The Boundaries of Scientific Communities

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Outline

1. Scientific communities in philosophy of science
2. Two case studies
   - 2.1 Garage-scale biology
   - 2.2 Control systems research
3. Some speculations about impact for our examples

The take-home: Contemporary science creates real problems for the notion of 'scientific community,' and philosophers of science should work to adapt.

What's a Scientific Community?

Science is (or can be reasonably approximated by) a collection of discrete, bounded scientific research programs, instantiated in communities of researchers.

Discreteness and boundedness make these communities in some sense *evaluable*.

Rouse's Account

Communities have constitutive mutual accountability (Rouse 2002, 2006):

- there are implicit or explicit rules for the behavior of members of the community *qua* members
- these rules include reflexive rules of accountability and enforcement
- to be a member of the community is, in part, to be accountable to other members for one's behavior *qua* member, according to these rules, and to hold other members accountable for their behavior *qua* members

Why Do We Care?

Tracking Theory Change

Tracking scientific change is commonly taken to require that theories and the communities which utilize them are evaluable in this way.

Tracking Theory Change

I claim that the typical descriptive unit of great scientific achievements is not an isolated hypothesis but rather a research programme. Science is not simply trial and error, a series of conjectures and refutations. (Lakatos 1978, 4)

Tracking Theory Change

Competition between segments of the scientific community is the only historical process that ever actually results in the rejection of one previously accepted theory or in the adoption of another.

[…]

… which depends on characteristics of the scientific community that require much additional exploration and study. (Kuhn 1970, 8)

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Response: Possibly, but how do we confirm whether or not the accounts are valid if we can't track them down into real-world practice?

Tracking Theory Change

And also (though not today): recent literature on selective realism, with direct connections to scientific practice

Ethics in Practice

Several classes of recommendations concerning ethics in scientific practice entail that scientific communities are distinct enough to be objects of intervention.

Ethics in Practice

- 1975: Asilomar Conference on Recombinant DNA Molecules
- 2004: Call for "another Asilomar" for synthetic biology
- 2012: Call for "another Asilomar-type moment" for gain-of-function virology research

Ethics in Practice

> Adequate ethics codes … would be constructed by scientists and enforced by scientists, and they could be revised … when conditions require it or new knowledge enables it. Adequate ethics codes, in short, would represent scientists regulating themselves.… (Kourany 2010, 117)

Some Others

- Theories of the movement of scientific knowledge (from "core" to "periphery" or vice-versa, e.g., Henry Bauer)
- Historical succession in scientific change (e.g. David Hull on "Planck's Principle")
- The nature of scientific publication, popularization, "science communication"

Dissolving the Boundaries

Garage-Scale Biology

Garage-scale biology forms an example (of many!) of a trend in research that challenges the boundedness of scientific communities.

Garage-Scale Biology

For a very small investment, I found I could make substantial progress in the garage. In the end it is thus no surprise … that garage hacking – that garage *innovation* – has come to biology. (Carlson 2010, 185–6)

Garage-Scale Biology

- Brussels: Open BioLab
- Ghent: ReaGent
- Amsterdam: Dutch DIY Bio Group
- Eindhoven: BioArt Laboratories

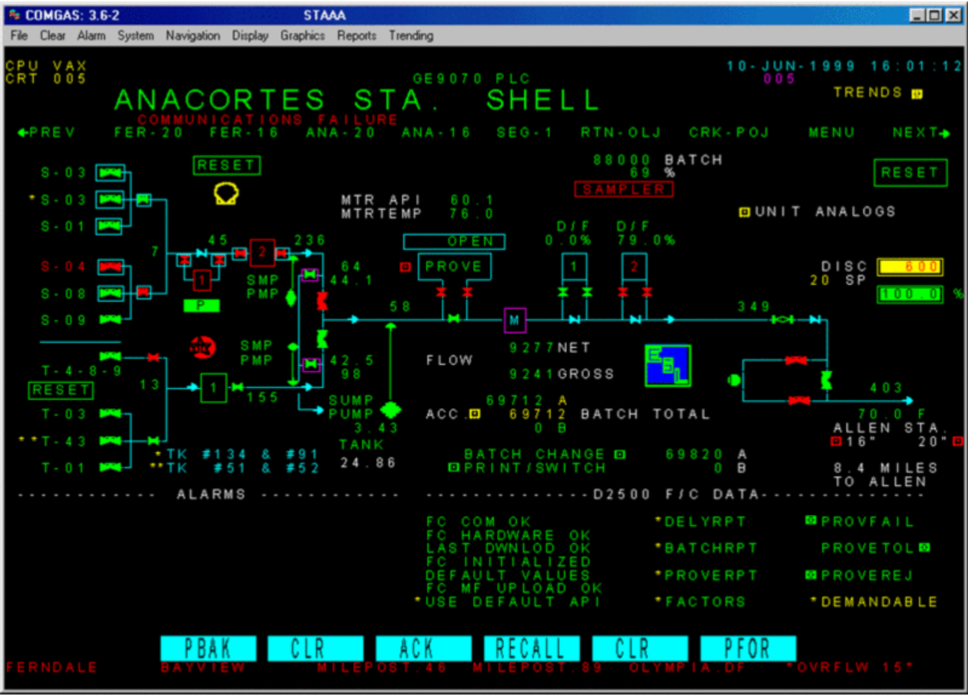
Garage-Scale Biology

Are these independent hackers members of the scientific community, or not? What is their relationship to theoretical knowledge?

Given their existence, is the molecular biology community still clearly bounded?

Control Systems Research

Control systems research forms an example (of many!) of an area of research that challenges the discreteness of scientific communities.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FLOW
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9241 GROSS
ACC.
69712 A
69712 BATCH TOTAL
0 B
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ALLEN STA.
16" 20"
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69820 A
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**T-43
T-01
ALARMS
D2500 F/C DATA
FC COM OK
FC HARDWARE OK
LAST DWNLOD OK
FC INITIALIZED
DEFAULT VALUES
FC MF UPLOAD OK
*USE DEFAULT API
*DELYRPT
*BATCHRPT
*PROVERPT
*FACTORS
PROVFAIL
PROVETOL
PROVEREJ
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PBAK CLR ACK RECALL CLR PFOR
FERNDALE BAYVIEW MILEPOST.46 MILEPOST.89 OLYMPIA.DF *OVRFLW 15*

Control Systems Research

To meet future needs, the Department of Defense must increase access to commercial state-of-the-art technology and must facilitate the adoption by its suppliers of business processes characteristic of world class suppliers. (Perry 1994)

Control Systems Research

Nathan Michael, CTO, Shield AI

"Shield AI is the home of Hivemind, an artificial intelligence which enables robots to see, reason about, and search the world. Hivemind allows robots to learn from their experiences. Shield AI's first product, Nova, is a Hivemind-powered robot that autonomously searches buildings while simultaneously streaming video and generating maps."

Control Systems Research

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- "Nonlinear Model Predictive Control via Feasibility-Perturbed Sequential Quadratic Programming" (Tenny, Wright, and Rawlings, 2004, *Computational Optimization and Application*) [chemical plants]

Control Systems Research

In eight years: from chemical plant process optimization to advanced maneuverability for quad-rotor helicopters, and sold to the military

Control Systems Research

(Aside: This is where the now-disappeared connection to dual-use research comes in…)

Control Systems Research

Given the extensive interconnectedness of this research with other domains, can we still identify control systems research as a discrete community?

In Short...

Trends of democratization and interconnectivity in contemporary science make trouble for traditional approaches to scientific communities.

Investigating the Upshot

Theory Change

Work on theory change needs to be sensitive to the contemporary context of diffuse scientific knowledge across broad and multifaceted communities.

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- In cases like selective realism: pay attention to context!
- Theory change after clearly defined 'theories'?

Ethics in Practice

Our approaches to the ethics of science in practice have to be adapted to the shifting, unstable, and sometimes undetectable boundaries of scientific communities.

Ethics in Practice

Example: DIYBio has a code of ethics, built out of a series of worldwide conferences in 2011.

But: Divergences between the codes used in Europe and those used in North America, adherence by each local group is voluntary, and the codes are vague enough to achieve wide acceptance.

Ethics in Practice

Open questions (at least for us!):

- Do these communities really rise to the level of Rouse's constitutive mutual accountability?
- What kinds of social structures could encourage the development of accountability, and what kinds will discourage it?
- Is the case of 'lone' biohackers significant enough to merit philosophical attention, or is it 'noise' within the signal of these larger groups like DIYBio?

Ethics in Practice

Example: Recent work in the science and values literature (e.g., that of Heather Douglas, Matt Brown) that scientists need to be (sometimes, to some extent) accountable for downstream consequences of their work.

But: To what extent can we really encourage such responsibility in cases of highly interconnected and unpredictable scientific community structure?

Questions?

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