

# Why almost everyone is wrong about the problem(s) of demarcation:



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‘For this is one of those disheartening instances  
where truth requires full as much bolstering as error.’  
(Herman Melville, *Moby-Dick; Or, The Whale*, ch. 45)

**WRONG!!!**

(Lex Luthor, *Superman Returns*, 2006)

# Why am I starting my talk about Aristotle and teeth?

Bertrand Russell: ‘Aristotle maintained that women have fewer teeth than men; although he was twice married, it never occurred to him to verify this statement by examining his wives’ mouths.’ (Russell, *The Impact of Science on Society*, Simon & Schuster, 7)

Aristotle: ‘Males have more teeth than females in the case of men, sheep goats, and swine; in the case of other animals, *other observations have not yet been made.*’ (Aristotle, *On the Parts of Animals*, Book III, emphasis added)

It’s heavily implied from the passage that *Aristotle made observations.*

# Why this matters

- Russell thought Aristotle was using a dialectical method to derive physical laws from metaphysics. But (as far as we can tell) he wasn't.
- While Aristotle was wrong (he likely miscounted--darn impacted molars!), Russell was *comically* wrong (Aristotle was a good empiricist).
- Russell screwed up exegesis of Aristotle. So what?
  - Even the most illustrious philosophers fail at basic exegesis.
  - Non-experts on Aristotle listen to Russell and continue to spread these myths on to the next generation of philosophers.
    - These actions compound on one another, producing a big game of scholarly Chinese Whispers, philosophic myths.
  - Philosophers should produce good scholarship, not shoddy work.
  - We should care about the truth!

# Overview

These structural problems in exegesis occur in philosophy of science:

- Philosophers of science routinely fail at basic exegesis of past philosophers.
- Philosophers of science pass on these myths to the next generation.

My talk covers two fronts:

- Almost everyone gets the territorial problem of demarcation wrong.
- Almost everyone gets Popper's demarcation criteria wrong, too.

Here's a helpful suggestion:

- Everyone that keeps getting these things wrong, please stop.

# The myriad ways people get territorial demarcation wrong

They're wrong about the *problem*:

1. The subject to be demarcated (Myth: science/nonscience. No, it's empirical significance/non-significance).
2. Purpose of demarcation (Myth: it's normative. No, it's territorial).

They're wrong about the *criteria*:

3. Number of criteria (One: falsifiability. No, it's falsifiability *and* predictability).
4. Scope (Myth: criterion of falsifiability applies to *isolated theories*. No, it's *theoretical systems*).
5. Whether criticisms accurately target these criteria (Myth: Duhem targets Popper's criteria. No, it doesn't).

# Almost everyone is wrong about the subject

The collected volume, *Philosophy of Pseudoscience* (2013), is illustrative of current scholarship: Popper's territorial problem of demarcation is repeatedly said to set out 'the distinction between science and nonscience in general' (Mahner 2013, 31; cf. Boudry 2013, 81; Nickles 2013, 101).

Pigliucci: 'Popper... wanted to distinguish scientific theories or hypotheses from nonscientific and pseudoscientific ones' (2013, 10; cf. Preston 1994, 320).

Mahner, Boudry, Nickles, Pigliucci and Preston are wrong about the territorial problem's *subject*: the territorial demarcation problem *isn't* about science/nonscience.

(They're wrong about another thing, too--we'll cover that in a moment.)

# Subject: If they'd only read primary texts

Popper said the demarcation problem is to 'provide a suitable distinguishing mark of the empirical, non-metaphysical, character of a theoretical system ... [that] would enable us to distinguish between the empirical sciences on the one hand, and ... "metaphysical" systems on the other' (1959, 11)

'Empirical sciences'? What's that? 'The system called "empirical science"... must satisfy the criterion of demarcation ... *i.e.* it must not be metaphysical, but must represent a world of possible *experience*' (ibid 16-17).

So... the scope to be demarcated is between the empirical and non-empirical character of these theoretical systems, *not* science vs. non-science.



# Subject: Where'd it go wrong? A bad translation

Popper, Julius and Ian Freed set out to faithfully translate *Logik der Forschung* (1934/5). They give a 'literal' one-to-one closest English equivalent of a German term.

'The original text of 1934 has been left unchanged for the purpose of the translation' (1959, xiv).

Popper's falsifiability criterion is as follows: '*it must be possible for an empirical scientific system to be refuted by experience*' (1959, 18).

The passage is a 'literal' translation of "*Ein empirisch-wissenschaftliches System muß an der Erahrung scheitern können*" (1934, 13).

# Subject: What's it say in the original German?

Popper likely translated this 'literally': Weibl and Herdina's English-German technical philosophical dictionary defines 'empirical science' as '*empirische Wissenschaft*... empirical knowledge, knowledge by experience, empirical generalisation' (1997, 120).

The closest English word to *Wissenschaft* is 'science'. But the two terms do not track each other's use: anyone that knows German knows 'Wissenschaft' is strictly broader than 'science'.

Popper carefully makes the distinction between 'empirical' ('empirischen') and 'natural' ('natur') when using the term 'science' ('Wissenschaft') to differentiate between 'empirical knowledge' and 'natural sciences'.

Too bad Popper took the 'literal' translation. Unclear writing produced bad exegesis.

# Purpose: Laudan, please, it's territorial, not normative

From Larry Laudan: Popper's demarcation criteria 'has the untoward consequence of contending as "scientific" every crank claim which makes ascertainably false assertions' (1983, 121). (See also Mahner (2013, 20) and Boudry (2013, 87)).

But *it doesn't matter* if there exists ascertainably false theoretical systems. We're not making any *normative* assessment, only determining whether a theoretical system is *empirically significant*.

If it's ascertainably false, it's ascertainably false *because it is empirically significant*. We have ascertained the crank claims are false because we got up out of the armchair and *tested them empirically*.

(Seriously, what's up with Laudan?)

# Almost everyone is wrong about the scope

What of his falsifiability criterion? Let's look at the criterion again: '*...it must be possible for an empirical scientific system to be refuted by experience.*' (1959, 18).

Popper repeatedly claims '*... we can indeed falsify only systems of theories*' (1983, 187; cf. 1934/5, 12-13; 1963, 56).

Popper is insistent on this: '*it is important to remember that [falsifiability] applies to theoretical systems rather than to statements picked out from the context of a theoretical system*' (1983, 178; 1963, 186, 256)

It's like (for some strange reason) everyone misinterpreted him for fifty-odd years.

So... falsifiability applies to *theoretical systems*, not individual theories.

# Scope: a bad argument about what is being demarcated

From Philip Kitcher: ‘one can appeal to naive falsificationism to show that *any* science is not a science’ (1982, 44): Kitcher notes an isolated theory can’t be scientific, for it requires auxiliary hypotheses in order to make any predictions. (See also Thornton (2016) and Putnam (1974)).

This is considered a debilitating objection, and one reason why Kitcher and Putnam reject Popper’s demarcation criteria.

But this issue is *exactly why* Popper’s criterion of falsifiability applies to *theoretical systems* and not *isolated statements*! (We’ll cover this in more detail shortly.)

# An even worse argument? The Duhem thesis and holism

- The Duhem problem says that it is difficult (or impossible) to locate error in the theoretical system. Holism is true, therefore falsification cannot occur in practice.
- That would be a powerful objection... if Popper's criterion of falsifiability wasn't applied to the entire theoretical system.
  - In fact (as mentioned previously), Popper repeatedly says 'we can indeed falsify only *systems of theories*' (Popper 1983, 187; cf. 1934/5, 12-13; 1963, 56)
    - Wait a minute, Popper's a *holist*!? He sure is! He's not dissimilar from Quine and Duhem on this point.
  - There is no problem of distribution of blame (the whole system is falsified), so no Duhem problem.
  - A better name than 'falsifiability' would be 'possibility of incoherence with low-level theoretical statements' (more on this later).

# They're also wrong about the *number* of Popper's criteria

It's conventional wisdom that Popper presented one criterion of demarcation: falsifiability.

The SEP article on Popper: Thornton (2016) says Popper set out falsifiability as the sole 'criterion for demarcating science from non-science.' (The same mistake is on the IEP page, too, if you're wondering. Two influential entry-points to the topic are *wrong*.)

Thornton is wrong about the solution's *scope*, *subject*, and *number of criteria*:

1. the criteria aren't about science/nonscience
2. falsifiability isn't even the criterion for individual, isolated theories
3. *there are two criteria* (we'll cover this in the next section)

# Popper's two criteria

- Popper's two criteria: one for *systems of sentences* and one for *individual sentences*.
  - *Empirically significant theoretical systems* must be **falsifiable**: the theoretical system must contradict a possible synthetic basic statement.
    - This is a limiting case of Ayer and Carnap's criteria of confirmation/partial confirmation and verification/partial verification.
  - *Empirically significant sentences* must be **predictable**: a synthetic basic statement must be derivable from the sentence not present in the theoretical system alone.
    - Popper's criterion of predictability is also a limiting case of Ayer and Carnap's criteria of predictability.



# Preliminaries

- Some synthetic sentences are uncontroversially empirically significant (*basic*); other synthetic sentences are presently controversial (*auxiliary*), in that they are not fully reducible to basic sentences.
- Meaning postulates  $\Pi$  (Lutz 2015) provide the necessary tools for derivation of basic sentences from auxiliary sentences. They are treated as *analytically basic* (Hempel 1951, 71-72; Carnap 1956).

# Basic statements (*B*-statements) under Popper

- A basic statement (*B-statement*) (Lutz 2012) is a statement that every member of an epistemic community would assent to through observation (Analogous to Hempel's (1966) and Quine's (1960) approaches).
  - '[I]t is a basis that is *not firm*. ... Our observational experiences are never beyond being tested; and they are impregnated with theories' (Popper 1959, addendum, 1972, 94).
- It is *uncontroversially treated as* empirically significant.
- A *B-statement* is empirically significant if it specifies the existence or nonexistence of an intersubjectively agreeable entity at a particular spatio-temporal location *k*.

# Analogies to Hempel and Quine

- Any assent is relative to a time and theoretical background of an epistemic community.
- *B*-sentences can only be assented to by accepting a corresponding *auxiliary system* (*A-system*): ‘Every description uses *universal* names (or symbols, or ideas); every statement has the character of a theory, of a hypothesis’ (Popper 1959, 94-95).
- Popper is practically a Quinean holist here, everyone.
  - The acceptance of corresponding *A*-system is necessary in order for an epistemic community to accept a *B*-statement.
- With the distinction drawn between *A*-systems and *B*-statements, what of the criterion of falsifiability?

# Auxiliary systems (*A*-systems) and falsifiability

- Auxiliary systems (*A*-systems) are sets of auxiliary statements (*A*-statements) and *B*-statements.
  - In virtue of being an *A*-system, not all members of the set are reducible to *B*-statements (Popper 1959, 256).
  - (**N.B.** This is but to restate the problem of induction.)
  - Using Lutz's (2012) formalism, we have the following...
- An *A*-system is *falsifiable* in *L* iff

$$A \cup B \cup \Pi \models \perp.$$

# Dummett

- A side-note: Michael Dummett (1976 124-126) recognised this:
  - ‘The fundamental notion for the account of the linguistic act of assertion [of *B*-sentences] is, thus, that of the *incorrectness* of the assertion... By making an assertion, a speaker rules out certain possibilities; if the assertion is unambiguous, it must be clear which states of affairs he is ruling out and which he is not... we know [a theoretical system is falsifiable] when we know how to recognize that it has been falsified’.
  - Unfortunately, Dummett concludes in a footnote that he does ‘not feel at all sure that this approach is correct’ and (as far as I know) does not pursue it.

# The criterion of predictability

Popper (1959, 65-66; cf, 95) says that in order to be predictive:

‘... the theory [must] allow us to deduce, roughly speaking, more empirical singular statements than we can deduce from the initial conditions alone. ... A theory is to be called ‘empirical’ or ‘falsifiable’ if it divides the class of all possible basic statements unambiguously into the following two non-empty subclasses. First, the class of all those basic statements with which it is inconsistent (or which it rules out, or prohibits): we call the the class of the *potential falsifiers* of the theory; and secondly, the class of those basic statement which it does not contradict (or which it “permits”).

# Popper's error: why almost everyone makes this mistake

Nobody escapes unscathed. *Not even Popper.*

Popper sets out his criterion of 'falsifiability' of *theoretical systems*, and his criterion of 'falsifiability' of *individual statements*. He uses the *same term for two distinct criteria!*

In the very next section, he says: 'As to falsification, special rules must be introduced which will determine under what conditions a system is to be regarded as falsified' (1959, 66). (**N.B.** These are his 'methodological rules'/or *normative criteria*.)

Really, who in their right mind uses the same term for different criteria?

Ayer (1946) (of all people) correctly identifies the second criterion of individual statements as one of *predictability*.

# Empirical significance of auxiliary statements

- Following Lutz's (2012) formalism, an auxiliary statement (*A-statement*)  $\alpha$  is *B-predictive* in  $L$  iff for any set  $\{B\}$  of *B*-statements, any set  $\{A\}$  of an *A*-system and for any *B*-statement  $\beta$ ,

$$\{A\} \cup \{B\} \cup \alpha \cup \Pi \models \beta$$

$$\{A\} \cup \{B\} \cup \Pi \not\models \beta$$

$$\alpha \cup \Pi \not\models \perp$$

- *A*-statements that do not entail any *B*-statements are empirically non-significant.
- *A*-statements that do entail at least one *B*-statement are empirically significant.



# Quick summation

- The conjunction of the criteria of falsifiability and predictability are (so Popper thought) both necessary and sufficient to bypass the tacking problem:
  - It is possible to determine which members of a system are not empirically significant and which members of a system are empirically significant.
  - Since we are operating on the level of sentences rather than on the level of (Carnap's) theoretical frameworks, if an empirically non-significant statement should be appended, *what of it?*
    - Not analogous to Carnap's question of whether a theoretical system is 'cured' of infection (metaphysics).
    - Analogous to whether some cells within an 'organism' are alive (i.e. contains empirically significant content).

# Limited to two criteria: falsifiability and predictability

1.  $\beta_1$  is necessarily a member of a falsifiable theoretical system in order to be predictive:
  - a. Consequently,  $\beta_1$  in conjunction with its negation,  $\beta_2$ , leads to a contradiction (and therefore  $\beta_1$  is not an irrelevant conjunct).
2.  $\beta_1$  is (trivially) predictive.

$$\{A\} \cup \beta_1 \cup \beta_2 \cup \Pi \models \perp$$

$$\{A\} \cup \beta_1 \cup \Pi \models \beta_1$$

$$\{A\} \cup \Pi \not\models \beta_1$$

$$\beta_1 \not\models \perp$$

# Worse than Duhem? Arguments attributed to Quine's holism

1. But what of the analytic/synthetic distinction? We already have a criterion of empirical significance for sentences independent of syntheticity, i.e. 'basic sentences' aren't parasitic on syntheticity. Call it 'schmanalytic'/'schminthetic'.
2. But what of the fact that our 'web of belief' faces the 'tribunal of experience' only as a 'collective body'? Yes, Popper explicitly *advocates* holism.
3. But what of Quine's thesis that we can change any auxiliary statements in order to save the theoretical whole? Yes, that's true, but *trivial*. This fact doesn't conflict with territorial demarcation criteria. Popper's methodological rules (i.e. his normative criteria) are designed to eliminate this option as *ad hoc*.
  - The dialectic moves on to whether we should accept these rules (or revise them), and on what grounds we should accept (or reject) them.

# To recap

	Auxiliary	Basic
Analytic	Empirically non-significant	Empirically non-significant
Synthetic	Iff member of a falsifiable system and <i>B</i> -predictive, empirically significant  Otherwise, 'metaphysical'	Iff member of a falsifiable system and <i>B</i> -predictive, empirically significant  ( <i>Isolated existential statements?</i> )

# Isolated existential statements are not predictive

- But what of *isolated existential statements*? For example, ‘There exists a unicorn’, ‘There exists atoms’, ‘There exists cats on mats’...
- They *appear to be* synthetic basic statements, but...
  - An existential statement is predictive only insofar as it is a member of the consequence class of a falsifiable system and specifies a spatio-temporal region  $k$  (Popper 1983, 185; 1974, 1038).
  - If isolated existential statements *are* a logical consequence of a falsifiable system, still *not* predictive, for its inclusion makes no predictions about a spatio-temporal region  $k$  (*ibid.* 1983, 161).
  - Popper (*ibid.* 48) concludes: ‘On the basis of the criterion of demarcation... I shall therefore have to treat strictly existential statements as non-empirical’.

# What about isolated existential statements?

- Kneale (1974, 207): ‘there is a strange departure from the ordinary use of words in ... denying that [isolated] existential statements can ever deserve the... title [of empirical significance]. ... Indeed, if the word “empirical” is to be applied at all to propositions... , there is a much better case for applying it to those which may be *established* empirically...’
  - This is the *problem of concept-change* faced by Carnap (related to Frege’s *paradox of analysis*): any explication does not capture our intuitive concepts, thus the explication must be rejected.

# Removing motivations for isolated existential statements.

- A conjecture: it isn't (solely) the verifiability/confirmability criteria *per se* that produces the problems that plagued Ayer and Carnap's criteria; it is (in part) the *inclusion* of isolated existential statements that leads to the problems of irrelevant disjunction and conjunction.
- We may think, like Carnap, that the negations of empirically significant sentences must *also* be empirically significant.
- Consequently, since isolated existential statements are the negations of universal statements, they are empirically significant.
  - Again, we are not dealing with Carnap's linguistic frameworks; we're categorising *sentences* and *theoretical systems*, not *linguistic frameworks*.

# Reasons for rejecting isolated existential statements

- Isolated existential statements are necessarily consistent with any and all possible *B*-statements, both existential and non-existence statements.
  - The acceptance of the *B*-statement, ‘There does not exist an *X* at spatio-temporal locations  $k_1, k_2, \dots, k_n$ ’ does not entail the rejection of ‘There exists an *X*’.
- Two inconsistent isolated existential statements are also consistent with any and all possible *B*-statements:
  - For example, ‘There exists at most one tree inside the nearest black hole that bears only red fruit’ versus ‘There exists at most one tree inside the nearest black hole that bears only green fruit’.
- These features are shared with paradigmatic metaphysical theories, such as the multiple versions of idealism and materialism.



# To sum up

1. Manher, Boudry, Nickles, Preston, Pigliucci, Kitcher, Laudan, Thornton, Putnam, Kneale, Carnap, Quine and almost everyone else in philosophy of science are wrong about:
  - Popper's territorial demarcation problem (scope and purpose)
  - and/or Popper's demarcation criteria (number of criteria, subject, compatibility with holism).
2. Even papers designed to rectify mistakes contain basic errors (cf. Wedeking, 1969).
3. Popper in 1959 is a *horrible* translator of Popper in 1934/5. He also had a knack for using the same name for explicitly different criteria and problems of demarcation (ever wonder why there are *two* problems of demarcation? Horrible translation. Just... horrible.).

# Some broad philosophic morals

- There's an upside: we can learn from our mistakes (and the mistakes of others):
  - Gallant reads *both* primary and secondary literature charitably *and* critically.
  - Goofus relies solely on secondary sources to provide a summary.
  - Gallant checks whether criticism accurately targets a position.
  - Goofus uncritically accepts philosophic myths and 'received wisdom'.
  - Gallant approaches book reviews fairly.
  - Goofus only cares about writing that unfavourable review.
  - Gallant attempts to accurately characterise a philosophical position.
  - Goofus tells their students what they heard as an undergrad in Philosophy 101.

# A narrow moral for philosophers of science

- Why should we care?
  - Like the myth of Aristotle's teeth, these myths do a disservice to
    - the next generation of philosophers
    - philosophic scholarship in general
    - yourself
- We all make mistakes. That's fine.
  - *You now know better.*
  - Don't commit these errors!

# Thanks for listening!

In the words of LeVar Burton on the PBS television show, *Reading Rainbow*:

‘Don’t take *my* word for it!’

Do your own research on your own time.

Contact me at [nathan.oseroff@kcl.ac.uk](mailto:nathan.oseroff@kcl.ac.uk) and tell me I misread everyone.

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