Laws on Nature

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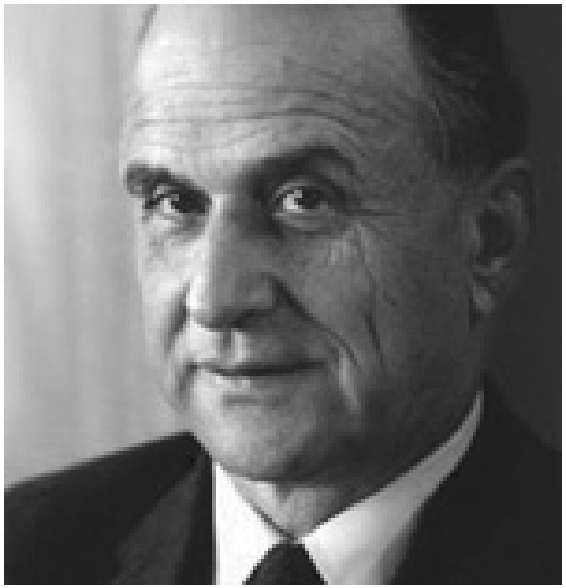
Why laws of nature?

Because they encode/underwrite/capture/systematize patterns in the world. More specifically,

- they play important part in scientific practice (Newton's laws, Mendel's laws, ideal gas law, law of supply and demand...)
- underwrite counterfactuals, i.e. are their truthmakers $\Rightarrow$ counterfactual support (add an object F and see whether it also behaves like G)
- underwrite explanations (covering-law models)
- underwrite inductive inferences (Goodman) $\Rightarrow$ instance confirmability (checking a subclass will not increase my confidence that unchecked instances follow the generalization)

Nelson Goodman (1906-1998): induction



- "Only a statement that is lawlike [i.e. is a law if true]—regardless of its truth or falsity or its scientific importance—is capable of receiving confirmation from from an instance of it, accidental statements are not." (*Fact, Fiction, Forecast*, Cambridge, MA: Harvard University Press, 1954, 73)
- predicates and hypotheses must be "projectible" (more on this when we talk about induction)

Intuitions and revisionism

- Methodological issue: How do we construct an account of laws?
- I.e. what are the criteria by which we judge the success of a proposed analysis?
- Answer for many philosophers: intuitions
- But there are problems with intuitions:
  - principled: diverging intuitions
  - practical: very hard to find an account that fully satisfies our intuitions

$\Rightarrow$ At least a mild form of revisionism seems unavoidable.

- But just how revisionary can or should we be?

Instrumentalist accounts of laws of nature

[Giere, van Fraassen, Mach, Pearson, Wittgenstein]

- laws are neither true nor false
- neither necessity nor universality of laws are objective features of world
- both necessity and universality of laws are human inventions that serve certain purposes, such as representation and prediction
- main problem: if laws are neither true nor false, how can we make sense of their being tested, confirmed or refuted?
- If position collapses into antirealism, then how can we sense of scientific practice, and what underwrites counterfactuals?

Regularity vs. necessitarian approaches

Regularity theories:

[Ayer, Carnap, Earman, Hempel, Lewis, Loewer, Mill, Nagel, Ramsey, Reichenbach]

- laws are privileged kind of descriptive summary of the way things actually behave
- laws' universality is objective and real

Necessitarian theories:

[Armstrong, Carroll, Dretske, Tooley]

- laws more than just summaries of how things actually behave, but statements about how things must behave
- laws' universality and necessity are objective and real

Ayer's epistemic regularity theory

Sir Alfred Jules Ayer (1910-1989), "What is a law of nature?," in Curd and Cover (eds.), 808-825.

universal generalizations: $(\forall x)(Fx \rightarrow Gx)$
[equivalently: $\neg\exists x(Fx \ \& \ \neg Gx)$]

law = universal true generalization + X (epistemic qualifier)

Candidates for X

- "our willingness to use the generalization in question to make predictions, especially about counterfactual situations;
- "our acceptance of the generalization as well confirmed even though we have examined only a relatively small, finite number of its instances;
- "the role that the generalization plays in a deductively organized system of (scientific) statements; and
- "our recognition that the generalization (unlike a mere generalization of fact) explains its instances." (Curd and Cover, p. 884)

Problems of Ayer's epistemic regularity view

- ignores the missing-values problem for functional laws (as Ayer admits)
- does not define the term "law of nature" because it does not offer necessary and sufficient conditions, but only sufficient conditions for lawlikeness
- unable to countenance the existence of unknown laws
- confuses an epistemological issue (why we believe something is a law of nature) with an ontological issue (what sort of thing a law of nature is)

The best systems theory of laws (BST)

Mill, Ramsey, Lewis, Earman, Loewer, Callender & Cohen

- Goal: offer regularity view that does not suffer from the weaknesses of Ayer's account and the log empiricist approach in general

Analysis (BST analysis of laws of nature)

The laws of nature are the axioms/theorems of the deductively closed system that best combines simplicity and strength.

- simplicity and (explanatory) strength compete: in general, the simpler a system, the weaker it is
- idea of unified science resurfaces: system is supposed to account for all regularities we observe

The attractions of BST

1. gives nec and suff conditions
2. accounts for vacuous laws, no missing-values problem for functional laws
3. unknown laws can be countenanced
4. account isn't just epistemic
5. underwrites the truism that scientific practice is aimed at the discovery of laws
6. broadly Humean: no overt appeal to modal concepts (such as counterfactual conditionals) or to modality-supplying entities (such as universals)

The problems of BST

1. laws are inappropriately mind-dependent bc BST appeals to concepts such as simplicity, strength, best balance: concepts depend on cognitive abilities, interests, purposes
2. big challenge: requires regimented language that offers thoroughly inter-theoretic notion of simplicity and strength and extra-theoretic notion of best balance
3. my worry: if theorems (rather than axioms) are taken to be laws, then it seems as if accidental generalizations might be ruled in again!
4. Is it really sufficient to underwrite counterfactuals? More generally, does not seem to make contact w/ typical requirements of counterfactual support and instance confirmability
5. BST cannot distinguish bw two identical worlds where the facts of one are lawlike, but the facts of the other are merely accidental (*Question*: does it have to?)

A problem for many regularity views

"Tooley (1977, 669) asks us to suppose that there are ten different kinds of fundamental particles. So, there are fifty-five possible kinds of two-particle interactions [$N(N+1)/2$]. Suppose that fifty-four of these kinds have been studied and fifty-four laws have been discovered. The interaction of X and Y particles have not been studied because conditions are such that they never will interact. Nevertheless, it seems that it might be a law that, when X particles and Y particles interact, P occurs. Similarly it might be a law that when X and Y particles interact, Q occurs. There seems to be nothing about the local matters of particular fact in this world that fixes which of these generalizations is a law."

(Carroll, Sec. 4, my emphasis)

Necessitarian theories: David Armstrong

Characterization (Armstrong's universals approach)

"Suppose it to be a law that Fs are Gs. F-ness and G-ness are taken to be universals. A certain relation, a relation of non-logical or contingent necessitation, holds between F-ness and G-ness. This state of affairs may be symbolized as 'N(F, G)'." (David Armstrong, What Is a Law of Nature?, *Cambridge: Cambridge University Press, 1983, 85; my emphasis)*

Characterization (Universal)

A universal is a property or relation that can be instantiated or exemplified by a number of different particulars or individuals (e.g. each white thing provides an instance of the property of "whiteness").

Amstrong: comments and justification

- Ex: “being uranium does necessitate being less than one mile in diameter, but being gold does not” (Carroll 2008, Sec. 3)
- law not just universal generalization, but relation bw two universals
- Amstrong’s account has the following attractions:
  1. necessitation not mind-dependent $\Rightarrow$ objective nomicity
  2. rules out “gruesome” predicates (cf. “Induction and confirmation”)
  3. good account of vacuous laws

Problems of the universals approach

Bas van Fraassen, *Laws and Symmetry*, Oxford, Clarendon, 1989, 96.

1. Identification problem: what is the lawmaking relation, the universal *N*?
2. Inference problem: "Does *N*'s holding between *F* and *G* entail that *F*s are *G*s? Does it support counterfactuals?" (Carroll 2008, Sec. 3)

A word on necessity

Question: are laws contingent or necessary truths?

Two reasons that laws don't depend on any necessary connection bw properties/universals:

1. conceivability of following scenario: it's a "law in one possible world that all *F*s are *G*s even though there is another world with an *F* that is not *G*." (Carroll, Sec. 8)
2. seems as if there are laws that can only be discovered *a posteriori*

Replies:

1. conceivability is not a guide to possibility
2. Saul Kripke: $\exists$ a posteriori necessary truths