HPSC 1001/1901/2101/2901

WHAT IS THIS THING CALLED SCIENCE?

Semester 2, 2020

Lecture 11: Kuhn and Normal Science

Next topic: Thomas Kuhn's theory of how science works. Especially scientific "revolutions."

Kuhn's work was something like a revolution itself. *The Structure of Scientific Revolutions* (1962). The most famous book written about science in the last hundred years.

Kuhn was seen as using the history of science to argue that science is irrational, that knowledge is relative, that progress is an illusion. I think this is mostly false – he does not try to do that. But he does give a very picture of science from the one philosophers had been used to.

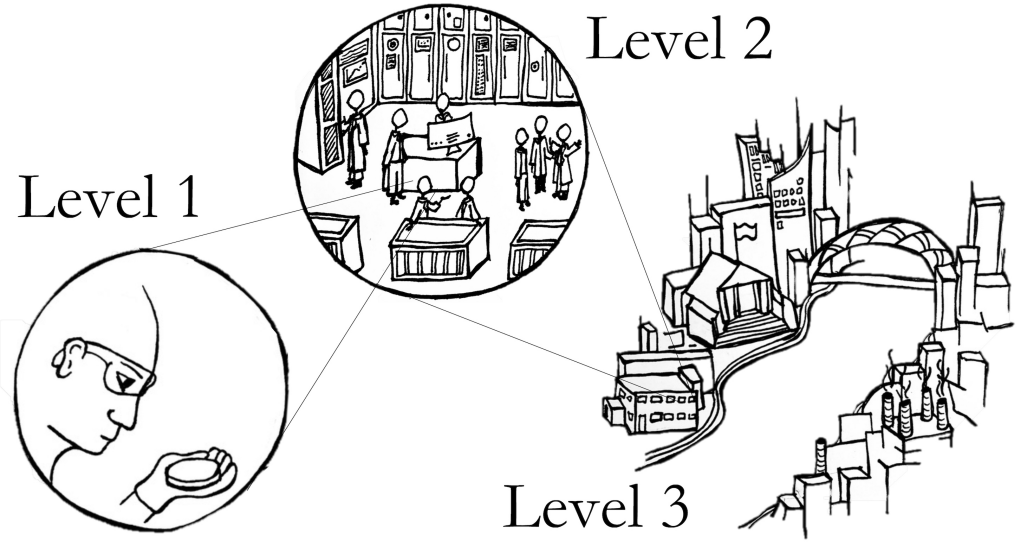
The book is hard! There are excerpts on Canvas as well as excerpts in CC. Do try to read them. But don't worry if you find it difficult (everyone does). *Theory and Reality* chapter 5 should help.

How K's work relates to earlier weeks: Empiricist philosophers did not say much about scientific change. They were interested in knowledge and evidence, and what scientific theories achieve. Some ideas about change are suggested by their view, but this was not a major theme. Popper: did care about change (C+R). He also thought about science in a rather individualistic way. And his view of the whole enterprise was driven by the logic of the situation

(falsification is deductive, and induction is never rational).

Kuhn: entirely different. He starts from a description of scientific change. That description is social. The units are scientific communities, not individuals.
From a social theory of scientific change he moves to conclusions about evidence, knowledge, and rationality.

Remember:



Three perspectives on science:

(1) A fine-grained or zoomed-in perspective: observation, reasoning, and belief as activities of individual people.

(2) Zooming out, we find the social networks that scientists work within, and the technological context of their work.

(3) Zooming out further still, we see science embedded in a larger society, with its influence on education, medicine, and other policy areas.

With Popper, we started to see some questions about L1/L2 relationships. Kuhn's view is full of surprises there.

Some basic ideas

Scientific change occurs in two modes: *normal science* and *revolutionary science.*

These are divided by a periods of unstable stasis: *crisis science.*

Normal science is guided by a *paradigm*.

In one (broad) sense, a paradigm is a package of ideas, methods, and habits that guides work in a field.

See T&R chapter 5 and below for the various senses of this term.

Paradigms are overthrown in revolutions.

A closer look at K's view of scientific change

1. Pre-paradigm science.
Chaotic. Endless debate about basics. No opportunity to build on each others' work.

2. First paradigm appears. Transition to "normal science."
Normal science (NS): work guided by a *paradigm*.

> In this essay, 'normal science' means research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice.

Paradigm in the narrow sense: an achievement that inspires and provides basis for further work.
Paradigm in the broad sense: a package of ideas, methods, and habits that guides work in a field.
The package is based on a striking achievement (a paradigm in narrow sense).

When I say "paradigm" without adding "broad" or "narrow," I mean the broad sense.

Normal science (NS): Well-organized. Everyone (or nearly everyone) agrees about which problems are important, and

about how to approach these problems. Workers can cooperate and build on each others' work.

One paradigm per field per time (usually). No debate about fundamentals.

Normal science often focuses on "minuscule" topics, but they often turn out to have deep implications.

Important passage:

> No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all. Nor do scientists normally aim to invent

new theories, and they are often intolerant of those invented by others. Instead, normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies.

Perhaps these are defects. The areas investigated by normal science are, of course, minuscule; the enterprise now under discussion has drastically restricted vision. But those restrictions, born from confidence in a paradigm, turn out to be essential to the development of science. By focusing attention upon a small range of relatively esoteric problems, the paradigm forces scientists to investigate some part of nature in a detail and depth that would otherwise be unimaginable. And normal science possesses a built-in mechanism that ensures the relaxation of the restrictions that bound research whenever the paradigm from which they derive ceases to function effectively. At that point scientists begin to behave differently, and the nature of their research problems

changes. In the interim, however, during the period when the paradigm is successful, the profession will have solved problems that its members could scarcely have imagined and would never have undertaken without commitment to the paradigm. And at least part of that achievement always proves to be permanent. (pp. 24-25)

* Remember the green part for lecture 3.
* The blue part is relevant to the level 1/level 2 relationships.

"Puzzle-solving" is the main NS activity.

> The scientific enterprise as a whole does from time to time prove useful, open up new territory, display order, and test long-accepted belief. Nevertheless, *the individual* engaged on a normal research problem *is almost never doing any one of these things.* Once engaged, his motivation is of a rather different sort. What then challenges him is the conviction that, if only he is skilful enough, he will succeed in solving a puzzle that no one before has solved or solved so well. Many of the greatest scientific minds have devoted all of their professional attention to demanding puzzles of this sort. On most occasions any particular field of specialization offers nothing else to do, a fact that makes it no less fascinating to the proper sort of addict. (38)

* Again, blue part is relevant to level 1/level 2 relationships.

3. Accumulation of anomalies

Some phenomena *resist* treatment using the tools of the paradigm. These are anomalies.

The usual and proper first response: "A poor workman blames their tools."

> ... the project whose outcome does not fall in that narrower range [an expected range] is usually just a research failure, one which reflects not on nature but on the scientist. (35)

But anomalies tend to accumulate. And the organized nature of NS makes them more and more acute: "This *should* be

solvable!"

More high-prestige workers take on the problem, and fail.... The field transitions into *crisis*.

4. Crisis

A loss of confidence. A return to debate about fundamentals. A *very partial* return to the chaotic state characteristic of pre-paradigm science (not that similar, as the field does not give up its social organization and its knowledge of all sorts of details that came from the fallen paradigm). Philosophy starts to seem relevant to science – never the case in normal science!

This ends with: a new achievement that provides inspiration... a new paradigm. This is a scientific revolution.

Before we do revolutions in detail, look at some relations between level 1 and level 2 properties. Remember this from above:

> Perhaps the most striking feature of the normal research problems we have just encountered is how little they aim to produce major novelties, conceptual or phenomenal. (35)

> The scientific enterprise as a whole does from time to time prove useful, open up new territory, display order, and

> test long-accepted belief. Nevertheless, *the individual* engaged on a normal research problem *is almost never doing any one of these things.* (38)

The field uncovers dramatic discoveries *despite* the goals of the individuals in the community. They just want to solve their puzzles, not overthrow the paradigm. But this close attention to the details of nature does tend to lead to surprises and novel discoveries that overthrow the current paradigm. These discoveries can only result from socially organized, detailed, cooperative work – work guided by faith in the current paradigm.