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# Critical Reasoning

## ‘A Typology of Inferences: Part II’

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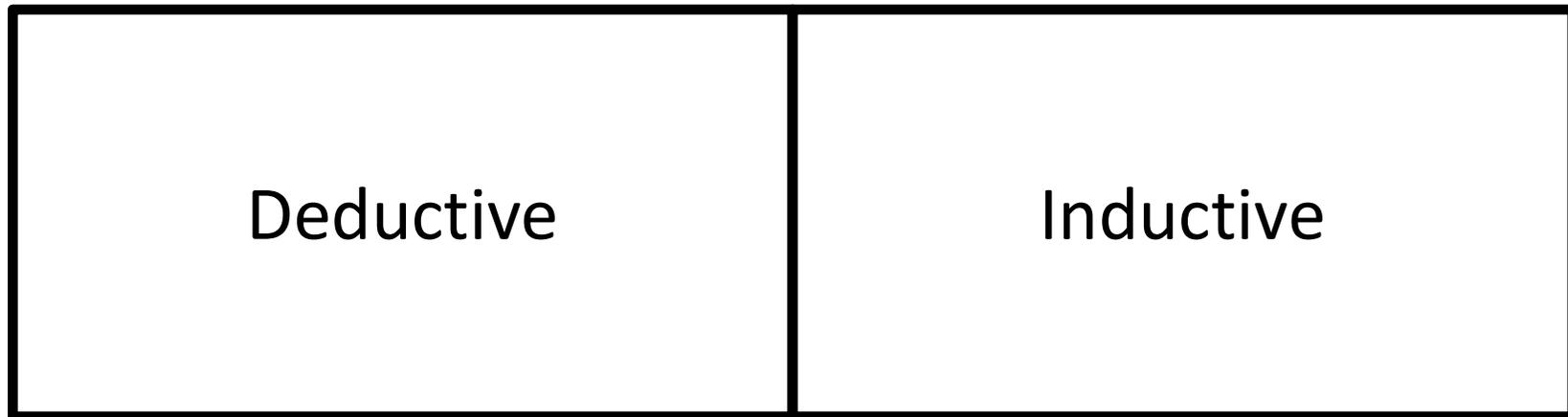
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# Induction

## The broad construal

- According to this construal, the set of inductive inferences is one and the same as the set of non-deductive ones.
- Inductive inferences are those where the (supposed) truth of the premises *fails to guarantee* the truth of the conclusion.

### Inference Types

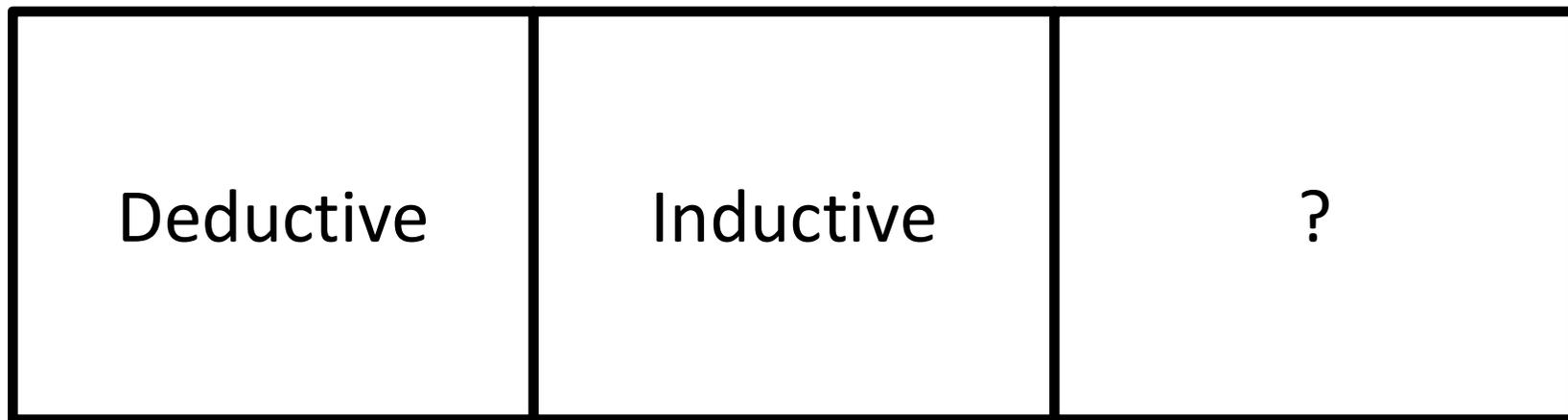


- On this view, there are only two inference types.

## Narrow construal(s)

- Some find the broad characterisation too coarse. As a result, narrow construals have emerged.
- According to *one* version, inductive inferences are non-deductive inferences from past to future observations.

### Inference Types



- On this view, there are three (or more) inference types.

## Novel content but at least some risk

- **Advantage:** Inductive inferences facilitate the production of new content.

*NB:* They are thus known as ‘ampliative’, ‘content-increasing’ and ‘non-demonstrative’.

- **Disadvantage:** Induction is, by definition, risky.
- Indeed, as you may imagine, this makes it a prime target for critique in philosophical discussions.
- It is also non-monotonic: An inductively strong argument may cease to have this quality once you add premises to it.

# Emulating deductive logic

- Proposals about a logic of induction have attempted model themselves after deductive logic (e.g. Carnap 1950).

## Deductive Logic

entailment

## Inductive Logic

degree of support

inductive strength

partial entailment

- Recall that in induction the premises do not guarantee the conclusion's truth but they may offer *some* support to it.
- A logic of induction is thus thought to be an *extension* of the logic of deduction from certain to uncertain reasoning.

# Absence of truth/content preservation



Premises

Conclusion

# Types of induction

- **Enumerative induction:**

Reasoning from one or more particular (observed) instances to all instances, i.e. generalising.

$A_1$ 's cerebellum has a muscle coordination function.

$A_2$ 's cerebellum has a muscle coordination function.

All subjects' cerebella have a muscle coordination function.

# Types of induction

- **Induction-to-the-next-instance:**

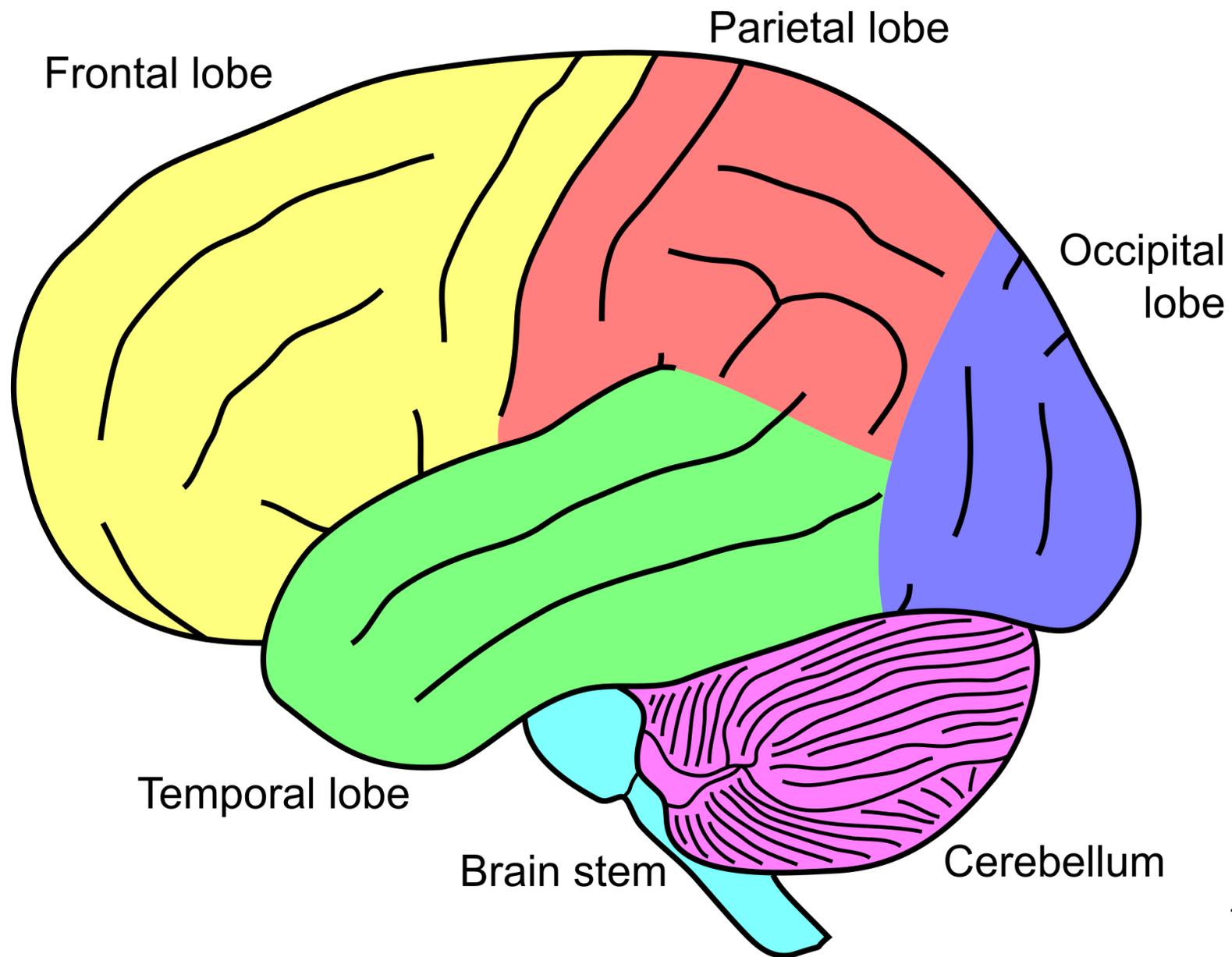
Reasoning from one or more (observed) instances to the next instance.

$A_1$ 's cerebellum has a muscle coordination function.

$A_2$ 's cerebellum has a muscle coordination function.

$A_3$ 's cerebellum has a muscle coordination function.

# The cerebellum



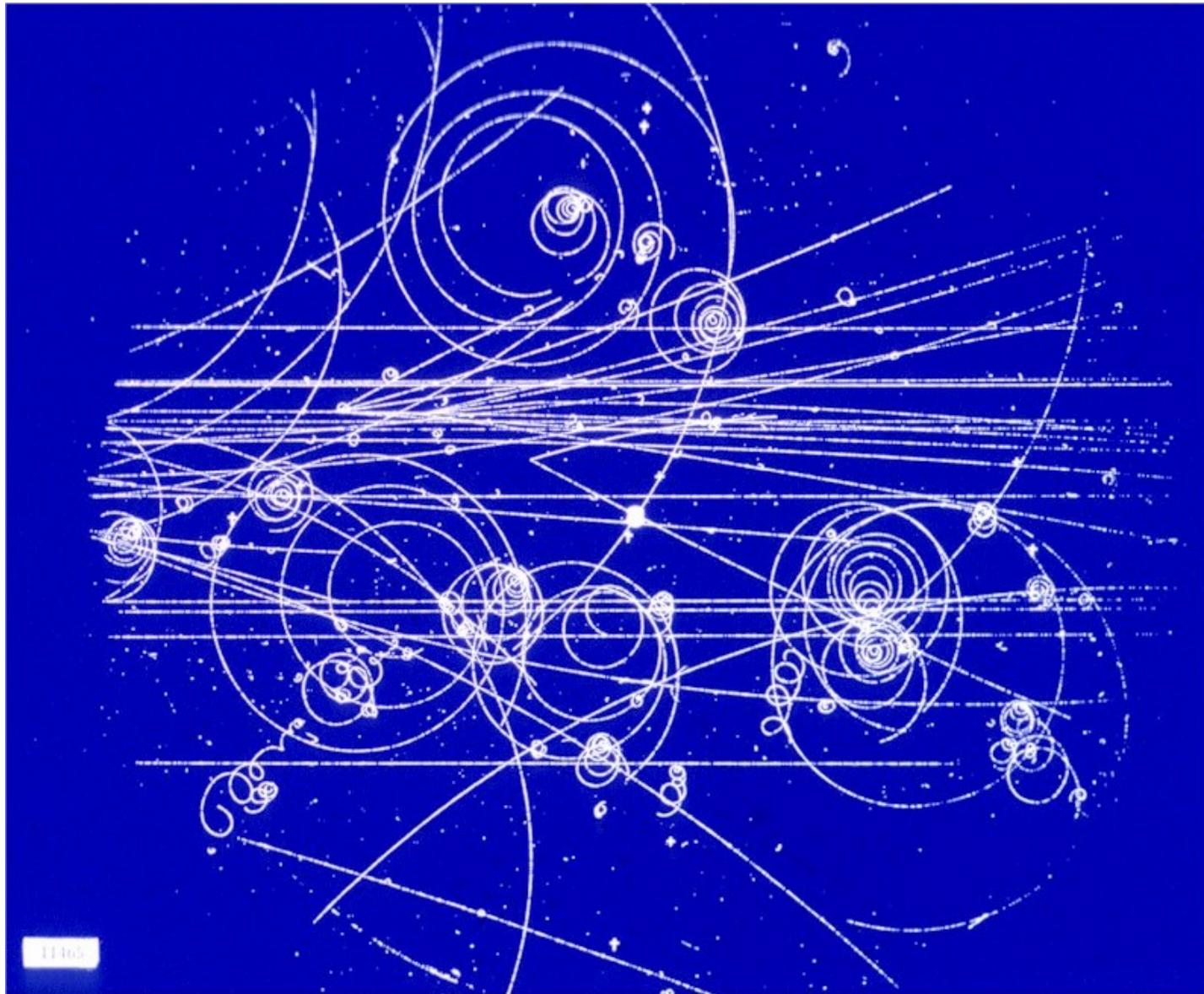
# Types of induction

- **Induction-to-unobservables:**

Reasoning from observables to unobservables.

Tracks  $g_1$  to  $g_n$  in photos have geometric properties  $\phi$ .  
The experiment generated  $w$  particles.

# Bubble chamber photograph



# Types of induction

- **Induction-to-causes:**

Reasoning from effects to causes.

Patient Z suffered from symptoms  $q$  and  $s$ .

Patient Z's symptoms were caused by disease  $\psi$ .

# Types of induction

- **Direct inference:**

Reasoning from frequencies about populations to frequencies about samples, i.e. sub-populations.

$m/n$  members of a population  $P$  are female.

$P_1$  is a sub-population of  $P$ .

$m/n$  members of  $P_1$  are female.

# Types of induction

- **Retrodictions:**

Reasoning from the present to the past.

Fossils exhibit a continuum of morphological features.

All past organisms have evolved through a process of slow cumulative change.

# Multiple instantiation

- Sometimes a token inductive inference may be the instantiation of one or more of the above types.

## Example:

Patient  $Z_1$  suffered from symptoms  $q$  and  $s$ .

...

Patient  $Z_n$  suffered from symptoms  $q$  and  $s$ .

All past patients with such symptoms were caused by micro-disease  $\psi$ .

This is an *enumerative induction, induction-to-causes, induction-to-unobservables & a retrodictive induction.*

# Inductive reasoning is

risk-free and  
content-increasing

risky and  
content-preserving

risk-free and  
content-preserving

risky and  
content-increasing

# Which of the following is NOT a type of inductive inference?

induction-to-unobservables

monotonic induction

retrodictive induction

induction-to-causes



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# Abduction

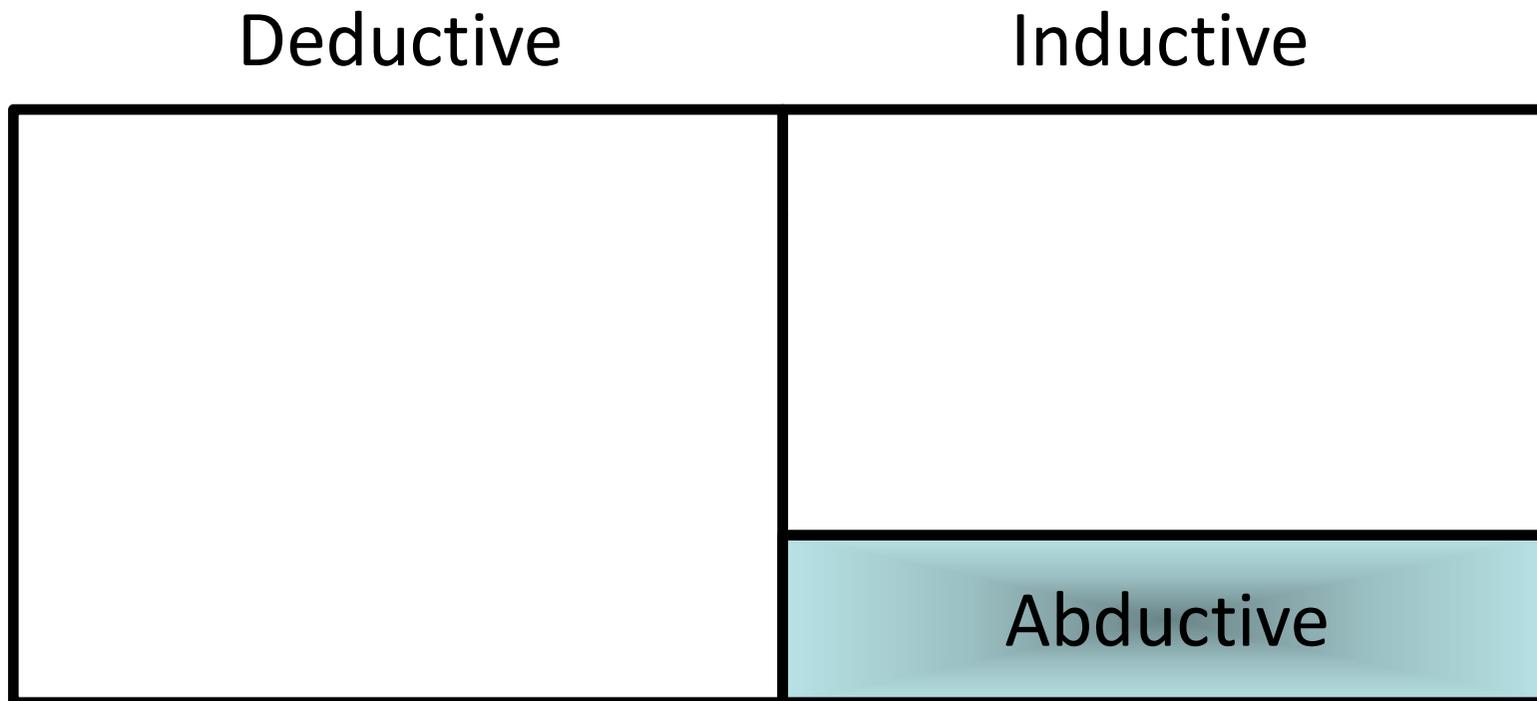
# Introduction

- Abduction is more commonly known as inference to the best explanation (IBE).
- **Terminology:** The term 'abduction' was introduced by C.S. Peirce (c. 1865). Harman (1965) coined the expression 'IBE'.
- If induction is construed narrowly, then (typically) abduction is classified as a separate type of inference.



## Introduction (continued)

- If induction is construed as broadly as possible, then abduction is classified as a form of induction.



# Abduction: Properties

- Like deduction and induction, abduction seems to be widely used, both in science and beyond.
- Unlike deduction but like induction:
  - \* it comes in various strengths
  - \* it is content-increasing
  - \* it is risky (though generally meant to be less risky)
  - \* it is non-monotonic

# Explanation and inference

- **Key idea:** Explanatory factors can guide inference.
- IBE counsels preference for the hypothesis that best explains the available evidence.

Premise 1

Premise 2

...

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∴ Conclusion

} Evidence

} Explanatory Hypothesis

**NB:** This reliance on explanatory factors is what sets IBE apart from inductive inferences like enumerative induction.

# Deciding the best

- In more detail, one inferentially determines the best hypothesis from a set of alternatives.
- What counts as ‘the best explanation’? Opinions differ but they tend to articulate it in terms of the notions of:
  - \* increased simplicity
  - \* increased unification
  - \* increased understanding
  - \* decreased ad hoc-ness

## Some credentials

“It can hardly be supposed that a false theory would explain, in so satisfactory a manner as does the theory of natural selection, the several large classes of facts above specified” (Darwin 1876: 421).

“In the present paper, I find an important confirmation of this most radical theory of relativity; that is, it turns out that the secular rotation of Mercury’s orbit in the direction of the orbital motion, discovered by Leverrier, which amounts to about 45” in a century, is explained qualitatively and quantitatively, without having to posit any special hypothesis at all” (Einstein 1915: 831).

# Example 1

## Evidence:

- \* tiny bite marks on cheese
- \* droppings
- \* imprints of small feet

## **Better (best?) explanation:**

A mouse ate the cheese.

## *Other explanations:*

A housemate's prank; a burglar ate the cheese.



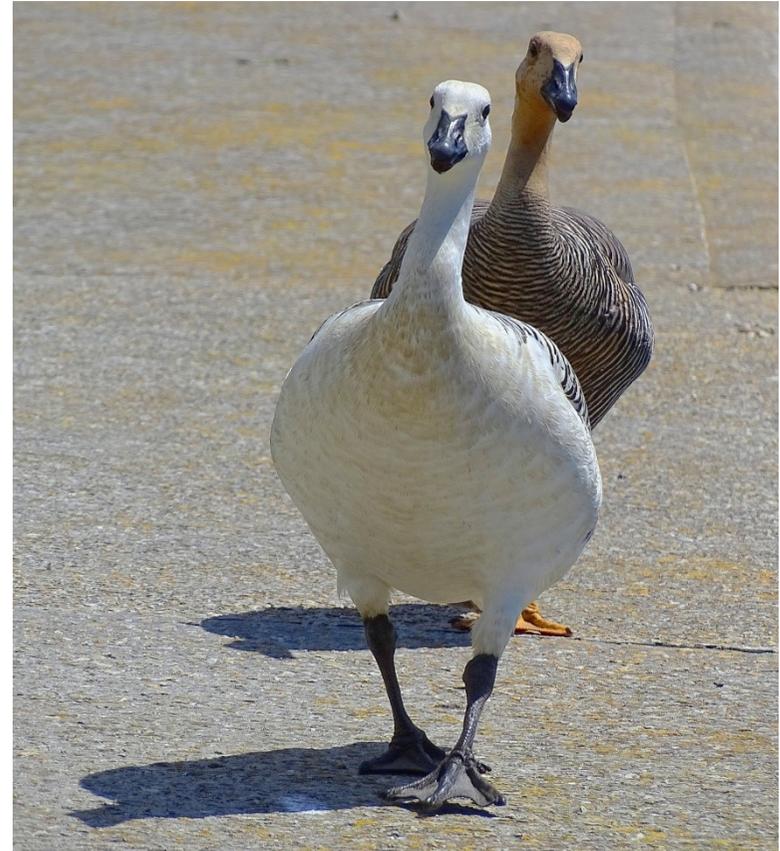
## Example 2

### Evidence:

- \* Fossils
- \* Artificial breeding
- \* Geographical variation
- ...
- \* Vestigial traits

**Better (best?) explanation:**  
Evolution by natural selection.

*Other explanations:*  
All-at-once creation; continuing creation.



## Example 2 (continued)

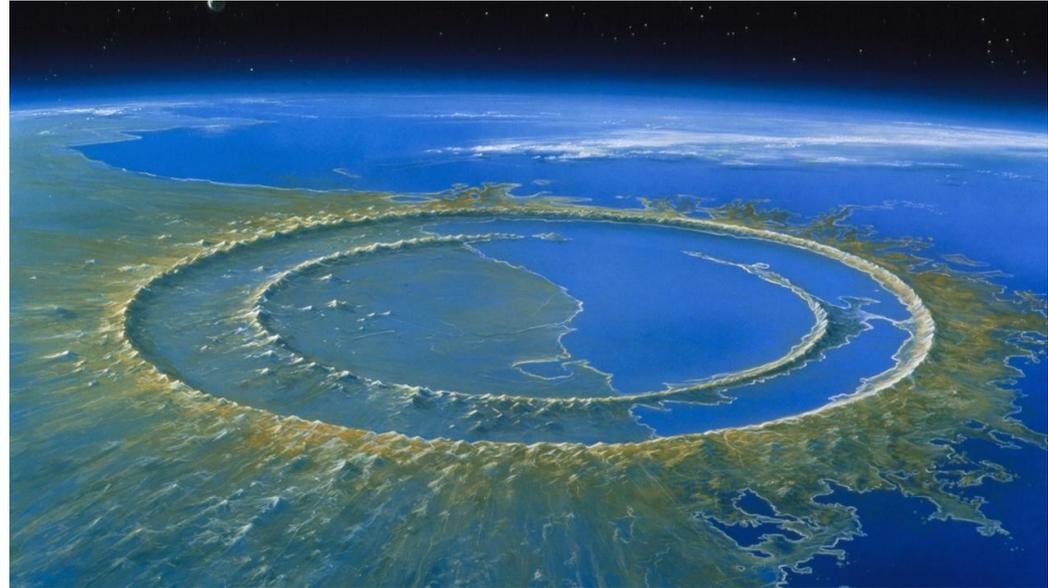
- A problem that turned out to be a confirmational boost:

Darwin: “With respect to the lapse of time not having been sufficient since our planet was consolidated for the assumed amount of organic change, and this objection, as urged by Sir William Thompson, is probably one of the gravest as yet advanced, I can only say, firstly, that we do not know at what rate species change as measured by years, and secondly, that many philosophers are not as yet willing to admit that we know enough of the constitution of the universe and of the interior of our globe to speculate with safety on its past duration” (1879: 409).

## Example 3

### Evidence:

- \* Chicxulub crater
- \* Iridium deposits
- \* Radiometric dating
- ...
- \* Tsunami sediments



### **Better (best?) explanation:**

Extinction caused by asteroid/comet impact 66 million y.a.

### *Other explanations:*

Cretaceous-Paleogene extinction caused by virus; alien abduction.

## No guarantees

- There is of course no guarantee that the best *available* explanation is true (van Fraassen 1989: 143).

**NB:** Known as ‘the best of a bad lot’ argument.

- If there were a guarantee, then we wouldn’t describe abductive inference as non-deductive.
- The real question is whether such inferences lead us, more often than not, to true conclusions.
- The task of experts in this field is to improve the principles of abductive logic.

**Abductive reasoning is \_\_\_\_\_ and appeals  
to \_\_\_\_\_.**

risk-free, deductive  
considerations

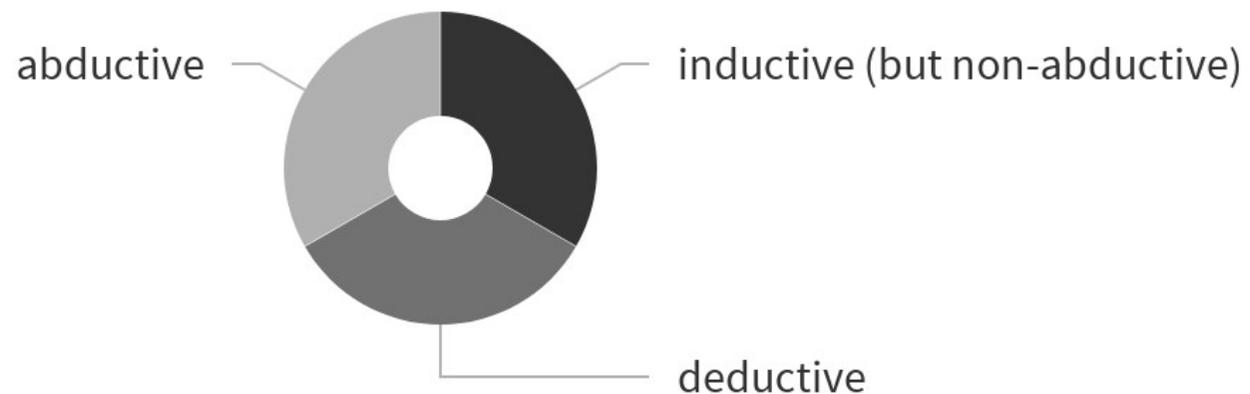
risky, deductive  
considerations

risky, explanatory  
considerations

risk-free, explanatory  
considerations

**What kind of inference is the following? 'All humans are mortal. Some humans are intelligent. Therefore, some mortals are intelligent.'**

 inductive (but non-abductive) **A**  deductive **B**  abductive **C**





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The End