Kitcher

Believing Where We Cannot Prove

Should We Accept the Traditional Contrast Between Science and Religion?

- Is Evolutionary theory conjecture, faith, or "philosophy"?
- What does it mean to be a science?
- If something is a science, what are it goals and objectives?
- Kitcher: "Virtually all of science is an exercise in believing where we cannot prove. Yet, scientific conclusions are not embraced by faith alone."

Is There Ever Conclusive Evidence?

- There's little doubt that 2+2=4 or that you are sitting in a desk and I'm pacing about the front of the room
  - There seem to be some things that we do not doubt and find little reason to doubt
- But, in our deeply skeptical, "philosophical" moods, we might find reason to doubt lots of things
  - Is there ever anything about which we can be absolutely certain? Aren't we, as humans, fallible beings?

Scientific Reasoning and Proof

- Kitcher thinks that sometimes we might have conclusive reasons for accepting a claim as true
  - But, he thinks we should not include scientific reasoning as an example of absolute proof
  - All scientific reasoning is fallible: "Fallibility is the hallmark of science."
- Scientific reasoning can be proven wrong when new evidence arises
  - But, when history proves a scientific theory wrong it does not show that the scientists were unjustified in holding that theory
  - The evidence supported their theory and the scientists were justified in holding that theory

Why Is Science Fallible?

- Natural science is not natural history
  - Natural history provides a record of things we have witnessed
- Natural science attempts to discover laws that hold universally
- Using these universal laws, science advances claims about things beyond our power to directly observe
  - E.g., nuclear physics and laws governing radioactive decay: laws thought to be true for this element throughout the universe; physicist restricted in what he can actually observe

How Is Science Possible?

- How is it that we have confidence about the far corners of the universe or subatomic particles?
  - Scientists use clues from what we **can see** to make indirect arguments about what we **cannot see**
  - New discoveries can call these arguments into question showing that the evidence has been misread
  - When scientists talk about seeing molecules, they are presupposing a large amount of theory in their descriptions
    - If the theory were amended even subtly, then the description of "seeing" molecules might also be amended

Fallibility of Natural Science

- Even the most successful scientific theory (e.g., Newtonian mechanics) is subject to amendment (Einstein's theory of relativity, Bohr's quantum mechanics)
- "Once we have appreciated the fallibility of natural science and recognized its sources, we can move beyond the simple opposition of proof and faith. Between these extremes lies the vast field of cases in which we believe something on the basis of good–even excellent–but inconclusive evidence." (250)

Evolutionary Biology

- To the extent that what scientists believe today might have to be revised tomorrow, then one might consider all science a theory
- To say that evolutionary biology is a theory does not mean that there are alternatives that are equally worthy of scientific study
  - "All theories are revisable, but not all theories are equal." (250)
  - Evolutionary biology best explains the evidence and there is no theory that offers a reasonable (possibly justifiable) alternative

Challenge for Creationists

- When evolutionary biologists say evolution is a proven fact, they are saying that the evidence for evolutionary theory is as good as the evidence supporting any other theory in any field of science
- "For the Creationists to succeed in divorcing evolutionary biology from the rest of science, they need to argue that evolutionary theory is less well supported by the evidence than are theories in, for example, physics and chemistry." (250)
  - Is evolutionary biology less well supported by the evidence than other scientific theories?
  - What does it mean to be well supported by the evidence?
  - What does it mean to be a successful science?

Predictive Success

- A genuine scientific theory will have observational consequences
- A good scientific theory should not be false, i.e., it should not have observational consequences that conflict with statements comprising the theory

What is a Theory?

- A theory is a collection of statements
- Some statements offer generalizations about the features of things
- These statements are used to make predictions whose truth or falsity is determined by observation
  - Theories attempt to explain nature
- Observational consequences support a theory when these prediction statements are true and falsify a theory when these prediction statements are false

What's Meant by "Fact," "Theory," "Law"?

- According to the National Academy of Sciences:
  - scientific theory: "a well-substantiated ***explanation*** of some aspect of the natural world that can incorporate facts, laws, inferences, and tested hypotheses."
  - law: a ***descriptive*** generalization about nature
  - scientific fact: "an observation that has been repeatedly confirmed and for all practical purposes is accepted as 'true.'"

Theory and Law

- Laws ***describe*** (or report) general patterns in nature
- Theories attempt to ***explain*** general patterns in nature
  - Theories do not turn into laws

Discrediting Theories

- When observation determines that the observational consequences of a theory are true, then the theory is strengthened
- When observation determines that the observational consequences of a theory are false, then one or more statements of the theory are false
  - This just follows from the definitions of deductive validity and observational consequences
- So, theories can be conclusively falsified with the discovery of false observational consequences

Nature of Scientific Theories

1. If a theory has no observational consequences, then there is no way to show that it is false
2. And if there is no way to show a theory is false, then it is not a scientific theory

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3. "So, to be a genuine scientific theory, a group of statements must have observational consequences." (252)

- Are Creationism and Intelligent Design scientific theories?

No, because neither has observational consequences.

What Makes for Successful Science?

- While naive falsificationism fails, there is something right about it--we do want it to be the case that "a science can succeed only if it can fail"
- The problem of Uranus--what to do with the irregular motions of the planet?
- Should one discard the theory?
- Or, could one use the theory to make new and unexpected observations?

First Moral of Uranus and Neptune

1. Auxiliary hypotheses should be independently testable

- Adam and Leverrier added an auxiliary hypothesis to Newton's celestial mechanics
  - Aux. hyp.: there are more planets than we first thought
- The auxiliary hypothesis could be tested independently of Newton's theory or assumptions about Uranus
  - It was tested independently of the theory it was supposed to save

Why Was Newton's Theory Not Discarded Once Conflicting Evidence Was Found?

- Newtonian mechanics was a successful theory that solved problems by invoking the same problem-solving strategy
- For each problem, Newtonian mechanics applied the same reasoning strategy to new problems
  - The same strategy is used for all celestial bodies
  - And, a different but single strategy is used for any question about motion (e.g., revolutions of planets, motions of projectiles, tidal cycles, pendulum oscillations)

Second Moral of Uranus and Neptune

2. A science should be unified

- A science should be a coherent whole, not patched together
- Good theories have one or just a few problem-solving strategies that successfully solve a wide range of problems
- Bad theories are ones in which the problem solving strategies fail to solve the problems they are meant to solve or do so only with untestable auxiliary hypotheses

Third Moral of Uranus and Neptune

3. Good scientific theories raise new questions and spark new research

- One should not view science as static and insular
- Raising more questions than it can immediately answer means that a flourishing science is incomplete
- But, "incompleteness is the mother of fecundity"
- Good theories raise new problems and assume that the new problems can be solved without changing the problem solving strategies

Bad Science vs. Good Science

- **Bad science fails to meet these three signs of good science: independent testability, unity, fecundity**
- If the science fails to pass various tests related to the three signs of a viable theory, then there's reason to think that the doctrine is a poor scientific theory, if not pseudoscience
- Good science provides successful predictions, solves problems, and explains phenomena within a unified framework
- Good science is as concerned with reducing unexplained phenomena as much as offering predictions

Creationist Standards for Science

- Creationists claim that evolution is not a science
- But, Creationist standards rest on a poor understanding of science
- "If one accepts the idea that science requires proof, or if one adopts the naive falsificationist criterion, then the theory of evolution—and every other scientific theory—will turn out not to be a part of science. So Creationist standards for science imply that there is no science to be taught." (256)
- According to Kitcher, evolutionary theory meets the requirements of a good science

Deficiencies in Evolution

- IDers attempt to discredit evolutionary theory by pointing out the deficiencies of the theory
  - For example, "there are gaps in the fossil record," or certain organs are simply "irreducibly complex" and thus too complex to have evolved by natural selection
- All sciences have "gaps" or areas in their domain that are not well understood or satisfactorily explained
  - Newton's law of gravitation is a *descriptive* generalization about the relationship of mass and distance to gravitational attraction
  - But, there is no well-accepted theory of gravity--there is no *explanation* of why gravity operates the way it does

Dawkins' Hidden Assumption

- Dawkins argues that IDers depend on a "hidden" assumption to make their argument
  - If theory E has some difficulty in explaining phenomenon P, then one must automatically prefer theory C, without asking whether theory C is any better at explaining P
    - Using this dishonest assumption: Theory E fails because it cannot produce the required evidence and theory C wins without producing any evidence at all!
  - "Teach both sides" appeal is dishonest–it requires of one side what the opposing side is incapable of providing
    - To be consistent, IDers should demand that all science be rejected since all sciences have unexplained phenomenon (but there is nothing with which to replace the explanatory power of science)

Controversies Worth Debating

- There are numerous debates in evolutionary theory worth debating:
  - The "Cambrian Explosion" – first multicellular animals lived 640m years ago and diversity of species was low until about 530m years ago. Then over a period of 10m to 30m years there was a sudden proliferation of species. What occurred and how did these events lead to "modern" species?
  - Target of Natural Selection – Natural selection acts on genes in organisms (individuals carrying genes that give them a reproductive or survival advantage leave more descendants/"individual selection"). Some evolutionists think selection can operate at higher levels, like populations (group selection) or species (species selection). What is the relative importance of individual versus higher-order selection?

Physicist Richard Feynman

Physicist Richard Feynman once said, during an introductory quantum physics lecture to a non-specialist audience,

"I'm going to tell you the theory and you'll think it's crazy; many of you won't want to believe it. But it doesn't matter if you *like* it or not, because *it's the way it is*. Nature doesn't care if you don't like the way she does things; they happen that way whether you like them or not."

On a separate occasion, Feynman stated: "Science is a way of trying not to fool yourself. The first principle is that you must not fool yourself, and you are the easiest person to fool."

Is Science Intolerant?

- Many Creationists/Id'ers claim that scientists and the scientific community are intolerant
  - But, an accurate understanding of the methods and practices of science discredit this accusation
- Scientists are in the game of prediction and explanation. If you propose a viable theory with observational consequences and that theory better explains the natural world, then the scientific community will listen and either join you or, at least, the next generation will join you.
  - Science is not infallible, but it is self-correcting. If the scientific theory is wrong, then evidence will mount to reveal the theory's mistake.
  - Religious beliefs about the origin of the species can hypothetically enter the game of scientific explanation. To do that, creationism has to advance a theory that explains and predicts at least as well as the competition. The problem is that ID has no observational consequences.