Historical Science

Methodology and Differences from Experimental Science

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OVERVIEW

- Differences in the methodology of classical experimental science and prototypical historical science: two different patterns of evidential reasoning.
- The role of common cause explanation in the evaluation of historical hypotheses.
- The Principle of the Common Cause and the asymmetry of overdetermination.
- The priority of common cause over separate causes explanation in historical science.

The structure of Classical Experimental Science

- Focus: Is on a single (sometimes complex) hypothesis which typically has the form of a universal generalization (All C's are E's).
- Central Research Activity: Consists in repeatedly bringing about the test conditions specified by the hypothesis and controlling for extraneous conditions that might be responsible for false positives and false negatives.

The Experimental Program vs. Solitary Experiment

- Failed predictions: do not result in the rejection of hypotheses; they are best interpreted as attempts to protect the hypothesis from false negatives.
- Successful predictions: Are not followed by risky tests (in Popper's sense); they are best interpreted as attempts to protect the hypothesis from false positives.
- Acceptance / rejection of a hypothesis: occurs only after a hypothesis is subjected to a series of experiments controlling for plausible auxiliary assumptions that could explain predictive successes and predictive failures.

The structure of Prototypical Historical Science

Focus: Is on proliferating multiple, rival hypotheses to explain a puzzling body of traces encountered in field world.

Central Research Activity: Consists in searching for a ‘smoking gun’ a trace(s) that sets apart one or more hypotheses as providing a better explanation for the observed traces than the others.

A Case Study

The Alvarez Hypothesis

- Two pronged hypotheses: impact, extinction
- Initially many different explanations for the end-Cretaceous mass extinction: pandemic, evolutionary senescence, climate change, supernova, volcanism, and meteorite Impact.
- Discovery of an iridium anomaly (“smoking gun”) in K-T boundary sediments narrowed it down to two possibilities: volcanism and meteorite impact. Discovery of extensive quantities of a rare form of shocked mineral subsequently cinched the case for impact over volcanism.

The Evaluation of Historical Hypotheses

- Not grounded in prediction:
  - Historical predictions are not 'risky' in Popper's sense; too many highly plausible extraneous conditions (e.g., iridium poor meteorite, geological processes, unrepresentative samples) capable of defeating them.
  - Predictions are typically vague, e.g., Ward's 'prediction' about Cretaceous ammonites; they serve more as guides for looking for a smoking gun than predictions.

The Evaluation of Historical Hypotheses(cont.)

- A hypothesis may be rejected on the basis of evidence that does not refute it, e.g., the contagion hypothesis for the end-Cretaceous extinctions.
- The acceptance of a hypothesis does not require a successful prediction, e.g., the iridium anomaly was not and could not have been predicted or retrodicted.

The Evaluation of Historical Hypotheses(cont.)

- Grounded in explanatory power:
  - Hypotheses are accepted and rejected in virtue of their power to explain (vs.predict) puzzling bodies of traces discovered through field work.
  - The Alvarez hypothesis explains an otherwise puzzling association (correlation) among traces better than any of its rivals. It is for this reason that it is viewed as ‘confirmed’ and its rivals are no longer seriously entertained by scientists.

Common Cause explanation

- Common cause explanations and narrative explanations, e.g., sexing a T. rex.
- Reichenbach's epistemic Principle of the Common Cause: seemingly improbable associations (correlations or similarities) among traces are best explained by reference to a common cause.
- Presupposes an ostensibly metaphysical claim about the temporal structure of causal relations in our universe: most (not all) events form causal forks opening from past to future (leave many traces in the future).

The Asymmetry of Overdetermination

- A time asymmetry of causation: Most local events *over*determine their past causes (because the latter typically leave extensive and diverse effects)and *under*determine their future effects (because they rarely constitute the total cause of an effect)
  - Much easier to infer an ancient volcanic eruption than a near future volcanic eruption.

The Asymmetry of Overdetermination (cont.)

- Physical source is controversial but it characterizes all wave (radiative asymmetry)and particle (2nd law of thermodynamics) phenomena; an objective and pervasive physical feature of world.
- Physically (vs. logically or strictly metaphysically) grounds the Principle of the Common Cause and the methodology of historical natural science.
  - Asserts that the present is filled with epistemically overdetermining traces of the past; hence one can never completely rule out finding a smoking gun for any scientific hypothesis about the past.

The priority of common cause over separate causes explanations

- The asymmetry of overdetermination (A of OD) does not guarantee that every improbable association among traces is due to a last common cause; it is a statistical / probabilistic claim.
- The A of OD does suggest that improbable associations among traces are more likely to be the result of a common cause than separate causes
- In the absence of special theoretical or local background information, historical natural scientists exhibit a preference for common cause over separate causes explanations.

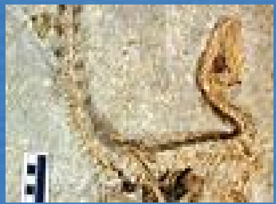
A Case Study

The end-Permian Extinction (245 mya)

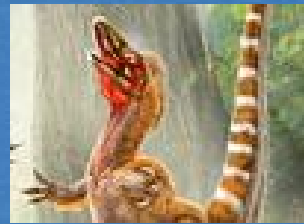
- On the basis of an initial body of correlated traces, paleontologists conjectured that there was a single, prolonged extinction event lasting millions of years, and they proliferated a number of rival common cause hypotheses to explain it.
- As they accumulated more evidence it became clear that there were actually two extinction pulses separated by a period of around 10 million years.

The end-Permian Extinction (cont.)

- In the absence of specific theoretical reasons or empirical evidence that the end-Permian extinction was produced by separate causes, paleontologists opted for rival common cause hypotheses.
- Having acquired compelling local empirical evidence that there were two extinction events, they opted for separate causes.
- They then returned their focus to common causes: separate common causes of the two extinctions and the possibility that both resulted from an earlier common cause (e.g., Pangaea)



Conclusion



- Researchers in historical natural science exhibit a preference, all other things being equal, for common cause explanation over separate causes explanation
- The A of O D underwrites this preference
- The objectivity and rationality of the methodology of historical natural science is grounded in a global physical feature of our universe, as opposed to a logical relation between evidence & hypothesis

References

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