Class 6 - Scientific Method

I. Holism, Reflective Equilibrium, and Science

Our course is centrally concerned with methodology in philosophy.
We started by looking at foundationalist epistemologies, and a bit at coherentist ones, in order to examine the ultimate methods of justification for our beliefs.
We have found two sorts of problems with foundationalist theories.

The first kind of problem involved particular choices of foundational beliefs.
Perhaps Descartes just took the wrong axioms.
Perhaps sense-data are not the ultimate atomic facts.
These problems seemed worrisome, but not fatal to the foundationalist attitude.
Better choices of foundations could ameliorate such worries.

The second kind of problem was more profound, and arose in two directions.
The color incompatibility problem led us to Sellars's insights about the myth of the given.
According to the foundationalist, our atomic beliefs are supposed to be immediately, or self, justifying.
If there are no self-justifying givens, then there are no immediately-perceivable, atomic facts.
There are two kinds of resultant holism.
Semantic holism is the thesis that meaning is a property of entire languages (or at least large swaths of language).
Confirmation holism is the thesis that a statement is neither confirmed nor refuted by itself, but presupposes a larger theory.

From another direction, Goodman argued that justifications for induction and deduction follow the same patterns.
He noticed that we accept certain general principles because they yield the specific claims we believe.
We justify those beliefs because they are derived from acceptable general principles.
Goodman argued that the apparent circularity of these defenses is virtuous, and that a consequence of accepting the method implicit in his observation leads to a dissolution of the problem of induction.
If he is correct about induction and deduction, then foundationalism must may be replaced by what has come to be known as reflective equilibrium.
We have particular claims, none of which is privileged.
We have general theories, none of which is taken as dogma.
We look to balance the general theories and the particular claims, and to achieve a stable relationship between them.
The name 'reflective equilibrium' was coined by John Rawls, in the context of theorizing about ethics.
But the procedure originates in epistemology.

Goodman arrived at the method of reflective equilibrium in the context of analyzing the problem of induction, of trying to characterize the differences between acceptable and unacceptable inferences.
He argued that the problem of induction is small potatoes compared to the new riddle of induction, which arises when we try to determine how evidence confirms a theory.
We have seen much of what Papineau says about the problem of induction before, though he presents the problem elegantly and in greater detail.
He shows that inductive solutions to the problem of induction are doomed.

> Even if observed patterns have tended to hold good so far, what guarantees that they will continue to do so? As Bertrand Russell once said, it is no help to observe that *past* futures have conformed to *past* pasts; what we want to know is whether *future* futures will conform to *future* pasts. Given that we are trying to vindicate induction against objections, an inductive argument for induction once more begs the question (127)

Some people attempt probabilistic solutions to the problem of induction.
The probabilist accepts that our knowledge of the past can not give us certainty about the future.
But perhaps, they suppose, we can gain probable beliefs about the future from past experience.
If I can not know that the sun will rise tomorrow, at least I can be confident on the basis of its likelihood.
Unfortunately, such probabilistic solutions remain inductive attempts to solve the problem, and the same difficulties arise.

Karl Popper attempted to avoid the problem of induction by arguing that science is not inductive.
Instead of proceeding from particular claims to general theories, according to Popper, scientists posit general theories as grand hypotheses, hazarding conjectures, and look to refute them.
A theory which is refuted is discarded.
A theory might say that all Ps are Qs.
Finding a P that is not a Q will refute it.

A theory which is irrefutable is useless.
For instance, there may be no Ps.
There may be no observable Ps.
There may be no way to tell whether Ps are or are not Qs.
In such cases, a theory that all Ps are Qs is irrefutable and so useless.
Popper, like the positivists, was concerned to distinguish between science and pseudo-science.
He claimed that the mark of legitimate science was refutability.
Pseudo-sciences always have ways to account for the failures of their predictions.
For example, macro-economists will tell us lots of reasons why they did not predict our recent economic difficulties.
And, they will present a theory that will explain those difficulties.
But, they will (generally speaking) not conclude that any principles of macro-economics were refuted.
Popper himself argued most vehemently against Freudian theories of the unconscious and Marxist theories of history.

Lastly, a theory which is refutable but withstands refutation is maintained.
Such a theory may be, according to Popper, rationally believed.
Popper avoids the problem of induction only by giving up any explanation of how we generate hypotheses in the first place.

> The central objection to his account is that it only accounts for *negative* scientific knowledge, as opposed to *positive* knowledge. Popper points out that a single counter-example can show us that a scientific theory is wrong. But he says nothing about what can show us that a scientific theory is right. Yet it is positive knowledge of this latter kind that is supposed to follow from inductive inferences. What is more, it is this kind of positive knowledge that makes induction so important (130).

Papineau's own approach to the problem of induction is called reliabilist.
We make what we know to be reliable inferences.
We believe that the sun will rise tomorrow, and it is rational to believe it.
The reliabilist claims that the reliability of such rational inferences suffices as a response to the problem of induction.

> A deductively valid inference will generate true conclusions our of true premisses in *every* possible world. A reliable but non-deductive inference, by contrast, always generates true conclusions out of true premisses in the actual world, but would go astray in other possible worlds (such as worlds, say, in which humans live for more than 200 years. Given this distinction, it seems clear that reliability is a minimal requirement for a form of inference to be acceptable. However, to ask in addition for deductive validity seems like overkill. If we have a form of inference which works in the actual world, why require in addition that it should also work in every other possible world, however unlikely or outlandish (134-5).

The reliabilist solution, while not circular, like the inductive solutions, or completely unsatisfying, like Popper's approach, is thin.
It does not tell us what makes our inferences reliable.
That the sun will rise tomorrow is an easy case.
There are more-difficult ones in which reliability is itself in question.
That's one of the results of Goodman's version of the new riddle of induction.
The problem of induction, as Goodman presents it, looks so intractable that it must be relying on a mistaken description of the problem.
Quine wrote, "The Humean predicament is the human predicament" ("Epistemology Naturalized," p 72).
He means that there is no straight solution to the problem of induction, and thus no possibility of self-justifying, immediately-given experiences or observations.
Once we accept the impossibility of solving the traditional problem of induction, we have to adopt something like Goodman's virtuously circular method.
The only possible response is to dissolve the problem, as Goodman (and Hume) did.

The lessons we have learned so far are these:

1. Justification seems to be holistic, rather than atomistic.
2. There is an interaction between general theories and particular statements that supports all of our beliefs.

Given holism, the method of seeking reflective equilibrium between our theories and our particular beliefs finds a proper home in the philosophy of science.

II. Resolving Contradictions in a Theory

We are looking at scientific methodology.
But, the lessons of these discussions are not meant to be limited to a narrow field.
We are seeking guiding principles for the management of all of our beliefs, including philosophical ones.
The lessons from philosophy of science translate to philosophy, according to the holist, because all of our beliefs are linked together in a massive, interconnected web.
We do not isolate science from our ordinary reasoning, we do not separate distinct fields of study.

As a consequence, philosophy is not to be distinguished from science.
There is no metaphysics, apart from science; there is no epistemology apart from scientific method.
Scientific theories will tell us what exists.
The scientific method is the only method that matters.
We are all scientists, even in our everyday life, and our methods, if they are to be the best methods, must not differ from the scientific method.

One of the most important methodological lessons we take from science concerns how to manage a belief that contradicts ones we already hold.
Holism is manifest in what Papineau calls, and is widely known as, the Quine-Duhem thesis.

> Any theoretical claim *T* can consistently be retained in the fact of contrary evidence by making adjustments elsewhere in our system of beliefs (153).

Given a theory and a contravening, incompatible claim, we have to choose which hypothesis to cede.
We look at the various evidence.
A contradiction within a large theory merely tells us that there is a problem in the theory.
It need not tell us where the problem lies.
If we were to believe that there were going to be no parties this weekend, and then we received a flyer for a gathering on Friday, we could resolve the contradiction which results from adding the belief we gain from the flyer to our belief set in various ways.

1. We could check the date on the flyer; maybe there is a confusion about the data.
2. We could give up our belief about there being no parties this weekend.
3. We could redefine the term 'party' such that the gathering is not a party.

et al.

More technically, if we have a theory that yields a claim which is inconsistent with new evidence, we only know that assimilating the new claim with the original theory yields some kind of contradiction.
A theory is a set of sentences:

$$T \qquad S_1 \bullet S_2 \bullet S_3 \bullet \ldots \bullet S_n$$

In the case we are considering, T yields some claim O.

$$T \vDash O$$

But, we get new information: ~O
So, by modus tollens, we know that T is false.
The denial of T is equivalent to each of the following complex sentences.

$$\sim(S_1 \bullet S_2 \bullet S_3 \bullet \ldots \bullet S_n)$$
$$\sim S_1 \vee \sim S_2 \vee \sim S_3 \vee \ldots \vee \sim S_n$$

But, that's as far as the logic will take us.
As a logical matter, we don't know which of the sentences of the theory to reject.
Given that we have various options, we need methods for weighing the evidence, for choosing among those options.

Those methods are governed by various abstract principles.

The question of how to restore consistency to theories is not to be distinguished from the question of how to reason generally.
The answer is complicated by the fact that there are various ways to proceed each of which fit the logical requirements.
We can easily restore consistency to a theory which contains a contradiction in different, incompatible ways.

III. The Under-Determination of Theories by Evidence

Theories are generally under-determined by evidence.
Some people take under-determination to be evidence that we never attain knowledge in science, or that scientific theories are not true.
Simple examples include the fact that evidence often provides correlation without indicating causation.
For example, a recent study shows that Facebook users get lower grades in college.
We do not know whether to conclude that Facebook use causes lower grades or that people who use Facebook are those who are already likely to be less successful.
Similarly simple examples are ubiquitous.

We have choices among theories for the holistic reasons we have discussed.
When presented with a theory and an observation, there are various options of how to integrate the observation into the theory.
Even when an observation does not conflict with other, previously-accepted hypotheses, there are always lots of theories that can accord with our claims.
Some of those theories have extraneous elements.
We discount theories that refer to ghosts, for example, and seek an explanation of the noise in the attic that appeals only to natural phenomena, like wind and expansion or contraction of materials due to humidity.
We invoke principles of parsimony, or Ockham's razor: do not multiply entities beyond necessity.

IV. Principles of Reasoning; the Scientific Method

Scientific realism is the claim either that science is a body of truths or that scientific theories give us knowledge of the world.
In addition to worries about under-determination, Papineau sees an argument against scientific realism which he calls the pessimistic meta-induction from past falsity.
That's a long name for the simple claim that scientific theories are ordinarily discarded for new and improved ones.
Since we have given up so many theories, it is likely that even our currently-best theory will eventually be given up for false, too.

In the face of skeptical worries about science from under-determination and the pessimistic meta-induction, Papineau argues that scientists are not normally distracted by philosophical concerns.

> What the arguments show is that different theories will always be consistent with the data. But they do not rule out the possibility that, among these alternative theories, one is vastly more plausible than the others, and for that reason should be believed to be true... Certainly practising scientists do not regard [under-determination] as blocking their access to the theoretical truth. They recognize that we can always in principle concoct alternative explanations for any given body of data; but they simply discount as not worth taking seriously those complex alternatives that need to invoke hidden planets, or hidden forces, or other truth-hiding conspiracies. In effect, scientists are taught, in the course of their scientific training, that only certain sorts of theory are possible candidates for the truth; and once they have data that rule out all but one of *these* theories, they quite happily ignore all the other conspiratorial theories that remain consistent with the data (154-5).

When faced with inconsistency, it is just a logical fact that we have various ways to restore order: consistency and rational belief in the theory.
We have to balance a variety of factors.
Papineau mentions simplicity.
There are other virtues which guide our analyses of hypotheses, which help us to determine how best to restore consistency to our theory, or belief set, and which govern scientific reasoning generally.
Quine, in *The Web of Belief*, presents five so-called immanent virtues of a scientific theory.

1. Conservatism
2. Modesty
3. Simplicity
4. Generality
5. Refutability

Conservatism tells us to only revise as little as we need to, in order to maintain as much as possible of our previous theory.
We accept only the weakest, or most modest, principles, as the most plausible.
Simplicity for our large theory trumps simplicity for any portion of that theory, when the two conflict.
The claim 'objects fall to the Earth' is simple, but conflicts with gravitational theory, which is simpler overall, and more general.
This desire for generality applies to all the virtues.
We are looking for the most conservative total theory, and the most modest total theory.
Quine includes refutability as a nod to Popper's basic point that theories must be honestly tested, and not held as dogma.
But, as we saw, holism entails that any principle can be held irrefutable, as a logical matter.

V. From Science to Rationality

Quine's virtues are not limited to philosophy of science.
They are principles of rationality, generally.
Science is the epitome of a rational enterprise, especially when we consider science, as the holist does, in its most broad form.
In the holist's sense of 'science', every rational pursuit is science.
That includes philosophy.
These principles are not merely methodological virtues for the scientists.

They are guiding principles for philosophical theorizing.
There is no difference, methodologically, between our philosophy and our science.
All reasoning is governed by the same kinds of principles, the same scientific method, the same reflective equilibrium that Goodman discussed.

The central difference between reflective equilibrium in science and reflective equilibrium in philosophy concerns the nature of the particular claims we balance.
In science, we tend to balance general theories with claims referring to particular observations.
In philosophy, particular intuitions, often modal intuitions, may take the place of observations.
Whether this difference yields a distinction between science and philosophy is the central question for this course.
Does reliance on intuition somehow de-legitimize philosophy?

In the next few classes, we will see examples of how the method of reflective equilibrium has been most successful in philosophy.
Then, we will explore the contravening data.