Laws of Nature I

Preliminary Remarks

- Last week: Natural Kinds

- Among other things, natural kind terms appear in statements about laws of nature.

- This week: Laws of Nature

Introduction (1)

- Our experience of nature suggests that things fall into certain *patterns*.
- We successfully employ these patterns to:
  - Make predictions
  - Give explanations
- We call some of these patterns:

  'Laws of Nature' or 'Natural laws'
- What gets called 'law of nature' seems arbitrary to a certain extent: 'principle', 'equation', 'symmetry', etc.

Introduction (2)

- Many types of laws: deterministic, statistical, causal, phenomenological, etc.
- Examples:
  - Any particle attracts any other with a force proportional to the product of their masses and inversely proportional to the square of their distance.
  - The half-life of the isotope uranium-238 is 4.47×10^9 years.
  - If one factor is increased while the others are constant, there is a point at which the rate of return diminishes.

Introduction (3)

- Distinction between:

  Law (ontological category)

  vs.

  Statement of a law (linguistic category)

- Our focus will be on the following two issues:

  Metaphysical: What is a law of nature?

  Epistemological: Can we know them? If so, how much and what can we know?

What is a law of nature?

- *Moral laws* seem to be:
  - dependent on: society? god? (nature?)
  - binding but avoidable (potentially punishable)
- *Legal laws* seem to be:
  - dependent on: society? god? moral laws?
  - binding but avoidable (potentially punishable)
- *Laws of Nature* seem to be:
  - independent of society (and of God?)
  - binding and unavoidable

Regularity Account

- Laws are just regularities i.e. a law is simply the regular occurrence of its instances.
- They are expressed as true Universal Generalisations, having the following logical form:
  $(\forall x)\ (Fx \supset Gx)$
- It is a law that Fs are Gs *if and only if* all Fs are Gs.
- Empiricist motivation:
  - no metaphysics (causation, necessity)
  - only observations
- Prominent Advocates: D. Hume, A.J.Ayer, R. B. Braithwaite, C. Hemple, E. Nagel.

Regularity Account – Problems (1)

Not all Regularities are Laws

- Laws vs. Accidental Generalisations

  A. General Case:

  (a) All persisting lumps of pure gold-195 have a mass less than 1,000 kg.

  (b) All persisting lumps of pure uranium-235 have a mass less than 1,000 kg.

  Regularity defence: These examples are contrived.

  Objection: Can always find other (even historical) examples. Take Bode's 'law', $0.4+0.3 \times 2^n$

  Ultimate defence: These regularities are laws!!!

Regularity Account – Problems (2)

B. Single instance:

- Suppose that the earth is the only planet that has intelligent life forms.
- Now consider the generalisation 'All planets with intelligent life forms have only one moon'.

Regularity defence: Does it make sense to count these single instances cases as regularities?

Objection: Laws of nature could have single-instance forms (e.g. think of Big bang)

Ultimate defence: They are regularities and hence laws!!!

Regularity Account – Problems (3)

- Vacuous laws:

  Compare

  - All unicorns have wings
  - A body on which no forces are acting continues at rest or in uniform motion along a straight line.
  - Identical goods should sell for the same price throughout the world if trade were free and frictionless.

  Problem: How do we distinguish between those empty regularities that are laws from all the other empty regularities?

Regularity Account – Problems (4)

- Co-extensionality Objection:

  Suppose

  F stands for ‘is a diamond’

  G stands for ‘has a refractive index of 2.419’

  K stands for ‘is mined in kimberlite’

  $(x)\ (Fx \supset Gx)$ is a law

  $(x)\ (Fx \equiv Kx)$ holds

  From this we can derive

  $(x)\ (Kx \supset Gx)$

  Problem

  $(x)\ (Kx \supset Gx)$ is a universal truth but not a law.

Regularity Account – Problems (5)

- Counterfactuals

  Problem: Regularity account does not support counterfactuals, for they go beyond the actual instances of a law!!!

- Uninstantiated Values

  Problem: Mathematical formulas go beyond the regularities, in that their terms can take values that are never actually realised.

Food for Thought

- If being a regularity is a necessary but not a sufficient condition for being a law, what other conditions, if any, can be added to reach sufficiency?

- Is the regularity condition necessary?

Reading

- Bird, A. ‘Natural Kinds’, ch. 1, pp. 25-34.
- Ayer, A.J. (1956) ‘What Is a Law of Nature?’, in Curd and Cover, pp. 808-825.