, secondary drop breaks with same shape. The explanation of this universal phenomenon requires an infinite idealization.

Phase Transitions

Solid Fluid

Liquid

Vapor

$P_c$

$T_c$

Many phenomena pose interesting “fundamental” questions for both physics and philosophy of science. Understanding and explanation often seem to require non-Galilean, essential idealizations. But idealizations are false. This fact suggests that we need to give up on the view that truth is a necessary condition for explanation.

Types of Idealization

Galilean: They are eliminable, de-idealizable.

Non-Galilean: They are explanatorily essential, and cannot be eliminated.

Our contention is that non-Galilean should be taken seriously.

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