Chapter 6

Science, Reasons and Truth

6.1 Homework

Readings – DW 3,4,8

Study questions – Give a short answer to the following questions:

1. Explain the distinction between empirical and conceptual facts. Give an example of a conceptual fact within a. the Aristotelian worldview, b. the Platonic worldview, c. your worldview. Explain: what is the empirical component of these conceptual facts? what is the conceptual component?
2. Give the most simplified form of a confirmation reasoning. Give an example.
3. Give the most simplified form of a disconfirmation reasoning. Give an example.
4. What is the most important difference between inductive and deductive reasoning? Which one of confirmation and disconfirmation reasoning is inductive? which one is deductive?
5. What are "auxiliary hypotheses". How is the impact of their necessary usage within scientific reasoning on the reliability of confirmation and disconfirmation reasoning?
6. What does it mean to have an instrumentalist attitude toward science? What does it mean to have a realist attitude towards science? Give examples.

6.2 Introduction

We described the history of science as a succession of worldviews, i.e. interconnected systems of beliefs. This raised the issue of the kind of truth these worldviews have. We distinguished between two theories of truth: the correspondence theory of truth and the coherence theory of truth. It seemed like the coherence theory of truth is the one that would fit the best within our new view of science. This did not seem satisfactory though, because we strongly

believe that science is about the world. One important reason we have to hold the latter belief is that it seems that science can get confirmed or disconfirmed by the empirical facts, and this, the coherence theory of truth cannot make sense of. The chapter that follows adds more to the puzzlement, and make us lean even more towards the coherence view.

1. First our aim is to discuss is the ways in which a scientific theory is confirmed or disconfirmed. We have learned that the scientific method was partially born with Aristotle. In particular, we have seen how tight is the link between science and observation. With our notion of worldview in hand, we want to ask ourselves: what does observation bear on theory choice?

   - we will see that many of what we take to be "empirical facts" are in fact theory-laden.

   - we will see that the processes of confirmation and disconfirmation in science are far more complex that we may think, due to the presence of auxiliary hypotheses

2. The last part of the chapter tries to analyze our strong belief that "science is about the world". There are various ways in which one can interpret this statement. The point here is to make you aware of alternative ways of thinking about the status of science: instrumentalism and realism. It is not necessary to think that science aims at telling us the truth about what the world is like. A weakest view of science is that science aims at giving the right predictions.

6.3 Empirical Facts and Conceptual Facts

The distinction – The point is to understand that most of what we consider to be "obvious" are not as "obvious" as they seem. More precisely, the reasons we have to believe in these "facts" include conceptual views about the world.

1. Beliefs based on direct observation – Empirical facts
2. Beliefs based on a mixture of direct observation and inference – Conceptual facts
3. Beliefs based on reason only – no facts at all !

The trick is #2: these are most of our beliefs.

The examples that Dewitt gives :

- the pen under the table and the belief that the world is stable. Notion of substance.

- the basis for the idea that stars and planets move in perfect, constant and circular motion is similar to the idea that the moon is still there even when you don't look at it

Two notes – about the distinction above:

1. Calling these strongly held and well supported beliefs conceptual facts is not a way to diminish their credibility !
2. The distinction is not sharp : most of our belief are in between – continuum

6.4 Confirming and Disconfirming Evidence and Reasoning

Confirmation reasoning – the most simplified way to model confirmation reasoning is the following:

1. If Theory T is true, then Prediction P will occur

2. Observation: Prediction P occurs

3. So: Theory T is probably true

Example: fire burns...

Disconfirmation reasoning – simplified version:

1. If Theory T is true, then Prediction P will occur

2'. Observation: Prediction P *does not* occurs

3'. So: Theory T is not true

Example: All swans are white

Inductive vs. Deductive arguments – The two reasoning above differ in that:

- Confirmation reasoning is inductive

- Disconfirmation reasoning is deductive

What does it mean?

First characterization: general / particular

Second characterization: true premises and true/probable conclusion

In a deductively valid argument, one cannot draw a false conclusion from true premises

In an inductive argument, however true the premises are, it might be the case that the conclusion is false

Example: all people in Montana are republicans

Consequence about confirmation and disconfirmation – we *would* think that

- confirmation : never for sure – hence: "scientific theories cannot be proven"

- disconfirmation: certainty attainable – hence the idea that scientific theories *can* be disproved in a definitive way

The problem is that it is even more complicated

Auxiliary hypotheses – The necessary appeal to auxiliary hypotheses, in both cases of confirmation and disconfirmation make the situation even worse than the description above has it.

What are auxiliary hypotheses? – all these assumptions to which we don't pay much attention, but which are necessary in scientific confirmation and disconfirmation: most simply put, whenever we make an experiment, we *have to* make tons of assumptions. For example, whenever we use an instrument, we believe that the instrument is reliable: this involves theoretical hypotheses (the theories on the basis of which the instrument is based is true) as well as practical hypotheses on which approximations are acceptable.

Ex:

1. if you wanted to use a microscope
2. if you wanted to model a stone falling down

Disconfirmation is now more complicated, and not decisive

We don't have anymore:

1. If Theory T is true, then Prediction P will occur

2'. Observation: Prediction P *does not* occurs

3'. So: Theory T is not true

But instead:

1". If Theory T is true, and hypotheses $H_1, H_2, ..., H_n$ are true, then Prediction P will occur

2'. Observation: Prediction P *does not* occurs

3'. So: Either theory T is not true, or H_1 is not true, or H_2 is not true, or...., or H_n is not true

Ex: All swans are white, but some are dirty

Confirmation is made even worse

It may well be the case that the theory is false, but that it is "corrected" by the other assumptions !!

An additional problem – no clear cut recipe to decide:

- when the approximations are ok, and the confirmation is to be accepted

- when it is the theory or the auxiliary hyp that went wrong in the case of disconfirmation

6.5 Instrumentalism and Realism

Both process of confirmation and disconfirmation of scientific theories seem to be shaky now. That said, there is one assumption that we never analyzed in our way to think about science, and it is the assumption that science tells us what the world is.

Now what do we mean by that?

1. That scientific theories give us the means to adequately predict the way the world is going to behave?

2. That scientific theories give us an explanation of why the world is going to behave that way? And here an additional question is whether you are considering that:

   - a law provides you with a satisfactory explanation

   - only the full mechanism provides you with a satisfactory explanation

Depending on your answer to the above question, you show either a intrumentalist, or a realist attitude towards science (or anything in between the two extremes)

Definition 17 – ***Scientific Realism***

Scientific realism is the view that scientific theories are aimed at telling us, and indeed tell us a (maybe approximately, or structurally) true story about the world.

Definition 18 – ***Instrumentalism***

Scientific Instrumentalism is the view that scientific theories are aimed at predicting, and indeed predict how the observable world is going to behave.

The instrumentalist does not think that the aim of science is to tell us the true story about what the world is like. A theory is a tool for predicting. In particular, the instrumentalist does not think that what theories say about the unobservable is the true story

We'll see examples of great thinkers on both sides in the history of the scientific revolution

- Problems with scientific realism: all the ones we have seen !! Argument from history !

- Problems with cheer instrumentalism: fails to explain the success of scientific theories – no miracle argument – How can one explain that scientific theories are successful if not in saying that these theories adequately capture something of the mechanism of the world.

Some things that *nobody* denies:

- that scientific theories do not have the full, definitive truth

- that scientific theories do not grasp anything of the world, even at the observable level

In the middle, a continuum of attitudes towards science is open to you! It is only if you want to take a realist stance that you are in trouble with history, truth, etc.

6.6 Conclusion

We have seen that:

- History: succession of worldviews

- Worldviews: empirical and conceptual facts intertwinned

- Confirmation as well as Disconfirmation reasoning are not straightforward because the necessity of auxiliary hypotheses

At this point, it is really hard to see how we can still maintain that scientific theories tell us some truth about what the world is like. That is to say, it is hard to see how we can be realists towards science. To become full blown instrumentalists does not seem to be satisfactory either: *however hard it might be to confirm or disconfirm scientific theories, it remains possible to shift from one worldview to another, so that there must be cases in which*

we have satisfactory reasons to believe that a given theory is false, and another one is closer to the truth.

The study of the history of the Scientific Revolution will give us the means to see both:

- how the facts do not always dictate which theory is the right one to choose – Underdetermination
- what it takes for a scientific revolution to occur.