Chapter 22

Darwin and the Method of science

22.1 Reading and Homework

- Readings:
  - Required: Darwin Selections: pp. 52-7(Herschel), 257-65 (Hull), 265-7 (Sedgwick), 267-70 (Owen)
  - Recommended: pp. 28-9 (Mayr), 280-5 (Huxley), 493-500 (Ruse)
- Homework
  1. According to Herschel, what is a good candidate for being a true cause of great change in climate in the Earth's history?
  2. According to Hull, after the scientific revolution, what was considered the proper scientific method was the method of induction, which is?
  3. According to Hull, how much did Darwin rely on, respectively, the observation of empirical facts and his theoretical hypotheses?
  4. In the last quote of Darwin given by Hull, under what conditions is an hypothesis worth considering according to Darwin?

22.2 Introduction

The issue here is not the problem of the conflict between the theses defended in the *Origin* and the pre-Darwinian views. Darwin was aware of the fact that his theory was shaking his contemporaries' world view. The theory of evolution is clearly conflicting with the view of the world as perfectly designed by the hands of God, every creation holding a specific place, with human beings on the top of it.

The issue is rather about method. D**arwin had expected, according to Hull, that this would not be an issue at all.** Remember that he had spent 20 years to look for evidence for his theory, in order to avoid the treatment that received Lamark. He studied Lyell and Herschel on the principle of science, and believed to have follow the rules perfectly.

Many critics can be assumed to be biased by their religious beliefs. See Sedgwick who admits his profound disagreement with Darwin's theory for religious reasons at the end of his paper. He denounces the "unflinching materialism" and shifts from considerations about scientific method (inductive track and physical truth) to considerations about religious belief (final causes and demoralized understanding). Considerations about Darwin's religious beliefs do not qualify as criticisms of Darwin's scientific method.

That said, as Hull points out, to say that all critics were biased in this manner is unfair, and too easy. **Philosophers, on all sides, attacked Darwin's theory for being largely conjectural and lacking evidential proof**: See Owen! There is something about Darwin's theory that did not content the scientists of the time.

It is a serious issue, because the scientific character of the theory of evolution has been subject to attack from then up to now.

Our question thus is: **Does Darwin's theory satisfy the requirements of a scientific theory?**

Important Note

The theory of evolution IS a scientific theory now. This class is concerned with Darwinism, not evolution in general. Darwinism HAS BEEN controversial among scientists. The theory of evolution IS NOT a controversial scientific theory. It is accepted as scientific, and as the best theory we have

up to now, by the scientific community.

22.3 Two dreams: axiomatic science vs. inductive science

Epistemology, or how we come to know, is an important issue of philosophy from the beginning. That said, it seems that the specific issue of defining a proper method in experimental sciences comes largely from the scientific revolution.

22.3.1 Modern criticisms over Ancient science

Axiomatization

Rational systems: Aristotle: **The dream of axiomatic theory** – purely deductive – the paradox of Aristotelian theory of science vs. his own scientific accounts.

Ocult qualities

- The scholastic ways of explanation: Natural kind, defined by essential qualitative differences, and explanation in terms of intrinsic qualities

  - virtu dormitiva of opium: opium makes you fall asleep because it has the virtue of making people asleep.

  - Another typical example of occult quality: the natural tendency of (earthy) bodies to go in straight line toward the center of the Earth in Aristotle Physics. The caricature thus is the following: Why is the stone falling? Because it is the natural movement of a stone to fall.

- The modern model for science: laws of nature expressed in mathematical language,

- the world is reduced to material bodies and their properties, expressed in quantitative terms – mechanical model

- the qualities that appear to humans are irrelevant to science

Discussion: What about inertia?

22.3.2 The modern dream: inductive science

Hull tells us that it is a rather vague concept at the time. Every scientist claims to follow the inductive method, none agree on the definition.

- The "patron saint" (Hull 258): **Bacon**(1561-1626) *Novum Organum Scientarium*
- Popular understanding: induction and deduction are respectively **bottom up and top down** reasoning
- The inductive method?

  - gathering facts

  - discovering a regularities

  - formulate it under the form of a law

  - deduce other facts

  - confirm the law with other facts

- Bacon famously described the scientists as a **"busy bee"** devoted to a mere collection of raw data.
- All a scientist has to do is to participate to the great march of science: to follow the lead and fill in the gaps.
- Normative criterion: The method functions as a test: any theory which does not follow this method is not scientific.
- Discussion:

  (1)Logical trouble: Is this a method that warrants truth?

  Hume famously showed that induction is not valid logically and thence cannot ensure the truth of the generalized statement.

  (2)Practical trouble: Is it reasonable to think that you can find regularities in facts, without any idea of what you are looking for?

- **History** shows no instance of theory following this pattern: the only scientist you may think of is Tycho Brahe; but he was not the one to formulate a theory. Rather, Kepler, and later Newton did. Now they had ideas in mind when they formulated their theories. Clearly, Bacon

missed an important part of the process of discovery, a part in which **imagination** plays an important role.

- That said, if the inductive method construed as above, or some variety of it, was indeed considered as the proper method of science, then it is no surprise that Darwin's theory has not been considered as a scientific theory.

22.4 Mill, Whewell, Herschel: toward the hypothetico-deductive model

The main problem of the so-called inductive method as we described it is that it is both inaccurate for describing what happens in science, and inefficient as a scientific method.

It is pretty easy to get to that point. **A harder point is to frame a new method, introducing a way to guide observation which is not "framing hypotheses"**, that is, which does not go back to the old rationalist dream.

- The debate between Whewell and Mill is, according to Hull, damageable to Darwin. **The debate turns around the issue whether one should gather information from the "pure facts" with no biased mind, or rather interrogate nature with appropriate tools in mind.** These two views can be put under the respective name of Mill and Whewell (this is very rough, almost inaccurate, but should give an idea of the debate).

  - **Whewell: neo-kantian** – "superinducing of concepts on the facts by the mind"

  Note on Kant.

  - **Mill: empiricist** – discovery of empirical laws from the facts

- Herschel seems to me to be in the middle path:

  From a first reading, one gets the idea that Herschel's philosophy of science is supportive of the hypothetico-deductive model:

  – **Laws**:

- Either: direct proximate cause which *gives an explanation*

- Or: phenomenological laws without the true explanation or vera causa.

– **Vera causa**:

From Prof. Schmaus:

1. when we find causes that can explain a great **multitude of effects** besides the ones which originally led to our knowledge of these causes, then we have "true causes"

2. these are causes that really **exist** in nature (53)

3. they are not mere hypotheses

4. Herschel offers examples from geology

a. that the earth cooled from a state of fusion (hot liquid mass) or that volcanoes were once more active – these are not true cause, because we don't know they happened (53)

b. a true cause would be something like the rising and falling of continents

c. note that his examples support uniformitarianism over catastrophism

End of Prof. Schmaus's note

– **Theories**

- consists in a set of laws

- this set of laws apply to a domain, a set of phenomena (importance of unexpected application)

- Reason, but not uncontrolled imagination: rules for theorizing:

1. inductive method: hypothesis

2. hypothesis:

* action observed by direct induction

* or further empirically verifiable consequences

- **The hypothetico-deductive model of scientific theories:**

- domain: set of phenomena

- hypothesis

- deduction of predictions from the hypothesis and confirmation by experimentation

22.5 Saving Darwin's theory

22.5.1 Darwin's theory and the HD model

We have seen that:

- Darwin does not provide evidence for his theory in this strict sense of evidence;

- Darwin does not deduce any new empirical consequences of his hypothesis;

- He does not conduct further experiment to whether confirm and infirm the theory.

SO: If a theory is scientific *only if* it satisfies the requirements of the hypothetico-deductive model, then Darwin's theory is not a scientific theory.

22.5.2 Context of discovery and context of justification

Now, Mill has said that Darwin's theory satisfies the requirements of true inductive science. How is this possible?

Mill makes a distinction that can help us understanding: the distinction between

- *context of discovery* and,

- *context of justification.*

Mill makes the point that natural selection is a nice hypothesis, worth considering for further investigation. As it is, it is not a scientific theory for it has not been justified in the proper "scientific" way, but it is a scientific hypothesis for it has been discovered in the proper "scientific" way.

22.5.3 Inadequacy of the HD model

Why would we save Darwin? Because the HD model is not so accurate for science anyway:

The problem of induction strikes back in the HD model.

22.5.4 Falsifiability

- Can theories be infirmed by experience? One attempt to give a criterion for scientific theories has been made by Popper. His definition of a scientific

theory is that the theory can be falsified. This poses some issues, but let us accept it for now.

- Now, is Darwin's theory falsifiable?

- There is a prediction that Darwin's theory makes, and which is falsifiable: there will be evolution. So, take a bunch of organisms, put them in different circumstances, and see what happens: is there evolution or not? Here I think the breeding analogy takes all its meaning: domestic selection is a laboratory experiment for natural selection.

SO: the answer is then: Yes, Darwin's theory is falsifiable.

22.5.5 Explanatory and Unificatory power

Some passages in Hershel suggest a more open view on scientific theories, to which arguably Darwin's own method correspond.

- **the notion of hypothesis:** its importance and what makes an hypothesis acceptable from the point of view of the scientific method:

  - the role of hypothesis is important

  - the role of analogy in the process of formulating the theories – paragraph 206 p.56 – *This is what Darwin does !!*

  - the notion of hypothesis is **broadened**: in cases like the theory of ondularity of light, an hypothesis is acceptable when there is some probability that the content of the hypothesis is either the real process or something close to it.

  - **SO: an hypothesis is then acceptable if what it predicts is not contrary to experience** – para. 209

- **Importance of the unificatory and explanatory power of a theory**

- **Conclusion:**It seems that Darwin's method could be counted as compatible with the relaxed view on science to which Herschel's text tends to open to (even if Herschel himself did not think so).

  To discuss the issue of the scientificity of Darwin's theory

  1. Make sure to know what theory you are talking about (Darwin and the actual theory of evolution)

2. The answer depends obviously on what you count as science. Now, to find good criteria for a theory to be scientific is hard. In assessing whether Darwinism is a scientific theory, you thus have to make sure to make precise what are the criteria of scientificity that you accept, and explain why you accept these and not others.

The characterization of scientific theories has remained a hot topic in philosophy of science up to now. Many recent contributions to the debate elaborate on the notions of unificatory and explanatory power.

For more information on this, see Woodward, James, "Scientific Explanation", *The Stanford Encyclopedia of Philosophy* (Summer 2003 Edition), Edward N. Zalta (ed.), `http://plato.stanford.edu/archives/sum2003/entries/scientific-explanation/`.