

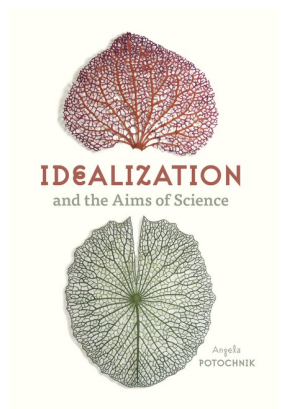
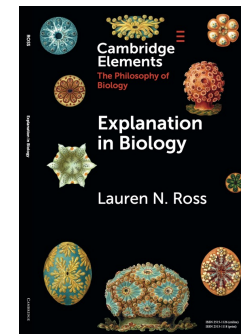
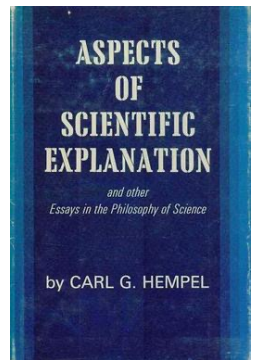
# Explanation in Biology: Principles and Pragmatics



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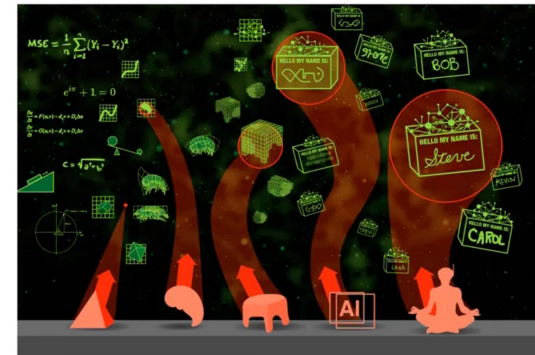


- Philosophy of Science
- Explanation
  - causal explanation
  - relevance other types too
- Tension
  - objective v subjective
  - when is a form/pattern explanatory?

What are the criteria for legitimate, genuine explanations?

### Platonic Space Symposium

- standard picture explanation limited
  - genes, environment, physical elements
- forms/patterns important role
  - impose on, cause, constrain outcomes



The First Symposium on **Platonic Space**  
and its Practical Consequences in Biology,  
Physics, Computer Science, and Philosophy

Michael Levin, and Hananel Hazan

2025

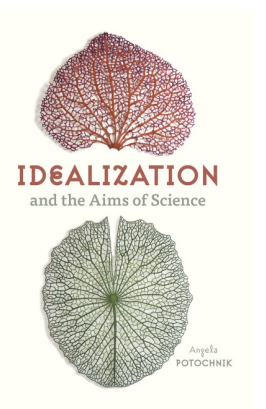
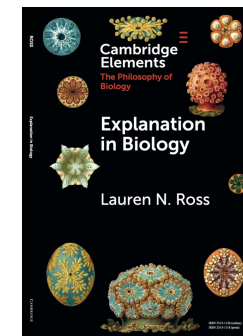
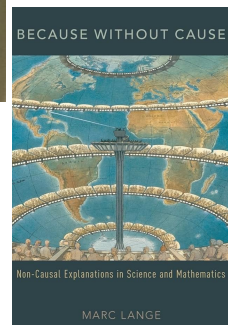
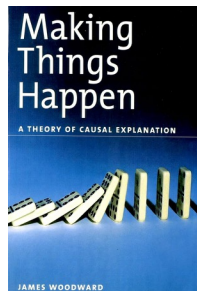
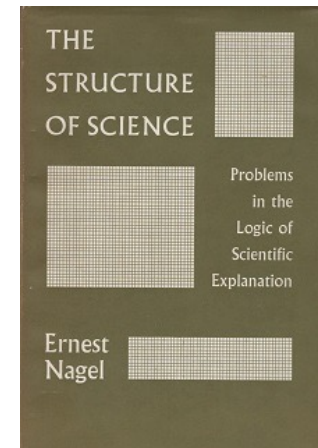
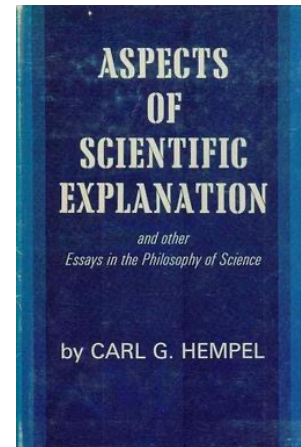
- Philosophy of Science
- Explanation
  - primary goal of science
  - form/structure/pattern (causal)

- Tension

--Explanation as:

- (1) **objective**, rigorous, principled
- (2) pragmatic, identified by scientists (humans)
  - subjective**, audience-relative
    - satisfying, persuasive (explainability xai)
    - (mere) verbal descriptions

How do we think about this? Resolve tension?

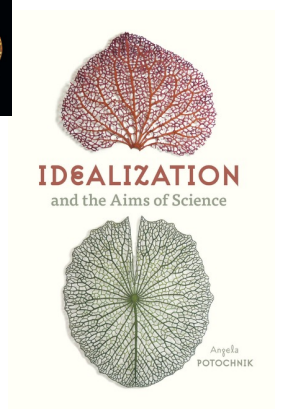
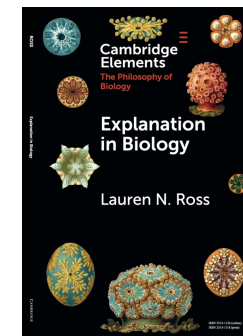
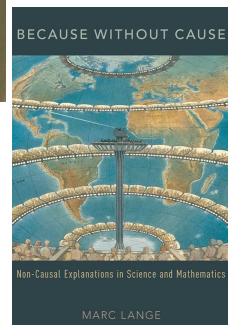
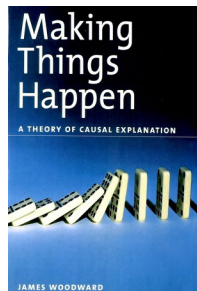
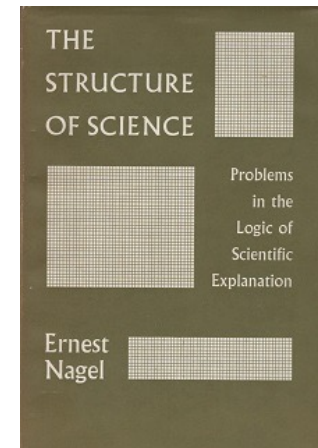
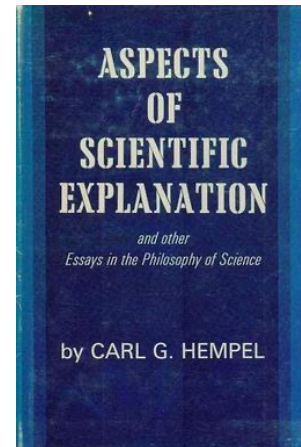


## How do we think about this? Resolve tension?

- (i) Given a well-defined explanatory target:
  - whether a causal patterns/form explains is a principled, objective matter
  - not anything-goes, not audience-relative
- (ii) However, explanations are also pragmatic
  - useful, functional for scientific goals (not mere subjective preferences)
- Causal explanation is **both** principled and pragmatic; model
  - provide analysis that supports (i) and (ii)

Plan:

- (1) approach philosophy
- (2) model explanation
- (3) control as principle, goal of explanation



# Philosophy of science

How do philosophers do this?  
Guidelines/standards of this research

- Providing an account of explanation in biology
  - “conceptual engineering”; functional, means-end approach
  - descriptive and normative

**goals:** control, prediction, etc.

how **do** scientists explain



how **should** scientists explain

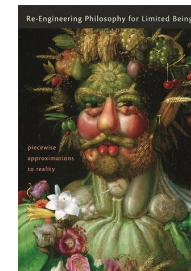


Approach involves both

- not easy
- powerful; guidance, advice

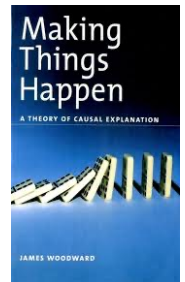
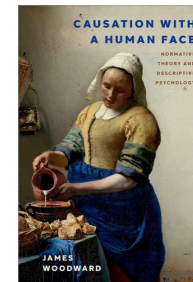
Here focus on how scientists reason

- We incorporate insights from cog sci, how humans reason (explain, etc.)



Re-Engineering Philosophy  
for Limited Beings

✧ PIECEWISE APPROXIMATIONS TO REALITY



## Explanation: three-part model

- Answers to why-questions
- Domain general account

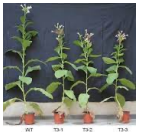
what does the  
explanatory work

*explanans*  
cause(s)



explanatory target

*explanandum*



## Distinguish explanation from other projects

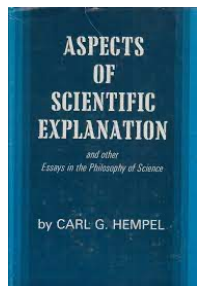
- description
- classification
- prediction



Give some understanding, but don't explain *why*

## How do we clarify distinction between explanation other aims?

- with causal explanation, main goal is **control**
  - interventionist account of causation (Woodward 2003)
  - can get description, classification, and prediction without this...

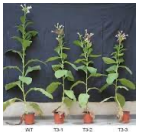




explanatory work



explanatory target



Explanatorily relevant causes, need to meet control criteria

Explanations provide information about what controls the target of interest

--**Minimal control**: does cause provide minimal control over target?

- handle cases:

- exclude bad explanation (5g wireless network, bull's eye rash)

- include good (germ theory)

--Helps with other challenges:

- sometimes suggested that there are infinite causes, just subjective choice about what explains

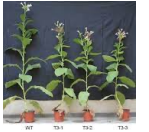
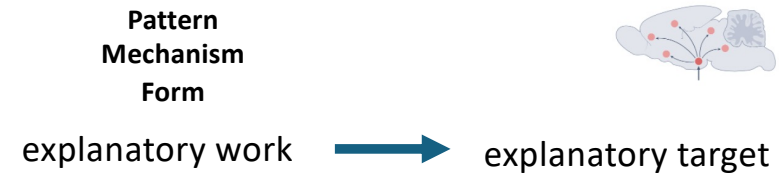
- (1) Big bang is a cause, as is entire causal history of target

- (2) Lower-level fundamental physics details are explanatory, infinite regress

Neither of these meets criterion of **minimal control**

- this criterion is excluding the right cases

Explanation isn't a game of how low can you go, but what gives you control



**Minimal control** is required for explanatory relevance

- but we want more than this

--Want explanations that also provide **better/ideal control, more control**

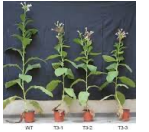
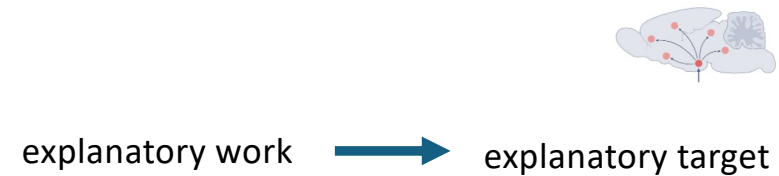
- include more causes, features to meet these criteria

--Targets are explained by many causes, interacting together

- Often called: **Pattern/Mechanism/Form**
- more causes, more control (black box)
- causes with “types” of control (stable, strong, fast, etc.)



# Tension



## What is objective about this?

- given well-defined explanatory target, factors with control is an objective, principled matter

## What is pragmatic about this?

- scientific goal of control
- useful, function for this goal
- also choice of what explanatory target to pick, when well-defined (yet) or not

## Specifying a well-defined explanatory target is an important, difficult step

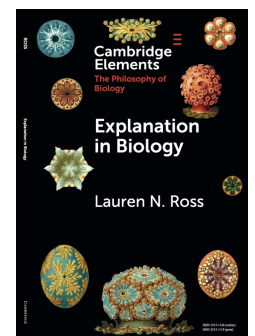
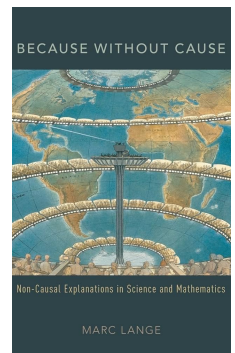
- need (i) contrastive focus
- (ii) clear definitions of terms, consciousness, intelligence
- (iii) target that is controllable (by things in the world)  
(a hard problem of scientific explanation)

# Causal explanation is:

- **selective** (some not all details matter)
- **principled** (control, not “capricious” or subjective)
- **relative** to the explanatory target
- **piecemeal** (no one, complete explanatory target, explain the system)
- Explanatory relevance criteria
  - control
    - minimal control (interventionism)
    - better/ideal/perfect control (causes with types of control: strong, stable, fast)
    - more control (intermediates)

# Conclusion

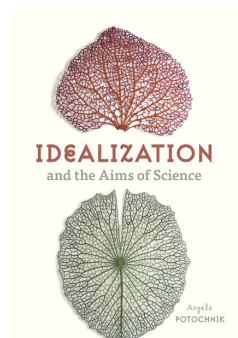
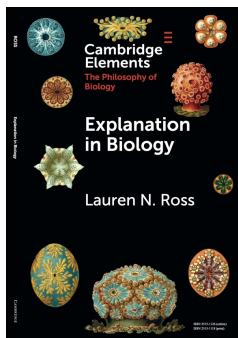
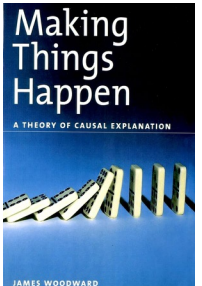
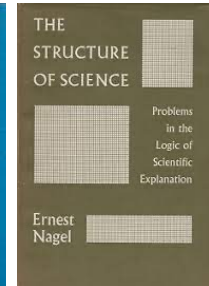
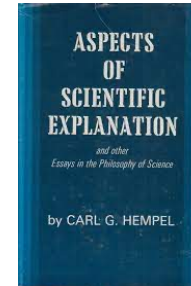
- Explanation is important, many implications
  - implications for responsibility, blame, what to target to remedy
  - important to capture when right, wrong: success science
  - if subjective/audience-relative, can't do this well
    - distinguish good explanation, from communication of it
- Philosophy that it descriptive and normative
  - guidance, advice; motivated by successful science
- Explanatory relevance criteria
  - important to consider what these are for types of explanation
  - principles and pragmatics, present without tension



# Thank you



NSF Career:  
#1945647



explanatory work → explanatory target