

## **Realism and Instrumentalism: Comments on the logic of factual support**

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### **From defender of realism to the “enemy of science”**

Feyerabend's career begins in the 1950s where he is a defender of realism, largely on Popperian grounds. By the mid-60s, he is beginning to wander away from these early views and introduces such notions and incommensurability, and by the end of the decade, gave up any attempt to see himself as an empiricist. Heavily influenced by Kuhn, published *Against Method* in 1975, arguing that scientific revolutions are irrational and scientists are methodological opportunists; put forward notion of “epistemological anarchism”. Feyerabend became known as a relativist who saw science changing, but not “progressing”. Resigned from Berkeley in 1990, and returned to Europe. Died in 1994. After his death, a festschrift was published in his memory entitled *Worst Enemy of Science?* Among the claims of his later career are that scientific success is a myth, and that society should be protected from the tyranny of science, just as it is protected from other ideological views like religion.

### **Realism vs. Instrumentalism**

- *Realism*: “...[scientific] knowledge is descriptive of (general or particular) features of the universe.” (176)
- *Instrumentalism*: “...even a theory that is wholly correct does not describe anything...” (176)

Feyerabend argues that realism is preferable to instrumentalism.

### **Distinction is not purely verbal.**

Some instrumentalists offer physical arguments for their point of view.

“...[Realists] cannot rest content with the general remark that theories *are* descriptions and not merely instruments. He must then revise the accepted *physics* in such a manner that the inconsistency [with observation] is removed; i.e. he must actively contribute to the *development* of factual knowledge rather than make comments, in a ‘preferred mode of speech’, about the *results* of this development.” (177)

Feyerabend is arguing here that only realists are so motivated. Instrumentalists, if they offer only to explain known observations, are content with mere correct predictions.

### **Aristotelian Dynamics and the Copernican Revolution**

In favor of Aristotelian Dynamics:

- Empirical success (good agreement with observation)
- Theoretical success (solved philosophical concerns)
- Comprehensiveness (generality)
- Consideration of details (better than rival atomist theories of the time)

Conclusion: Earth must be at rest.

Ptolemy, regarding those opposed to his planetary system and its Aristotelian foundations:

*“These persons forget however that, while, as far as appearances in the stellar world are concerned, there might perhaps be no objection to this theory in the simple form, yet to judge by the conditions affecting ourselves and those in the air above us such a hypothesis must seem to be quite ridiculous.” (180)*

Was Ptolemy a realist about his own system of planetary motion?

- Aristotelian physics still had not been overthrown (though cracks were showing) at the time Copernicus made his new model of the solar system.

“There was no independent evidence in favour of the heliocentric theory; this theory was, at least initially, a conjecture that had no foundation in empirical facts.” (182)

Compares Copernican system to a new choice of coordinates. These can make a problem easier to solve, but such a choice does not necessarily have dynamical implications. (183)

- As long as Aristotelian physics held sway, only an instrumentalist interpretation of the Copernican theory was possible.
- This conclusion does not depend in any way on epistemology.
- Religious arguments (that the Copernican system contradicted the Bible) were more common than those from Aristotelian physics. (184)
- Epistemological considerations were employed in the service of defending the Biblical view.
- Attacking philosophical views does nothing to counter the factual claims made against the physics.

“Predictive success in astronomy is therefore no indication of truth and of factual relevance. Proof alone is.” (184)

**Goal:** attack instrumentalism where it is strongest, on the basis of facts and not philosophy.

### Quantum Mechanics

- Quantum discontinuity leads to the quantum postulate (no intermediate states)
- No reference to knowledge or observability
- Anti-positivists expose fallacy of nonexistence  $\leftrightarrow$  unobservability, but do not address the physics
- Predictability also misses the point: Bohr says no is there to predict
- Classical mechanics is not the proper theory to analyze quantum mechanics

Feyerabend would have us abandon notions of position and momentum as defined by classical mechanics, and introduce *new notions* to explain quantum mechanics that will be well-defined when working in this theory. (189)

Bohr explicitly rejects this approach.

“If...the state function of some quantum theory should happen to develop in a well-defined fashion, then this development cannot have any real significance, it cannot correspond to any process in nature; that is, it can at most be regarded as an instrument of the prediction, different at different times, of observational results.” (190)

“These reasons are of precisely the same character as were Ptolemy’s: a realist interpretation of the quantum theory is bound to lead to incorrect predictions.” (190)

### Wave-Particle Duality

- Interference patterns cannot be accounted for realistically as conservation laws remain in effect
- Cannot be accounted for by action at a distance
- Popper (and others) attempt to employ a stochastic process to explain results – conservation laws only valid for large collections of particles
- Stochastic account must be developed in sufficient detail to account for large-scale behaviour. Until that is done, indeterminate states become only viable account

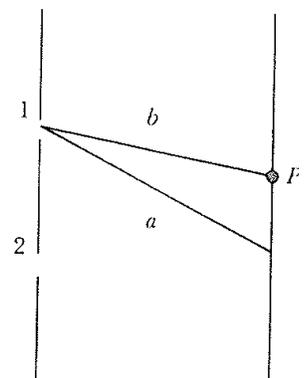


Fig. 2

Followers of the Copenhagen interpretation argue that their view must be *retained forever*, and that it be the foundation for any future physics at the atomic level.

“For many physicists it was therefore nothing but a stepping stone on the way to a really satisfactory theory, i.e. to a theory which could give us not only correct predictions, but also some insight into the nature and dynamics of microscopic entities.” (194)

Wave Mechanics, developed by De Broglie, Schrödinger, and others, attempted to form a strictly realistic account of quantum effects and introduced the stochastic effects mentioned above. This theory introduces inconsistencies with known physical laws. Such inconsistencies will need to be worked out if anything more than an instrumentalist interpretation is to be adopted.

### **Common factors in the Copernican Revolution and Quantum Mechanics**

- Both were initially interpreted instrumentally due to conflicts with accepted scientific theories at the time they were advanced
- Copernican system eventually lead to new dynamics and the triumph of the realist position
- This is an argument for, not against, realism
- The success of the Copernican theory could not be foreseen at the time it was introduced

### **If the success of scientific theories cannot be foreseen, how can this justify a realist interpretation?**

How can the future successful theories to be culled from the much larger mass of crazy nonsense?

### **The final answer lies in empirical support.**

- Aristotelian dynamics was successful, but it was rightly rejected in the light of new evidence it could not explain.
- Not even direct observational reports are exempt from criticism
- Contradictions must be investigated to determine how they affect existing or future theories
- It is the willingness to test that separates good science from the crazy nonsense
- “...[T]hese further theories [should] be developed in their strongest possible form, i.e. as descriptions of reality rather than as mere instruments of successful prediction.” (200)

### **We hide from ourselves the weaknesses in theories which we happen to believe in.**

Alternative theories allow us to test alternatives to existing theories where our instruments cannot necessarily directly given pre-existing knowledge.

### **This leads to a methodological justification for realism.**