1. **Background**

1.1. *The No Miracles Argument*

NM1. Current scientific theories are empirically successful.

NM2. The approximate truth of these theories best explains their empirical success. [probably]

NM3. ∴ Current scientific theories are approximately true. (From NM1, NM2)

1.2. *The Pessimistic Induction*

PI1. If current scientific theories are approximately true, then past theories cannot be.

PI2. These past theories were empirically successful.

PI3. If current scientific theories are approximately true, then past theories are not approximately true, but are nevertheless empirically successful. (From PI1, PI2)

PI4. For all statements \( p \) and \( q \), if \( p \) is false when \( q \) is true, then \( p \) is not the best explanation of \( q \).

\(~\text{NM2}\). If current scientific theories are approximately true, the approximate truth of a theory is not the best explanation of its empirical success. (From PI3, PI4)

• Earlier realist responses to the PI challenge PI2, by having a more demanding notion of empirical success, e.g. Worrall’s restriction to theories that make novel (and general) predictions

• However, some past theories make these novel predictions, but are still regarded as false by our current theories. (ether theory, caloric theory) What should realists do about these cases?

2. **Divide et impera**

2.1. *The Argument*

DI1. If our current scientific theories are approximately true, anything that generates novel empirical successes and has been retained in our current scientific theories is also approximately true.

DI2. The theoretical laws and mechanisms (*constituents*) that generated the novel successes of past theories have been retained in our current scientific theories.

DI3. ∴ If our current theories are approximately true, then the constituents of past theories that generated the novel successes of past theories and that have been retained in our current scientific theories are approximately true. (From DI1, DI2)

• Strictly speaking, DI3 does not falsify PI1; a past theory may not be approximately true on the whole, even though some of its constituents are approximately true.

• Nevertheless, DI3 shows that realists don’t need theories to be approximately true on the whole.

2.2. *Psillos and Worrall*

Worrall would accept most of the divide et impera argument (§2.1), but would replace “constituents” with “structures.” (All structures are constituents, but not all constituents need to be structures.)

Psillos defends his broader realist view with the following two points:

• First, there is no sharp distinction between structure and nature/content.

• Second, Psillos offers the following, which I’ll call the “Flimsy Structure Argument”

FS1. Either a mathematical equation is given a physical interpretation or it is not.

FS2. If a mathematical equation is not given a physical interpretation then it cannot generate a novel empirical success.

FS3. ∴ If a mathematical equation generates a novel empirical success, then it is given a physical interpretation. (From FS1, FS2)

FS4. If structural realism is true, then only physically uninterpreted mathematical equations can be theoretical constituents that generate novel empirical successes.

FS5. ∴ Structural realism is not true. (From FS3, FS4)

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1 This is (A) on page S307.
2 (B) on p. S307
3 (C) on p. S307.
2.3. **When do constituents generate a novel success?**

“Suppose that H together with another set of hypotheses H’ (and some auxiliaries A) entail a prediction P. H indispensably contributes to the generation of P if H’ and A alone cannot yield P and no other available hypothesis H* which is consistent with H’ and A can replace H without loss in the relevant derivation of P.” (S309)

3. **The Hindsight Objection**

3.1. **The Objection**

Note that the Divide et Impera Argument requires a constituent to both:

(a) *Generate* the novel success and
(b) *Be retained* in current theory.

The Hindsight Objection is the worry that (b) unduly influences realists’ judgments of (a):

- “…realists are bound to first identify that past constituents that have been retained and then proclaim that it was those (and only those) that contributed to the empirical success and which enjoyed evidential support.” (S311)

3.2. **Psillos’ Reply**

Scientists adopt different attitudes to various constituents of their theories, taking some constituents to be responsible for a novel success, and others to be “too speculative, or too little supported by the evidence” (S311)

Moreover, scientists are reliable in making these judgments: if a scientist believes that a theoretical constituent generated a novel success, then it is very likely that he/she is correct.

4. **The Reference Objection**

4.1. **The Objection**

R1. If a theoretical constituent is approximately true, then its central terms genuinely refer.
R2. “Ether” and “caloric” are central terms of past theories that do not refer.
R3. ∴ Any theoretical constituent positing “ether” or “caloric” is not approximately true.

4.2. **Psillos’ 1st Reply**

P1. Most scientists who worked on the caloric theory denied that there was enough evidence to believe in the existence of caloric.
P2. If a scientist believes that a theoretical constituent is not essential, then we should not be realists about that constituent. (See §3.2)
C. “Caloric” does not refer, but this is no threat to (Psillos’) realism. (From P1, P2)

4.3. **Psillos’ 2nd Reply**

A theoretical constituent is approximately true if its central terms *approximately* refer.

A theoretical term “α” *approximately refers* if:

1. α is an entity posited by a past theory, and we no longer believe in α;
2. β is an entity posited by our current theories and we believe in β;
3. β has some, but not all, of the attributes that were ascribed to α; and
4. β is considered to be causally responsible for the same phenomena as α.