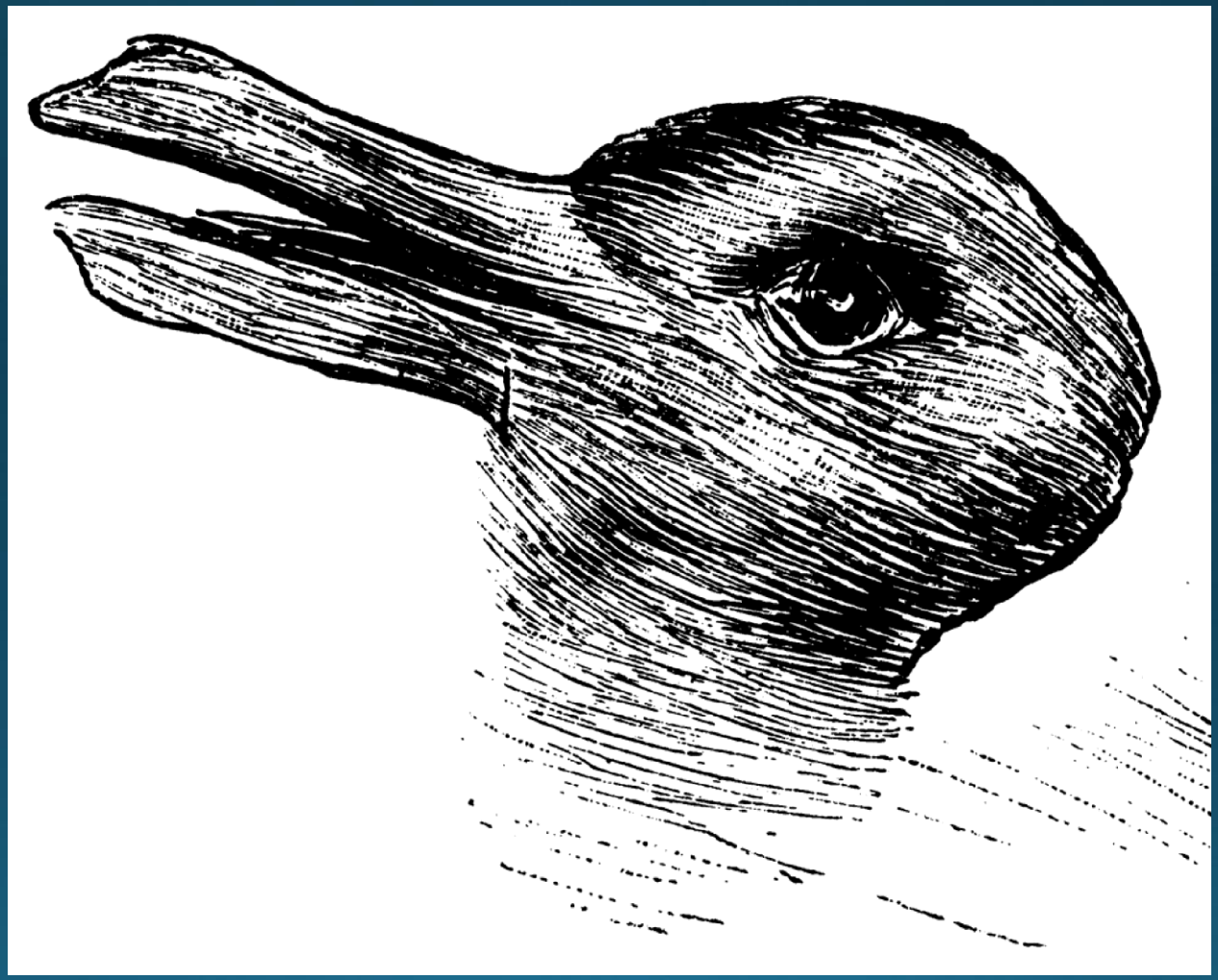
Lecture 4:

Social Construction of Scientific Knowledge

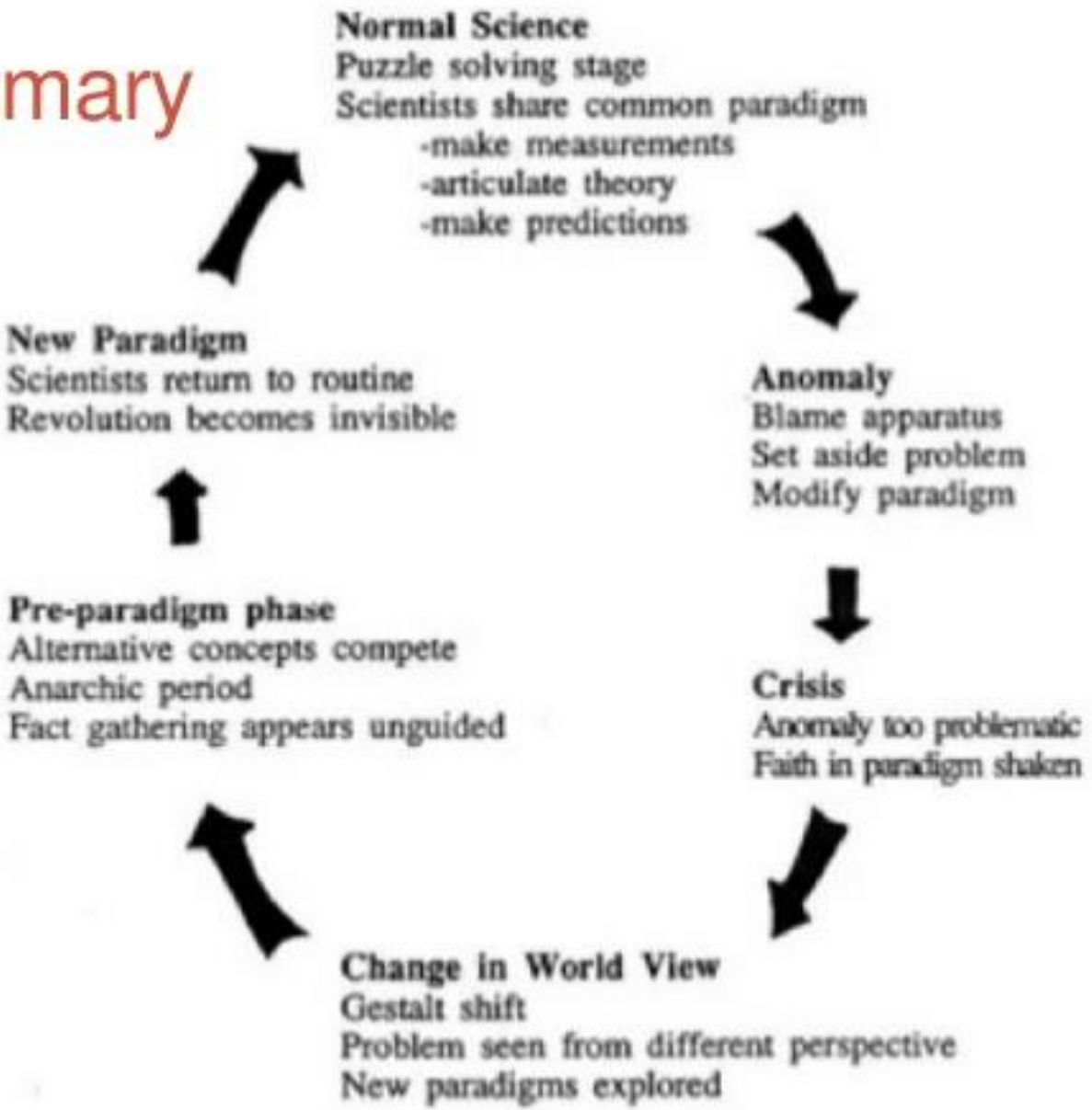
Course: Science, Technology and Society Studies

The Beginnings of Sociology of Science

Thomas Kuhn's '*Structure of Scientific Revolutions*'



In summary


Normal Science
Puzzle solving stage
Scientists share common paradigm
-make measurements
-articulate theory
-make predictions
Anomaly
Blame apparatus
Set aside problem
Modify paradigm
Crisis
Anomaly too problematic
Faith in paradigm shaken
Change in World View
Gestalt shift
Problem seen from different perspective
New paradigms explored
Pre-paradigm phase
Alternative concepts compete
Anarchic period
Fact gathering appears unguided
New Paradigm
Scientists return to routine
Revolution becomes invisible

Kuhnian Paradigm Shift

- Normal Science: Associated with a set of ideas, a set of tools, a set of assumptions. Provides a structural, theoretical framework, a model.
- Anomalies enter the scene: Dismissed as mistakes in experimentation, aberrations, or as minor irritants in an otherwise well-functional theory.
- Too many anomalies -> Crisis -> Extraordinary research.
- Exploratory nature of research: Structures/ideas associated with the old paradigm are discarded. New theories, thought experiments and experiments to explain the anomalies.

"*Proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and to debate over fundamentals*"

Ptolemaic cosmology -> Copernican model

Newtonian gravity -> General relativity

Kuhnian Paradigm Shift

NEW Paradigm: NEW meanings. Widespread change in meanings assigned to terms.

Implications:

TWO ideas are rejected:

'Progress' (scientists cannot recognize achievements of the other paradigm) AND 'Commensurability' (two completely different frameworks of understanding).

So scientific knowledge is NOT cumulative?

"*Science does not track the truth, but creates different partial views that can be considered to contain truth only by people who hold those views!*"

Kuhnian Paradigm Shift

Implications:

- Incommensurability: "Incomplete communication" or "difficulty of translation," sometimes leading to "communication breakdown".
- Theory-dependance of observations (against positivism)

  Theory/ideas drive data, NOT the other way around.

  Ideas and practices drive/organize scientific communities.

  Changes in vision causes changes in theory, NOT data.
- Anomalies are typically set aside (against falsification), get challenged *only* during scientific revolutions.

Pasteur-Pouchet Spontaneous Generation Controversy

Pasteur claimed that sterile air, without existing life, could not lead to the formation of moulds. Pouchet claimed that even pure air would cause putrefaction.

- Problems in the experiment:
  - How to prove that the air is indeed sterile? Is contamination entering along with the pure air? Pasteur saw germs, but were they living organisms or just dead dust?
  - How to remove all traces of life from air? WITHOUT removing nutrients required for life? Pass through a variety of mediums, acidic, alkaline, hot and filtered. Is that enough?

Moulding happened. So enough evidence for the spontaneous generation hypothesis to continue.

Pasteur-Pouchet Spontaneous Generation Controversy

Pasteur's response:

- Firstly, claimed that air must have been contaminated.
- Next, he claimed that the mercury was contaminated (dust on the mercury surface contained life forms).

90% of the time, Pasteur found life. Yet, disregarded the spontaneous generation thesis. Blamed himself, his experiments.

What do we see? Merely foresight by Pasteur. NOT the neutral application of the scientific method. FACTS and REASONS were ambiguous.

How did Pasteur destroy his opponents? By political maneuvering, by ridicule, and by drawing farmers, doctors and brewers to his side.

Pasteur-Pouchet Spontaneous Generation Controversy

How was the controversy resolved? By 2 commissions packed with Pasteur's supporters.

Political climate the day? The debate around Darwinism. Connection between Darwin's theory and spontaneous generation!

Echoes of the Kuhnian paradigm?

Pasteur's antics. The levels that he went to disregard the 'anomaly'. He blamed the apparatus (abandoning mercury-based experiments). He blamed the experimenter(himself) and therefore designed multiple new experiments (on the Appalachian mountains, for instance).

Sociology of Scientific Knowledge (SSK)

- Emerged in the 1960s/1970s
- Emerged in opposition to Merton's (science is production and extension of certified knowledge) structural functionalism (sociology of scientists -> sociology of scientific facts/trajectories)
- Proponents: Barry Barnes, Bruno Latour, David Bloor, Paul Feyeraband, Harry Collins
- Using interpretative sociology, looks for CONTEXT, SUBJECTIVITY and political, social, cultural, economic MOTIVES/FACTORS. MEANINGS and INTENSIONS.
- Asks: WHY did one scientific trajectory/interpretation succeed, while others failed?

Strong Programme in STS

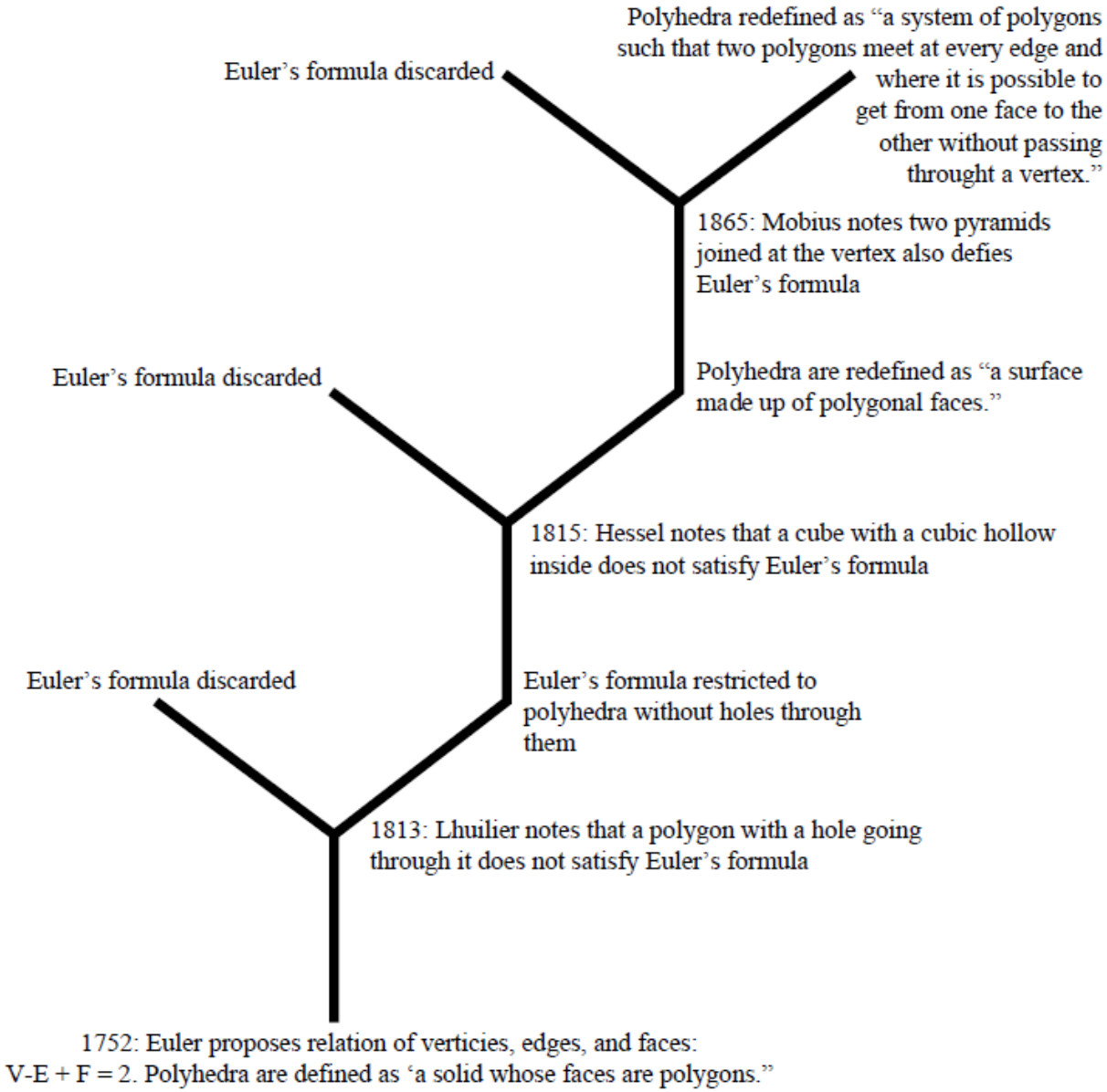
Founders: David Bloor, Barry Barnes.

Tending towards an INTERNALIST reading of science.

Founding Ideas:

- Based on CAUSALITY (look for conditions that bring about beliefs and ideas)
- Based on IMPARTIALITY (will not differentiate between 'truth' /'falsity', rational/irrational, success/failure)
- Based on SYMMETRY (same causes/conditions will lead to truth/falsity etc.)
- Based on REFLEXIVITY (awareness of conditions that lead to our beliefs)

EXAMPLE: The Euler equation for polyhedra (V-E+F =2)


Polyhedra redefined as "a system of polygons such that two polygons meet at every edge and where it is possible to get from one face to the other without passing throught a vertex."
Euler's formula discarded
1865: Mobius notes two pyramids joined at the vertex also defies Euler's formula
Polyhedra are redefined as "a surface made up of polygonal faces."
Euler's formula discarded
1815: Hessel notes that a cube with a cubic hollow inside does not satisfy Euler's formula
Euler's formula restricted to polyhedra without holes through them
Euler's formula discarded
1813: Lhuilier notes that a polygon with a hole going through it does not satisfy Euler's formula
1752: Euler proposes relation of verticies, edges, and faces:
V-E + F = 2. Polyhedra are defined as 'a solid whose faces are polygons."

Strong Programme in STS

Question: HOW do we explain this path in mathematics?

Practices and cultures -> Knowledge.

Strong programme: Considered to prefer structure (characterized by practices and cultures) > agency.

"*There are, then, many different strategies for increasing [cultural] capital. For example: Depending on the position they occupy in the structure of the field . . . the 'new entrants' may find themselves oriented either towards the risk-free investments of succession strategies . . . or towards subversion strategies, infinitely more costly and more hazardous investments which will not bring them the profits . . . unless they can achieve a complete redefinition of the principles legitimating domination*."

Empirical Programme of Relativism (EPOR)

Founders: Harry Collins

Tending towards an EXTERNALIST reading of science.

Founding Ideas:

- Extension/strengthening of the Strong School
  - *Stage 1*: Show that multiple interpretations of scientific findings are possible/available
  - *Stage 2*: Show how scientific controversies are resolved. Use relativism as a *methodological* tool. Ask: What are the institutional arrangements/networks that allow for settling of controversies?
  - *Stage 3*: Show how the closure of controversy is connected to larger socio-political and economic structures/phenomena

EXAMPLE: Pasteur's controversies (spontaneous generation, use of microorganisms in fermentation, germ theory).

Role of ideology, idiosyncrasy, political interests.