

Theories and methods: literature, science and medicine

Event 4 Session 3

The sociology of scientific understanding

James Sumner

What is the history of science?

History of science developed late C19-C20, largely in tandem with the **philosophy of science**. Most practitioners are **scientists themselves**, reflexively interested in their fields. One goal is to **define the nature of science**.

Science is widely presented as the enterprise of producing **universal truth**. Assumption that the stock of known truth is, by definition, generally agreed on, and **always increases** whenever worthwhile research happens.

According to this vision, history of science is a tale of **upward, cumulative progress**.

- William Whewell, *History of the Inductive Sciences*, 1847
- George Sarton, *Introduction to the History of Science*, 1927
- C C Gillispie, *The Edge of Objectivity*, 1960

which the mind of the philosopher employs itself;—the history of those branches of knowledge for the last three hundred years abundantly teaches us.

Accordingly, the existence of clear ideas applied to distinct facts will be discernible in the History of Science, whenever any marked advance takes place. And, in tracing the progress of the various provinces of knowledge which come under our survey, it will be important for us to see, that, at all such epochs, such a combination has occurred ; that whenever any material step in general knowledge has been made,—whenever any philosophical discovery arrests our attention ;—some man or men come before us, who have possessed, in an eminent degree, a clearness of the ideas which belong to the subject in question, and who have applied such ideas in a vigorous and distinct manner to ascertained facts and exact observations. We shall never proceed through any considerable range of our narrative, without having occasion to remind the reader of this reflection.

Successive steps in Science.—But there is another remark which we must also make. Such sciences as we have here to do with, are, commonly, not formed by one single act ;—they are not completed by the discovery of one great principle. On the contrary, they consist in a long-continued advance ; a series of changes ; a repeated progress from one principle to another, different and often apparently contradictory. Now, it is important to remember

A page from Whewell's *History*

Grand narratives

This kind of narrative appeals to many practising scientists. **Every generation** – including the current one – **can be seen to make things better...**

For the same reason, it also makes for **coherent, long-term, wide-ranging narratives** of scientific change

Even **Herbert Butterfield** – famous for pointing out the flaws in political/religious “upward progress” accounts (*The Whig Interpretation of History*, 1931), accepted science as genuinely cumulative in *The Origins of Modern Science*, 1968, with integrative phrases like:

“all the ingredients of Charles Darwin’s theory had already been discovered save the idea of the struggle for existence. The work of Malthus and the economic writings of the industrial revolution were soon to supply what was needed here...”

“It has often been a matter of surprise that the emergence of modern chemistry should come at so late a stage in the story of scientific progress...”



But...

By the time Butterfield published *The Origins of Modern Science* (1968), there were well-established arguments

1. that the history of science is not just the history of scientific knowledge: “**external**” factors (social organisation, industrialisation, warfare, religion...) fundamentally influence the content of science

and also

2. that scientific knowledge **does not accumulate** in an ever-rising progression, but is regularly abandoned or revised out of recognition.

Across the 1970s, these two insights were **combined** in ways that **made the conventional, progressive grand narrative increasingly impossible** in scholarly history of science.

In the process, history was largely **disengaged from philosophy**, and drew increasing inspiration from the **social sciences**

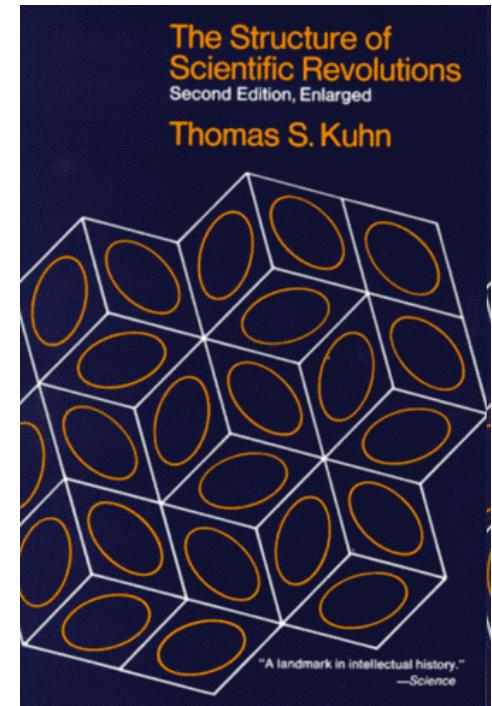
Is scientific progress cumulative?

Thomas Kuhn, *The Structure of Scientific Revolutions*,
1962:

- different areas of science oscillate (independently) between “normal” and “revolutionary” phases
- “revolution” involves changes such that fundamental concepts on either side of a revolution **cannot be translated into each other**
- thus, science perhaps **improves** (as measured by ability to explain or engineer the natural world), but it does not **progress**. Past science is not a subset of our own, but something **wholly different**.

NB: Kuhn is still giving a universal prescription for what science is.

But... **where's the grand narrative now?**



The sociological turn

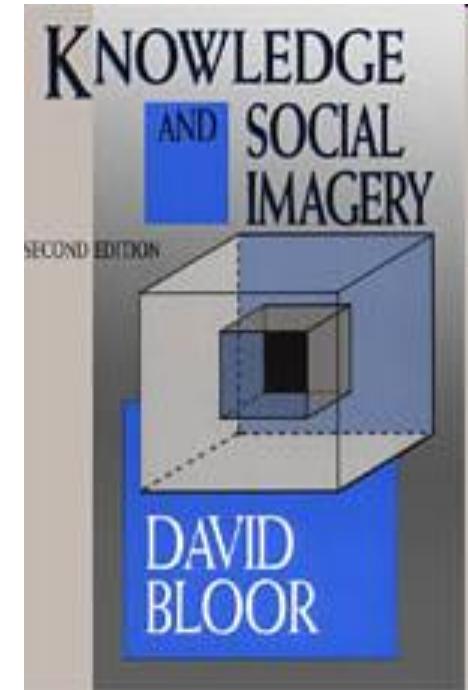
Robert K Merton (eg, “The normative structure of science”, 1942) had written sociology of **scientists**, but excluded the conceptual content of science.

Traditional view: don't need any social theories to explain how science works – scientists just follow objective rules (which science **must have to be** science)!

This is increasingly open to challenge. Kuhn: there is no one ever-growing body of “the right science”...

Indirectly promotes a manifesto for a **sociology of scientific knowledge (SSK)**, giving social explanations for why we work with our particular scientific claims rather than any other.

David Bloor, *Knowledge and Social Imagery* (1976): there has been past work giving social explanations for why **discredited** science was believed, but this is a “weak” programme because incomplete. We need to explain why currently **credible** science is so. This is the **Strong Programme** in SSK.



The Strong Programme in SSK

Key elements of Strong Programme investigation as defined by Bloor:

- **causality**: need to seek reasons for the emergence of knowledge claims among all relevant conditions (psychological, cultural, social)
- **symmetry/impartiality**: must do this using the same methodology whether the knowledge-claims being investigated are “successful” (accepted as scientific truths) or “unsuccessful” (not so).

Thus, “because it’s true” is **not** a sufficient explanation of how (say) Newton’s Law of Universal Gravitation took hold.

To understand the outcome of the process that secured Newton’s Law, we must follow the actions and motivations of those who disbelieved it **as though they were correct** (because **they knew that they** were).

- **reflexivity**: sociological investigation must be applicable to sociology itself.
NB: this can be pressed as the **appropriately scientific** mode of investigation.
Strong programmists would point out that knowledge of physics does not explain how physicists produce knowledge: this is surely a sociological question

The Edinburgh School and the historians

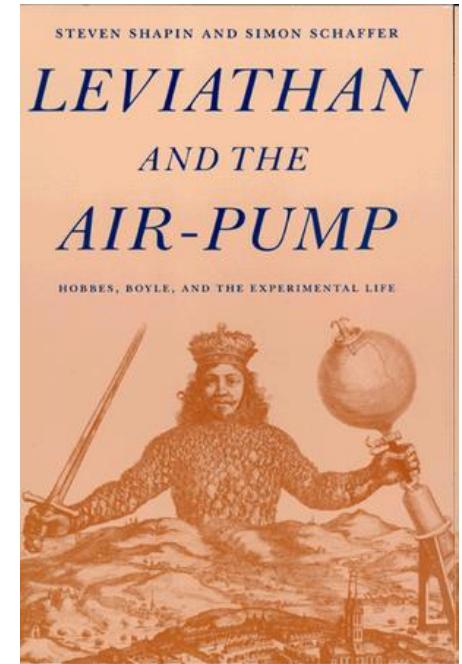
The Edinburgh School: Bloor and his sociological colleagues at the Science Studies Unit, Edinburgh (esp Barry Barnes, Donald MacKenzie), 1970s-80s. Search for broad explanations of general development of scientific disciplines.

Hence obvious grounds for influence on history of science. Chiefly 1980s onwards, Edinburgh School historians (esp **Steven Shapin, John Henry**) develop historical accounts that respect the SSK “symmetry principle”.

No longer a question of balancing “internal”-intellectual and “external”-social/economic studies. Science is now seen to be **socially constructed**. Its internals – the elements of knowledge – **are social too**, and can be explained using social-science techniques, just like other communities, workplaces, publications etc.

Historical manifesto articulated in Steven Shapin and Simon Schaffer, *Leviathan and the Air Pump*, 1985.

Technologies of fact-making: material, literary and social



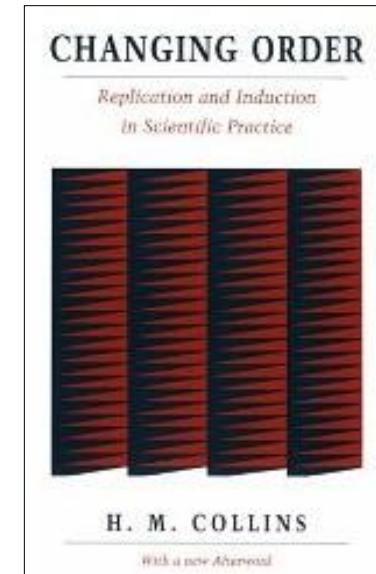
The Bath School

Whereas Edinburgh-School SSK tends towards broader explanations, the **Bath School** (Harry Collins, David Gooding, Trevor Pinch) focuses on grassroots-level studies of scientists at work, usually in laboratory settings. Collins, *Changing Order*, 1985: based on interview work with contemporary scientists and engineers (esp laser-builders).

The experimenter's regress: how can we judge whether an experimental set-up is giving the right results? By testing them against theoretical predictions? But the point of the experiment is to test the theory!

When there is **controversy** about new experimental work, the opponents can always point to something in the set-up that might be a source of error. Only way to test is by building another experiment – which can again be controverted... so **experimental investigation of nature alone cannot end controversy** and determine universally acceptable theory.

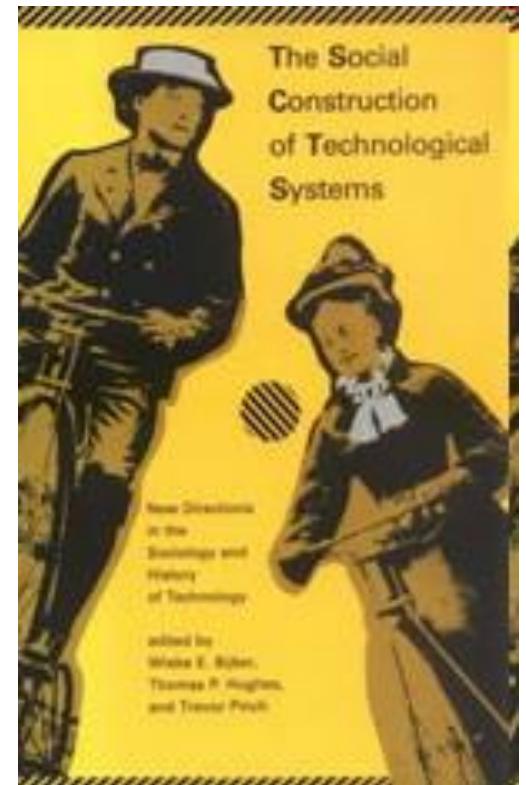
In practice, however, controversies usually end quickly. **The process is partly social**, depending on factors including **trust**



Social construction of technology (SCOT)

Guided by (mostly Bath) SSK's focus on **interpretive flexibility**: findings are interpreted differently by different scientific groups, hence controversy. A key task is to understand the mechanisms for **limitation** and **closure** of controversy, which must be social.

Trevor Pinch and Wiebe Bijker, "The social construction of facts and artifacts", 1987: SCOT manifesto applying similar insights to the development of **technological things**.



Social construction of technology (SCOT)

Using the case study of the bicycle, maps how

- each artifact is related to many social groups
- each social group is faced by many problems
- each problem is addressed by many contended solutions involving modification of the technology.

Tech development is thus best mapped as a **network**: people tend instead to believe in **linear** development (cf cumulative history?) because the account is simplified after **closure**

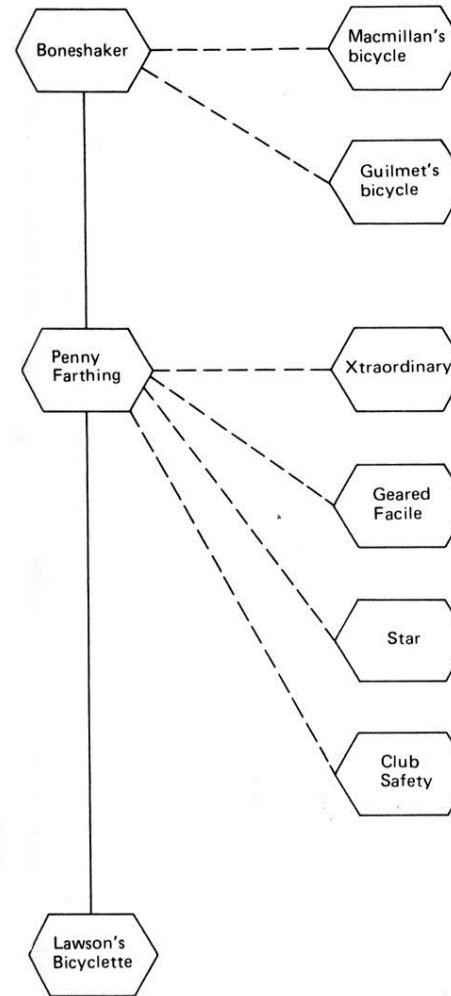


Figure 4

The traditional quasi-linear view of the developmental process of the Penny Farthing bicycle. Solid lines indicate successful development, and dashed lines indicate failed development.

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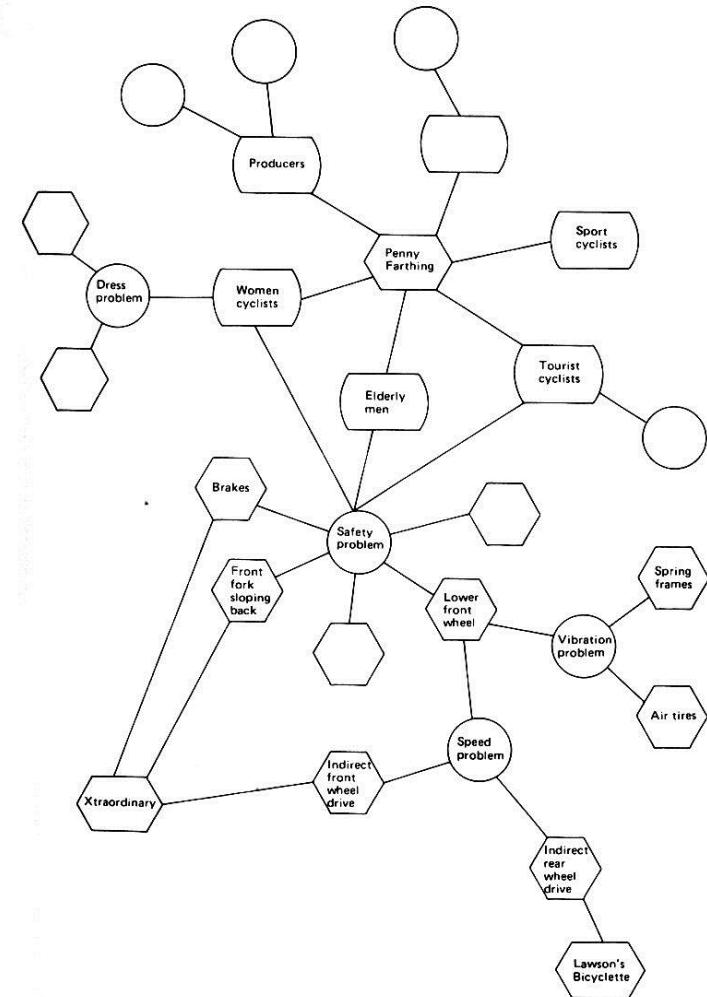


Figure 11

Some relevant social groups, problems, and solutions in the developmental process of the Penny Farthing bicycle. Because of lack of space, not all artifacts, relevant social groups, problems, and solutions are shown.

Getting away from presentist assumptions

Presentist thinking addresses the motives and actions of the past in terms of the categories of the present. Thus, often assumes people were

- paid to do research
- valued by others mainly because of their research
- specialised in their research interests
- basically post-Second World War secular liberals

None of these were general (or sometimes even comprehensible) features of life in the less-than-recent past. Tendency to quietly **hide** those elements which seem least “modern”

Following the **social turn**, most scholarly history of sci and techn is now **historicism/contextualist**: attempts to address the past on something more like its own terms

JOHN
DALTON

Field: Chemistry

Nationality: English

Dates: 1766 - 1844

ACHIEVEMENTS:

John Dalton was an English meteorologist who switched to chemistry when he saw the applications for chemistry of his ideas about the atmosphere.

Dalton, who was mostly self-taught, recorded over 200,000 observations of the atmosphere in his notebooks, and studied mixed gases and the expansion of gases under heat. Dalton's Law is still used to describe the law of partial pressures in chemistry. This work led him to his most important theoretical contribution to chemistry, a scientifically grounded atomic theory of matter.

Dalton's Atomic Theory (1803) stated that:

- (1) all matter is composed of small indivisible particles termed atoms,
- (2) atoms of a given element possess Copyrighted image unique characteristics and weight, and
- (3) three types of atoms exist: simple (Copyrighted image elements), compound (simple molecules), and complex (complex molecules).

Dalton set the atomic weight of hydrogen as 'one' and used this as a basis from which to determine the atomic weights of all other elements. He produced the first [table of atomic weights](#).

Dalton was the first to provide a scientific description of **colour blindness** (1794), a condition from which he suffered, and which was long called 'Daltonism'.

Due to his great work, Dalton was made a Fellow of the Royal Society.

QUESTIONS AND EXERCISES

® RESEARCH IS, OR
MAY BE, REQUIRED.

1. What is meteorology? ®
2. Explain in your own words why Dalton switched from meteorology to chemistry.
3. What is meant by the term 'under heat'? Copyrighted image
4. How does a theoretical contribution differ from a practical contribution?
5. What do you think is meant by 'scientifically grounded'?
6. What is the atomic weight of oxygen? ®
7. Write a few sentences about the condition known as colour blindness. ®

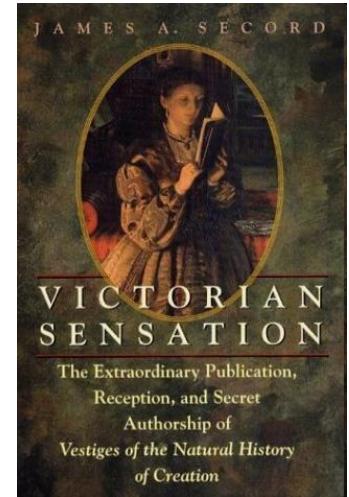
Knowledge communication and boundaries

If science doesn't spread "because it's true", why **does** it spread? Growing focus on discipline-building, professional institutions, journals, educational establishments, popularisation, **readerships** (Jim Secord, *Victorian Sensation*, 2000)

A text – say, a paper by Einstein – is not a simple reflection of Einstein's knowledge-claims. **It is a tool for a job** (of convincing and/or imposing authority)

Similarly, **boundaries** – science vs non-science, physics vs chemistry etc – are not "real things in the world": they are divisions drawn differently, at various times, by different people and groups, for various reasons, often to do with status (Thomas Gieryn, "Boundary-work and the demarcation of science", 1983).

Such concerns have also fed the recent development of **historical geography**...



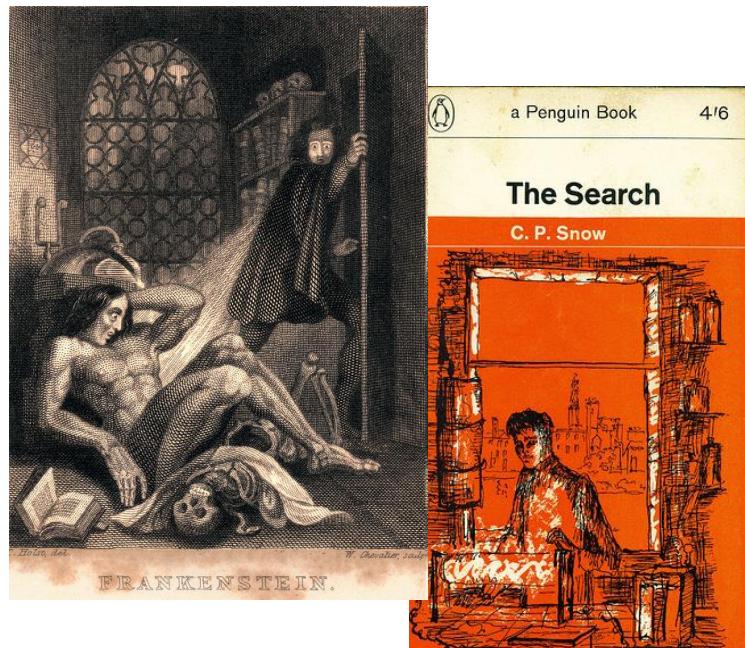
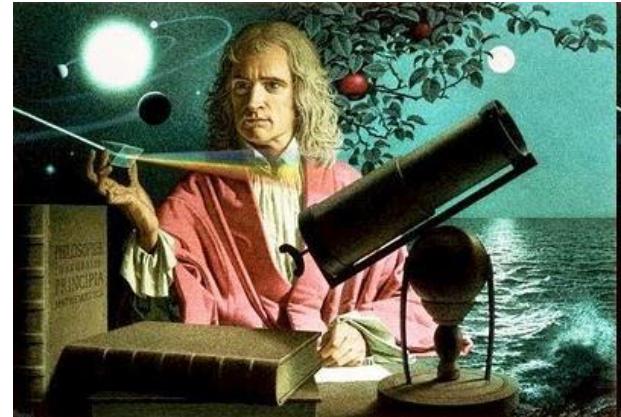
Mesmeric treatment: Scientific or not? Either claim aids its supporters' purpose

Lessons for LitSciMed?

How should we address the relationship between science/medicine and cultural phenomena, such as theological speculation or Romanticism? Traditional, cumulative view suggests that Newton or Davy at best “combined” very different activities (or, at worst, “got distracted” by unscientific fripperies...)

“The figure of the scientist”: important not to be ahistorical. What kind of scientists and when? Is the category “scientist” even relevant to how they saw themselves, and how others saw them?

Communication between disciplinary specialists and non-specialists...



and now...

...some extra content slides

A traditional “progress” narrative

Consider the tale of astronomy in the “Scientific Revolution”:

- Ancient cosmology from **Aristotle** to **Ptolemy**: Earth at centre of universe; sun and other planets orbiting; crystalline spheres
- **Copernicus** puts Earth in orbit, 1543
- **Tycho**, though geocentric, abolishes crystalline spheres and improves accuracy of readings, 1570s
- **Kepler** conforms Tycho’s data to Copernicanism; introduces ellipses, 1609
- **Galileo** promotes impetus theory, 1632
- **Newton** synthesises these developments to describe universal gravitation, 1687

“Before Kepler, all men were blind. Kepler had one eye, and Newton had two” (Voltaire, 1730s?)



A page from Copernicus’s *De Revolutionibus*

Externalist history of science

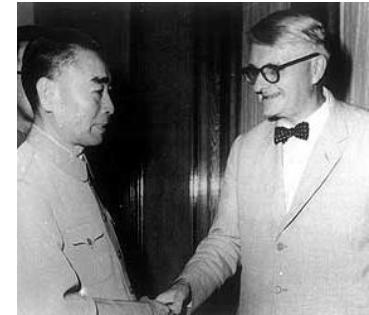
Boris Hessen, “The social and economic roots of Newton’s *Principia*”, 1931: all developments, including intellectual ones, are part of a general historical process which follows determinable rules. Course of history is determined by “the movement of the masses”, not individual genius/ideas; needs of transport, war etc



Robert K Merton, *Science, Technology and Society in C17 England*, 1938. Not only industry, transport, war but also **religion** influence course of science. C17 Protestant/ Puritan thought stressed mental discipline; moral importance of useful knowledge; knowing God through natural world. Merton, however, is keen to stress that “[s]pecific discoveries belong to the **internal** history of science”.



Joseph Needham, Christian Marxist embryologist. *Science and Civilisation in China* series, beginning 1954. “Needham Question”: Why did China fall behind Europe in sci/tech after 1400? Needham’s answer: chiefly due to China’s large interior and limited coastline, promoting agriculturally based stability. Power stayed with mandarins (= feudal bureaucrats). In maritime Europe, it passed to industrialists and merchants.



The internalism/externalism divide

Claims that content of science is influenced by **external** factors (mostly from the political Left, often explicitly Marxist) provoke fierce reaction from some established scholars.

Alexandre Koyré emerges, esp 1940s, as champion of opposing, **idealist** view: essence of “science” is scientific theory (universal, cumulative, etc); outside factors have no determining effect. This approach becomes known as **internalism**. Influences Butterfield, Rupert Hall, C C Gillispie.

Late 1950s-1980s: historiography of science usually introduced in terms of the **internalism/externalism polarisation**, usually with stern warnings to **avoid the “extremes”** of either. Task often defined as drawing the best features from each.

From the
Closed World
to the
Infinite Universe



ALEXANDRE KOYRÉ

“Let us now praise famous men”...?

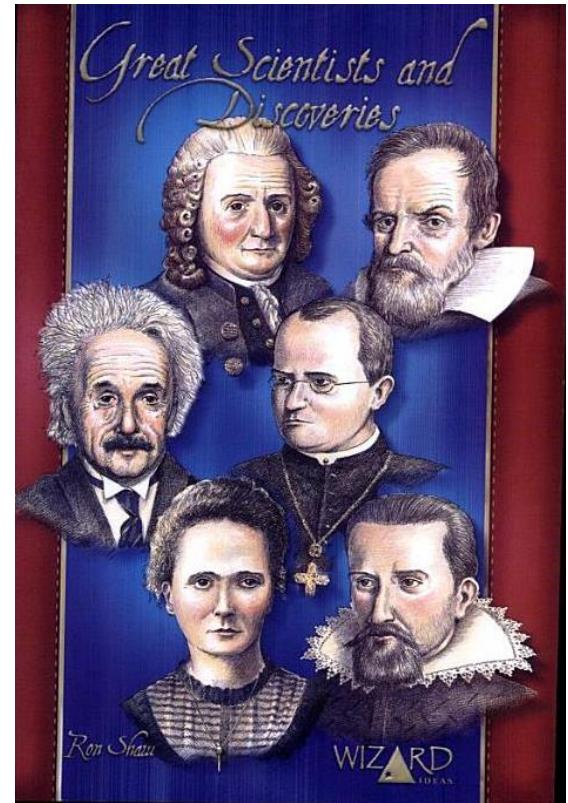
Rise of social constructivism confirms a (growing?) gulf between scholarly and popular/amateur views

“**Vulgar triumphalist**” picture (Robert Westman): bold new thinkers – eg Copernicus – blow away existing (superstitious?) patterns of thought, replacing them with something recognisably modern. Still found in textbooks, newspapers, some scientists’ own accounts of history...

“**Great men**” historiography (not only found in STM): focus entirely on individuals who, supposedly, made the crucial difference. Similarly **heroic inventors**

(NB: 2010 rebranding of Institute and Museum of the History of Science, Florence, as **Museo Galileo**)

Sometimes goes in parallel with **the condescension of the present**: how could our heroes’ enemies have been so **stupid** as not to think as we do?



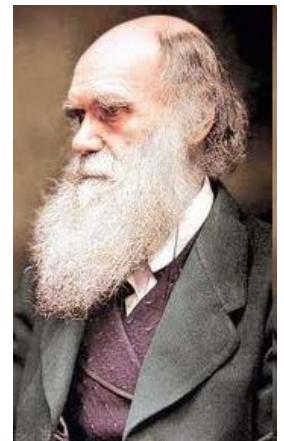
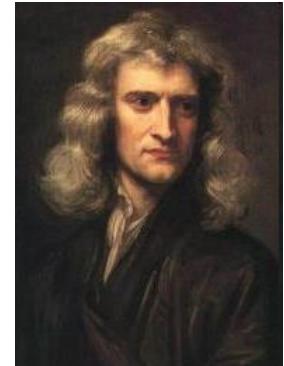
Australian school-age science education text, 2003

What if it wasn't science?

- “Scientist”: coined 1833, rarely used till late C19
- “Science”: used pre-C16 but simply meant “knowledge” (usually of the formalisable kind, as opposed to craft skills etc). Specialised towards its current meaning across the C18-early C19
- “Physics”: once the Aristotelian system of understanding the natural world; sometimes natural knowledge in general; specialised towards current meaning mid-C19
- “Biology”: proposed C19 with various meanings; approached present meaning late C19

Prior disciplines included **natural philosophy, natural history, mixed mathematics...**

Andrew Cunningham: important to get “the game” right. “Natural philosophy” is **not** ‘the old name for physics’. Boundaries often differently drawn; and priorities differed. eg, most natural philosophy invoked **God** in a way that most physics doesn’t.



Isaac Newton, mathematician, natural philosopher and alchemist; Charles Darwin, naturalist.