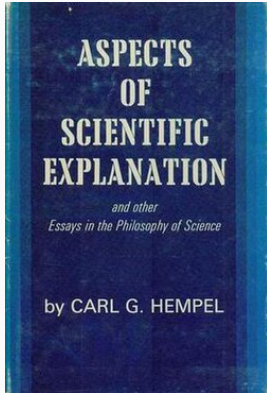


HaPoC: The history and philosophy of computing

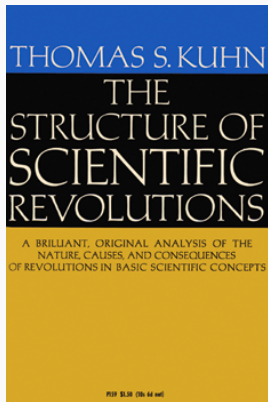
What can it mean?

Mid-20th C: Philosophy of science as logic



- **Logical empiricism** (e.g., Carnap, Hempel,...): analyse finished theories, not the messy history behind them
- **Confirmation:** (Carnap) given theory T and evidence e , how far does e support T ? Inductive logic.
- **Explanation** (Hempel): deduce e from laws plus initial conditions
- **Popper's rival view:** no induction. T is never confirmed, only survives attempts at falsification
- Shared assumption: *context of discovery* (history, psychology) is separate from *context of justification* (logic)

Kuhn's picture (1962): Revolutions!

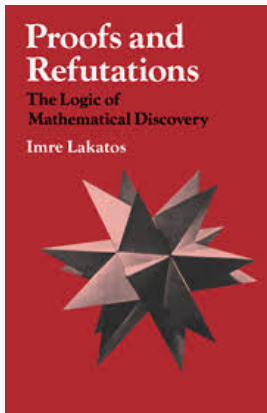


- **Normal science:** puzzle-solving inside a shared paradigm
- **Anomalies** accumulate, crisis follows, a **revolution** replaces the paradigm
- **Incommensurability:** rival paradigms do not share standards for judging each other
- Kuhn starts from what scientists actually did: **Case studies**
- The legacy: science became something with a *history* practised by a *community*, not just a method.
- Science is part of broader society.

Philosophy of science without history is empty, history of science without philosophy is blind. (N. R. Hanson, 1962)

Under the present dominance of formalism, one is tempted to paraphrase Kant: the history of mathematics, lacking the guidance of philosophy has become blind, while the philosophy of mathematics, turning its back on the most intriguing phenomena in the history of mathematics has become empty. (Lakatos, Proofs and Refutations, 1963-4)

Lakatos: history and philosophy together



- He began with **mathematics**: Cambridge doctorate (1961), with the essay on Euler's $V - E + F = 2$ published in four parts in 1963–64
- Method: a classroom dialogue where proofs meet counterexamples and are repaired, not discarded
- History chimes in through the footnotes

Does mathematics have revolutions?

Lakatos, 1976

Proofs and Refutations:
mathematics grows by
conjecture, counterexample
and revision, not by
accumulation of certainties.

Crowe's "no revolutions"

Michael Crowe (1975)
argued that revolutions
never occur in
mathematics: old results
are kept, not overthrown.

The 1990s reply

Gillies's edited *Revolutions
in Mathematics* (1992) and
Corry's work on structural
algebra asked whether
Kuhnian categories fit at all.

Close to what we're doing in the course: Groupoids, 2001

The importance of mathematical conceptualisation

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Abstract

Mathematicians typically invoke a wide range of reasons as to why their research is valuable. These reveal considerable differences between their personal images of mathematics. One of the most interesting of these concerns the relative importance accorded to conceptual reformulation and development compared with that accorded to the achievement of concrete results. Here I explore the conceptualists' claim that the scales are tilted too much in favour of the latter. I do so by taking as a case study the debate surrounding the question as to whether groupoids are significantly more powerful than groups at capturing the symmetry of a mathematical situation. The introduction of groupoids provides a suitable case as they score highly according to criteria relating to theory-building rather than problem-solving.

Several of the arguments for the adoption of the groupoid concept are outlined, including claims as to its capacity for reformulating existing theory, its ability to measure symmetry more systematically, and its 'naturalness'. This last notion is given an extensive treatment.

Outline

Abstract

Keywords

1. Introduction
2. Values in Mathematics
3. What is a Groupoid?
4. How Groupoids Compare with Groups
5. The Full Exploitation of One-Dimension...
6. Groupoid Algebras Used to Compensat...
7. Applications and Old Conjectures
8. New Prospects: Higher Dimensional Alg...
9. The Conceptual and the Natural
10. Conclusion

Science Studies: The social turn

Strong Programme

Bloor and the Edinburgh school (1970s): explain true and false beliefs by the same kinds of causes. Reject the idea that truth is explained by nature while error is explained by politics or bias; instead argue that all beliefs are socially negotiated and culturally situated.

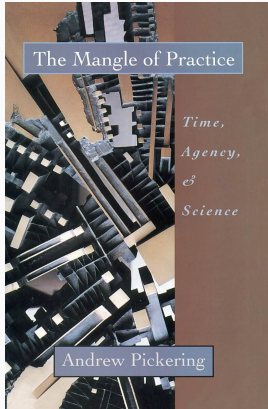
Laboratory studies

Latour and Woolgar (1979): ethnography of how facts get made in a lab. Track the daily routines of scientists to reveal that scientific truths do not simply exist in nature, but are meticulously manufactured through inscription devices, messy literary practices, and intense micro-political negotiations.

SCOT and ANT

Pinch and Bijker; Latour, Callon, Law (from 1984): technologies as outcomes of negotiation among human and non-human actors. ANT treats humans and non-humans (objects, technologies, laws, microbes) as equal actors within a network.

Pickering – The Mangle of Practice, 1995



...machines, instruments, facts, theories, conceptual and mathematical structures, disciplined practices, and human beings are in constantly shifting relationships with one another— “mangled” together in unforeseeable ways that are shaped by the contingencies of culture, time, and place.

Including a study of Hamilton's *quaternions*.

HPS comes to computing

Many avenues to explore:

- **Is computer science a paradigm?** Tedre and Sutinen describe three traditions: mathematical, scientific, engineering
- **Proof and trust:** De Millo, Lipton and Perlis (1979) argued that program verification is a *social process*; MacKenzie's *Mechanizing Proof* (2001) traces the fight over verified systems
- **Artifacts have politics:** Winner (1980); Star and Bowker on infrastructure and classification
- **Histories of computing:** Mahoney on the many communities that built “the computer”

How do computing concepts evolve?

How are they introduced into computing theory and practice?

Should we understand the evolution of concepts as necessary or contingent?

Can we speak of progress, and if so how?