UCLouvain

FIAL
Un éventail de formations, une multitude d'horizons

Scientific Explanation

LFILO2602 – Philosophy of Science
Session 6

Early Positivism

Karl Pearson's *The Grammar of Science* (1892):

> How idle is it, then, to speak of the law of gravitation, or indeed of any scientific law, as *ruling* nature. Such laws simply *describe,* they never *explain* the routine of our perceptions, the sense-impressions we project into an "outside world." (119)

Early Positivism

Karl Pearson's *The Grammar of Science* (1892):

> No objection can be raised to the words *explain* and *explanation* if they be used in the sense of the descriptive *how*, and not the determinative *why*. The former interpretation is the sole one given to them in this work. (133)

Hempel & Oppenheim (1948)

> To explain the phenomena in the world of our experience, to answer the question “why?” rather than only the question “what?”, is one of the foremost objectives of all rational inquiry; and especially, scientific research in its various branches strives to go beyond a mere description of its subject matter by providing an explanation of the phenomena it investigates. (135)

Terminology

explanandum — the thing we want to explain

explanans — the things doing the explaining (plural: **explanantia**)

The Deductive-Nomological Approach (D-N)

1. **deductive**

> ...the explanandum must be logically deducible from the information contained in the explanans, for otherwise, the explanans would not constitute adequate grounds for the explanandum (137)

2. **nomological**

> The explanans must contain general laws, and these must actually be required for the derivation of the explanandum. (137)

Or, the “Covering Law” Approach

Explanations are derived by showing how the laws “cover” the instances of the phenomena that we want to explain.

D-N Explanations

> [One kind of statements] indicate certain conditions which are realized prior to, or at the same time as, the phenomenon to be explained; we shall refer to them briefly as antecedent conditions. [...] [The other kind] express certain general laws.... The two sets of statements, if adequately and completely formulated, explain the phenomenon under consideration.... [T]he event under discussion is explained by subsuming it under general laws, i.e., by showing that it occurred in accordance with those laws, by virtue of the realization of certain specified antecedent conditions. (136)

Symmetry of Explanation and Prediction

> It may be said, therefore, that an explanation is not fully adequate unless its explanans, if taken account of in time, could have served as a basis for predicting the phenomenon under consideration. (138)

A Few Bad Explanations

1. Magic fairies make the moon orbit the earth.
2. (Newton's second law)
3. **Therefore,** magic fairies make the moon orbit the earth.

Conclusion: The laws must **be necessary** for the explanation to be valid.

A Few Bad Explanations

1. Smoking drastically raises the probability of lung cancer.
2. Person X was a heavy smoker.
3. Person X now has lung cancer.
4. **Therefore,** probably X's cancer was caused by tobacco.

Conclusion: This theory of explanation just doesn't apply to statistical or probabilistic explanations!

A Few Bad Explanations

1. All the coins in my pocket are silver. [a supposed “law”]
2. X is a coin in my pocket.
3. X is silver.

Conclusion: The statements of laws of nature cannot refer to particular places or times.

A Few Bad Explanations

Define “pocketcoin” = “coin in my pocket”

1. All pocketcoins are silver. [a supposed “law”]
2. X is a pocketcoin.
3. X is silver.

Conclusion: The **words in our language** have to be defined such that they permit good, “law-like” inferences (including, at least, not referring to particular places or times).

A Few Bad Explanations

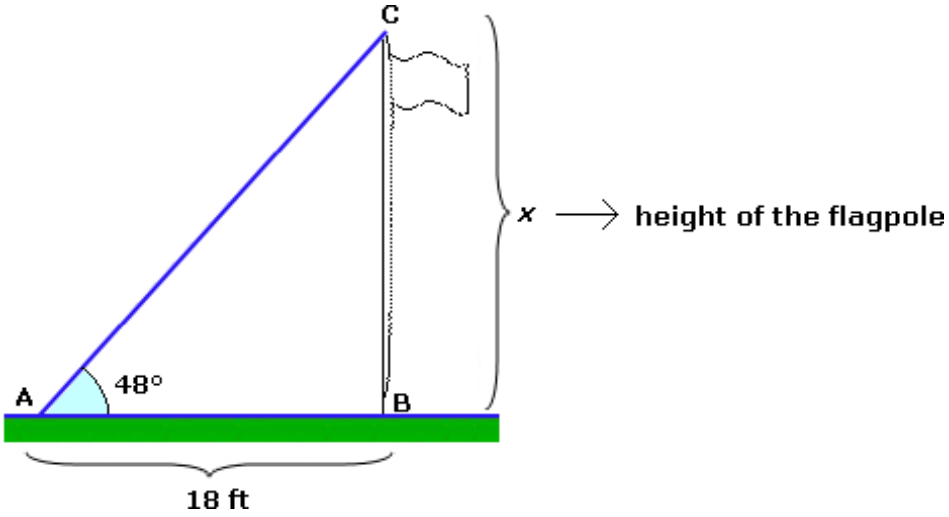
Compare:

- There exists no sphere of uranium-238 larger than 1km in diameter.
- There exists no sphere of gold larger than 1km in diameter.

The first sentence is (probably) necessarily true (lawlike), and the second is (probably) contingent. How can we tell the two apart?

Conclusion: Laws of nature are... uh... hard to understand?

A Few Bad Explanations



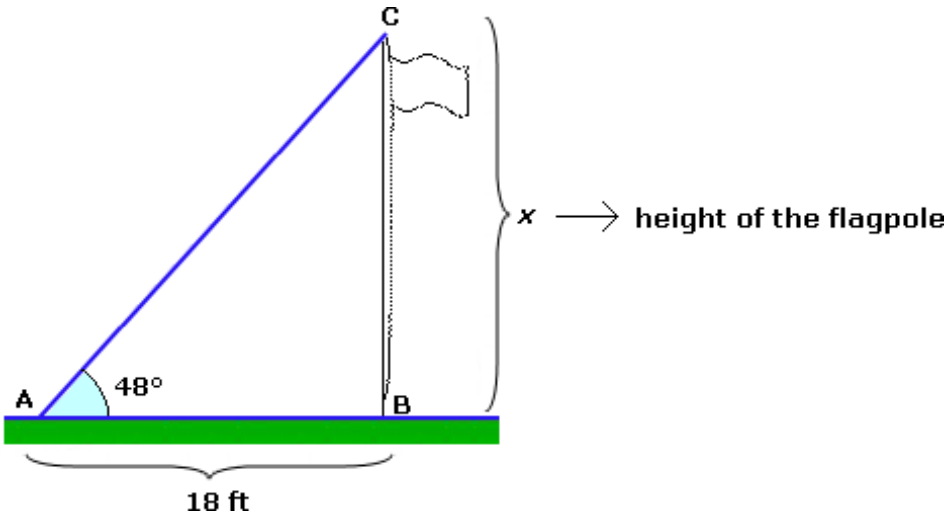
The asymmetry of explanations

The symptoms of an illness **do not explain** diseases. (Your disease is not *explained* by saying you are flushed and have a temperature of 39.)

But symptoms **can predict** the other symptoms of illnesses. (If you have this kind of fever, you probably have other symptoms A, B, C, because you probably have X disease.)

Explanations are asymmetric.

Pragmatism?



van Fraassen on Explanation

Three confusions about **why** we want explanations in science:

1. "Explanation is a relation simply between a theory or hypothesis and the phenomena or facts, just like truth for example."
2. "Explanatory power cannot be logically separated from certain other virtues of a theory, notably truth or acceptability." (That is, a theory explains only because it's true.)
3. "Explanation is the overriding virtue, the end [or aim] of scientific theory."

van Fraassen on Explanation

BvF: All three of those statements are wrong.

1. A fact is explained "when we have a theory which explains." But we only have a theory that explains when it is **acceptable in general.** That's a lot more than just "truth."
2. Accepting a theory **must** be different from that theory's ability to explain, because we cite the ability to explain as a **reason** to accept the theory.
3. No one really acts as if explanation is the main goal of science (science often leaves phenomena **unexplained**).

How did the D-N theory fail?

Former theories failed in two main ways:

1. Demand that a theory can explain everything in its domain
2. Imply that explanation and prediction are symmetric

What instead?

Explanations, fundamentally, are **pragmatically acceptable responses to "why"-questions.**

Why did P happen, rather than another member of a collection X?

Explanations and Contrast Classes

Why did P happen, rather than another member of a collection X?

- We need **reasons** to choose P from among the members of X.
- The content of the set X will vary according to the speaker and the context. (The relationship of “explanatory relevance”.)
- A theory thus only explains **in certain contexts.**

What went wrong?

Why did we ever think that explanation was a property of theories?

We **like** theories that explain lots of things, most of all because such theories are more likely to be admissible in **other** senses, more likely to win against their competitors, etc.!

Explanatory Relevance

We avoided lots of the objections to D-N (especially concerning laws), but what is this relation of “explanatory relevance”? How can we know that we’re offering good explanations in a given context? Van Fraassen doesn’t tell us much.