SCIENCE Defined

定义科学

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科教兴国

1977 Deng Xiaoping:

"Our country has to catch up to the world's advanced level.
Where do we begin? I think we have to start with science and education".

1995 《中共中央国务院关于科学技术进步的决定》put out the strategy:

Rejuvenating the country through science and education (科教兴国).

Then, we have to know what science is in order to carry out the strategy, right?!

科普法

2002 Popular Science Law 《中华人民共和国科学技术普及法》

To support 科教兴国, should popularize and promote

•Scientific and technological knowledge

•Scientific method

•Scientific thinking

•Scientific spirit

Government,…,other organizations (including IoP) and scientists has the duty to popularize science.

Then, one has to know what science is to avoid breaking the law inadvertently, right?!

Moreover, misunderstandings of science cause all sorts of problem and tragedy in human history.

Improper and Imprecise Definition

An example

American Physical Society:

Science is the systematic enterprise of gathering knowledge about the world and organizing and condensing that knowledge into testable laws and theories.

Problems:

- Systematic: Signature of mature science only; early or initial stages of science will be excluded.

- World: World = Universe?   World = Nature?

- Testable laws: Just an aim; not so easy for complex systems (e.g., Darwin's evolution theory).
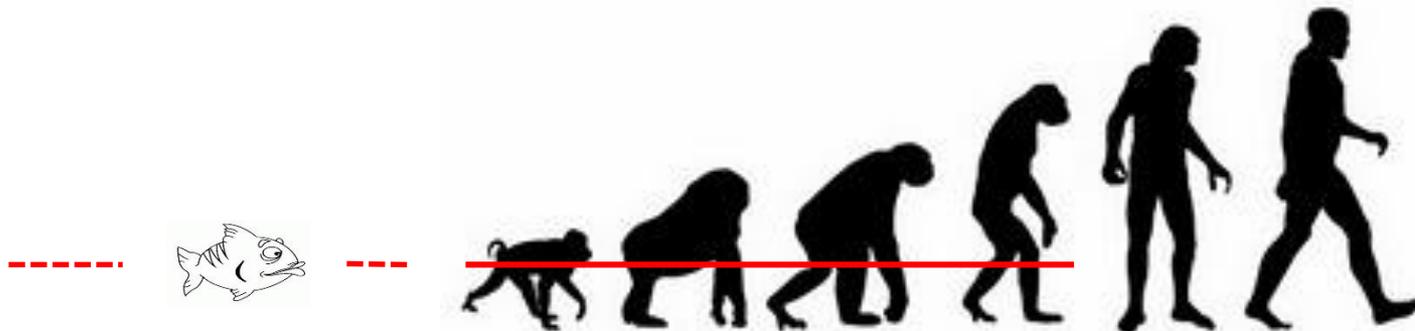
The Nature of Nature

Does Nature include humans?

Yes, because

- Nature includes all material systems.
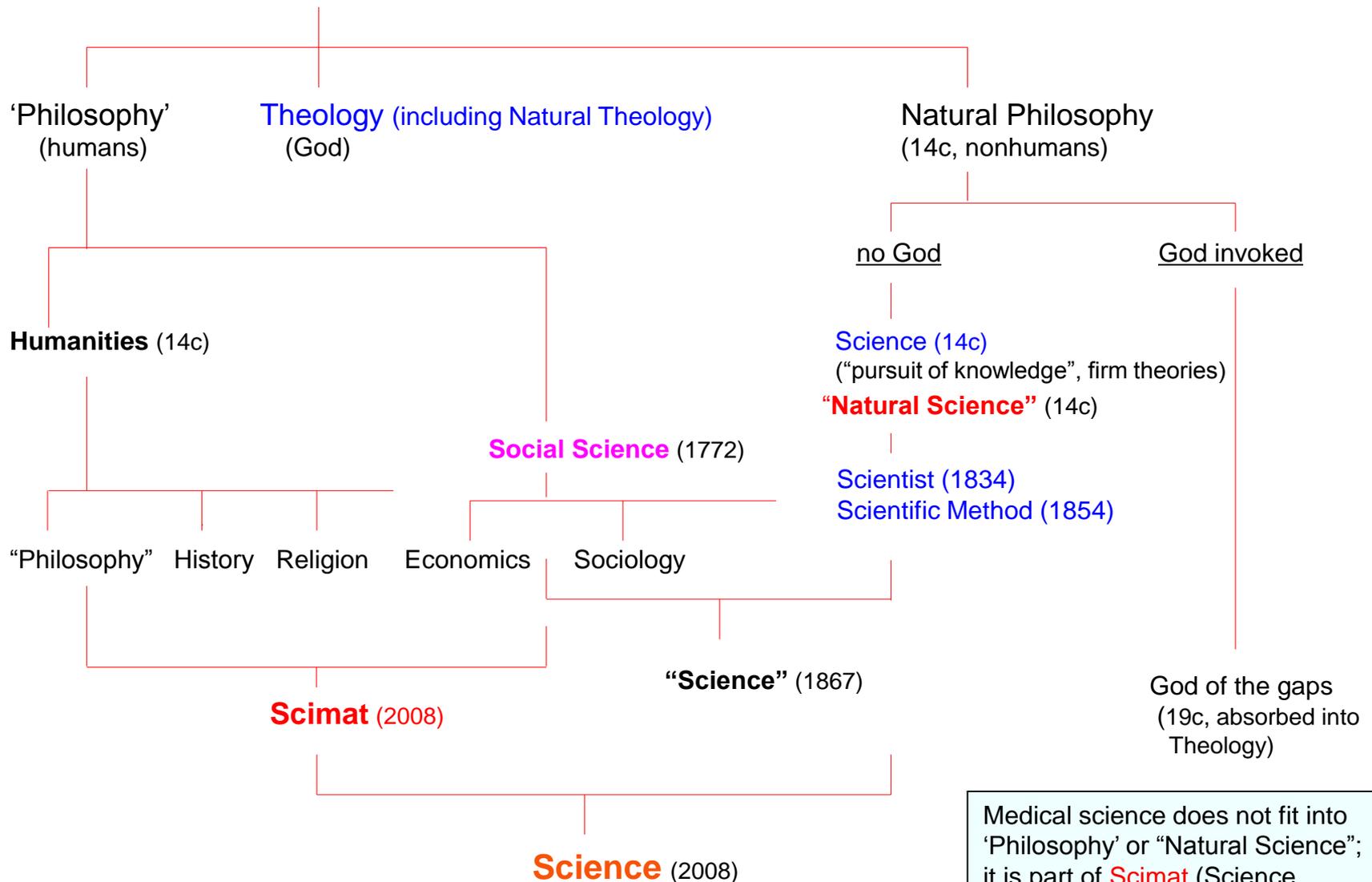- Humans are a material system made up of atoms.

Moreover,

- Einstein's Brownian motion theory (1905) shows (indirectly) that atoms do exist.
- Darwin's evolution theory (1859): Humans, like other animals, evolved from other more primitive creatures and organisms.
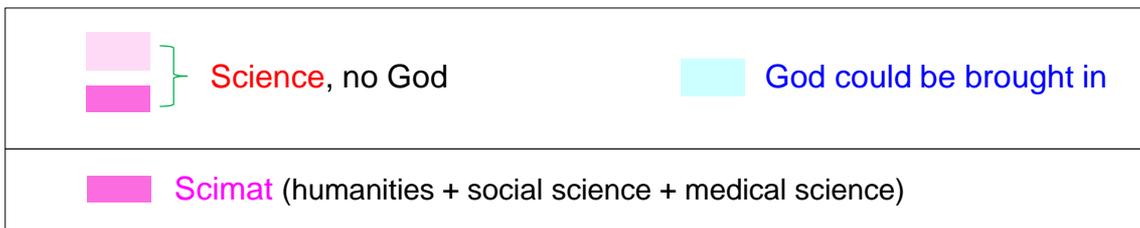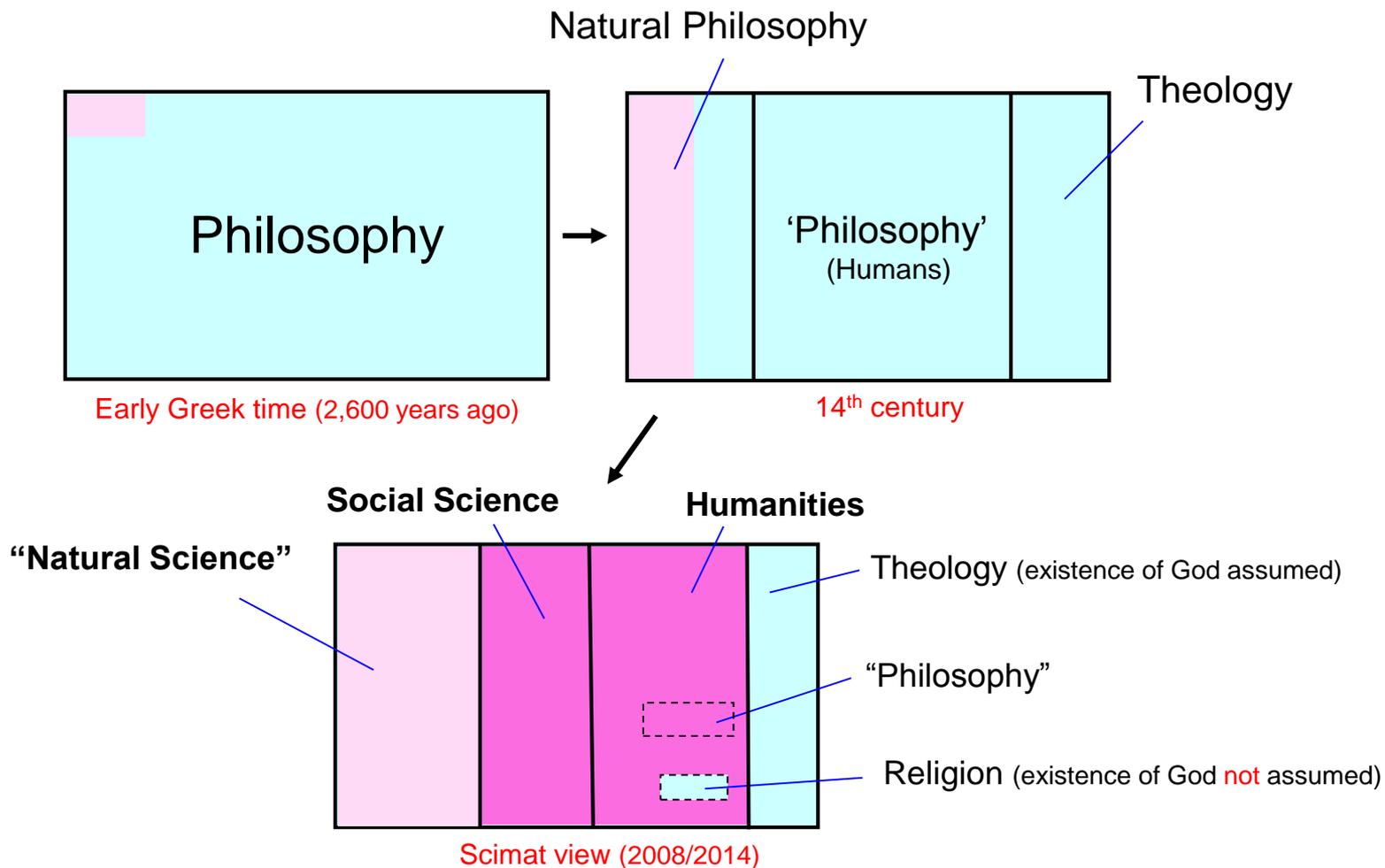
Birth of Disciplines & of Science

**Philosophy** (600 BC, "love of wisdom"; Pythagoras; 13c, English)

'Philosophy'
(humans)

Theology (including Natural Theology)
(God)

Natural Philosophy
(14c, nonhumans)

no God   God invoked

Humanities (14c)

Science (14c)
("pursuit of knowledge", firm theories)
"**Natural Science**" (14c)

Social Science (1772)

Scientist (1834)
Scientific Method (1854)

"Philosophy"   History   Religion   Economics   Sociology

"Science" (1867)

God of the gaps
(19c, absorbed into
Theology)

Scimat (2008)

Science (2008)

Medical science does not fit into
'Philosophy' or "Natural Science";
it is part of Scimat (Science
Matters, 人科) which includes all
human matters.

Retreat of God As Science Expands

Natural Philosophy

Theology

Philosophy

'Philosophy'
(Humans)

Early Greek time (2,600 years ago)

14th century

Social Science

Humanities

"Natural Science"

Theology (existence of God assumed)

"Philosophy"

Religion (existence of God not assumed)

Scimat view (2008/2014)

Science, no God

God could be brought in

Scimat (humanities + social science + medical science)

Science Defined

Science is humans' (earnest and honest) pursuit of knowledge about all things in Nature (which includes all human and nonhuman material systems) without bringing in God or any supernatural.


Scimat
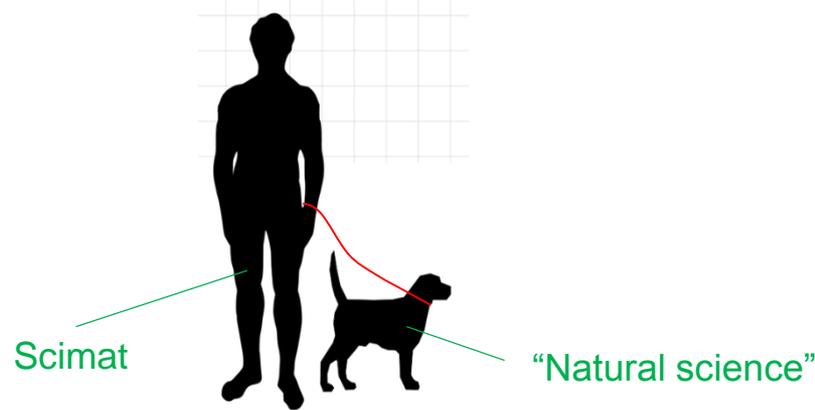
"Natural science"

- "Natural science" did enlighten our understanding of Nature (e.g., big bang), make our living easier (cell phone), and help prolonging our life (for good or bad).

- But it is the humanities that determine our quality of life (e.g., to pollute or not to pollute) and bring us genuine happiness (human relationships, arts).

- Also, it is humans (through decision making, a branch of humanities) who controls the use of "natural science".

- And that is why the humanities (itself part of science) are more fundamental and important than "natural science".

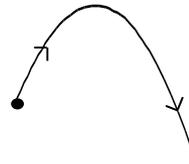# Implication 1: Science and Religion

- Science, by definition, has nothing to do with religion.

- But religion has everything to do with science whenever its sayings conflict with "established" scientific facts/theories.

caution

- Scientific "facts/theories" (e.g., projectile path, safety of food/medicine) could change with time (those that pass the Reality Check will be retained).
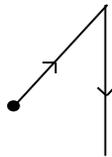
Before Galileo (Aristotle)   After Galileo (~400 yr ago)

- And religion can easily cope by using "God of the gaps" (e.g., Newton), and make itself viable by retreating fast enough (e.g., Pope, 1992, 1996)

Implication 2: Science and Antiscience

Marriage

Marriage (conventional definition):

1. A legal piece of paper
2. Signed by a woman and a man (who promise to take care of each other).

Anti-Marriage

is usually not against point 1 but is about point 2, which could mean replacing it by:

a legal document signed by a woman and a man, a women and a woman, or a man and a man.

It is a matter of definition of Marriage.

Similarly, the so-called antiscience is not against science *per se* (except for Plato) but are about

1. application of science,

2. choice of research topics,
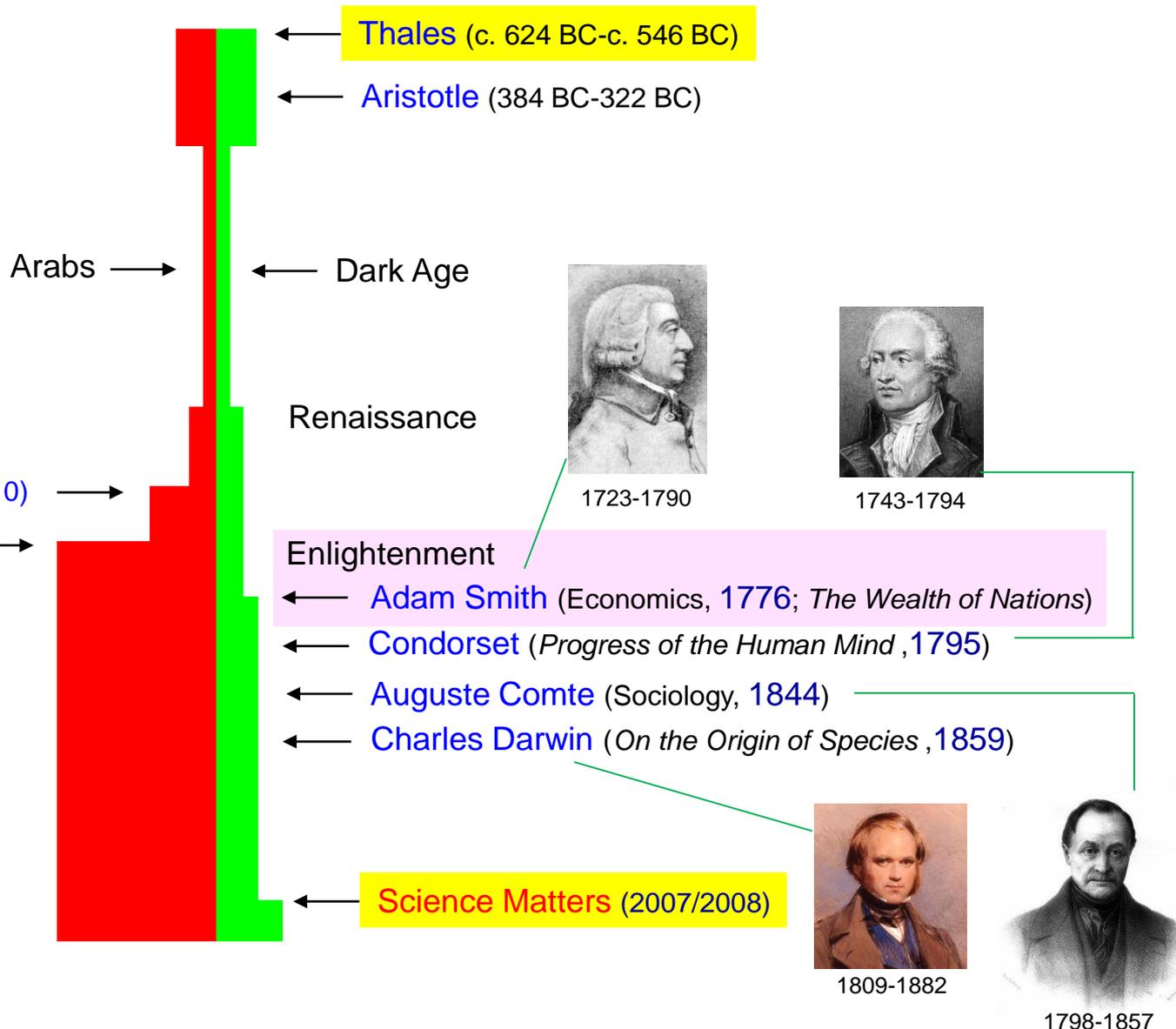
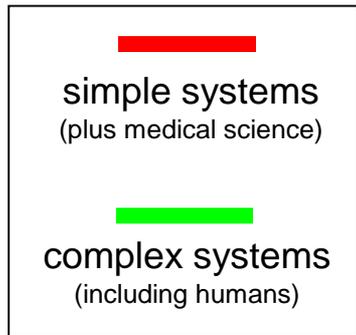3. allocation of government resources.

All these disputes are human-dependent matters, part of science (scimat),

There is no such thing called antiscience,
except for those dishonest scientists (including those in humanities) who cheat;
they are antiscientists.

Implication 3: Science and Pseudoscience

- The science-pseudoscience demarcation is a complex issue which is less about science *per se* but more about the competition for attention, prestige and resources.

- For example, the debate on intelligent design (ID, a form of creationism) being science or pseudoscience is due to the fuzzy definition of science used (either in the media or in court).

- If God is explicitly excluded from the definition of science, as defined here, this debate would never happen, case closed.

- Other "pseudoscience" claims (e.g., astrology), though unlikely, cannot be ruled out outright by science.

- The fight against pseudoscience should be through education (e.g., on probability knowledge) and persuasion (which depends on the credibility of the educator), but not by science "proofs" which do not really exist (since all science is done through approximations).

simple systems
(plus medical science)

complex systems
(including humans)

Thales (c. 624 BC-c. 546 BC)

Aristotle (384 BC-322 BC)

Arabs →   ← Dark Age

Renaissance

Galileo (1610) →

Newton (1687) →

1723-1790

1743-1794

Enlightenment

Adam Smith (Economics, 1776; *The Wealth of Nations*)

Condorset (*Progress of the Human Mind*, 1795)

Auguste Comte (Sociology, 1844)

Charles Darwin (*On the Origin of Species*, 1859)

Science Matters (2007/2008)

1809-1882

1798-1857

Philosophy, History, Sociolgy and Communication of Science, by focusing on "natural science", are doing only half of the job. The other half concerns complex systems (including the humanities).

Implication 5: The Two-Culture Problem

- With rapid advance of "natural science" in the last 200 years, humanities were underdeveloped and two cultures were formed (even though both are doing the same thing—to understand Nature; the former about nonhuman systems, the latter humans).

- Literature is stuck with the complicated aspects of humans (a very complex system), such as pride and prejudice.

- The method to bridge the gap advocated by C. P. Snow (1959, adopted in general education) is to ask each side to learn something about the other side.

- This is ineffective and insufficient. The effective step is to educate all students on the common principles governing both sides: chaos, fractals and active walks. Better, teach them the proper definition of science.

C. P. Snow
(1905-1980)

"Natural science" — SciMat — Humanities

Active walk

Fractal

Chaos
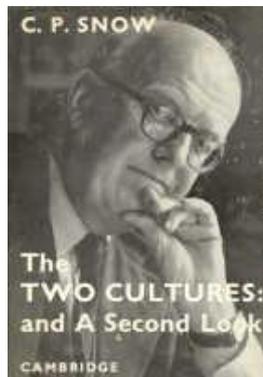
Humanities, Science, Scimat
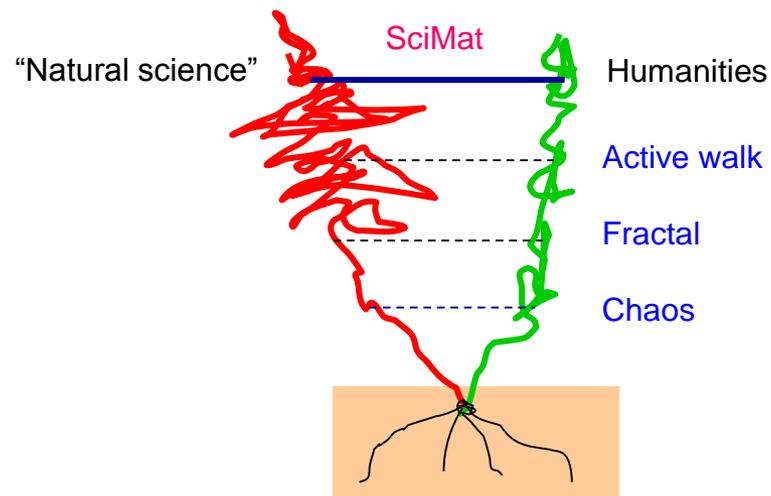
A 21st Century General Education Course for
All Students and Everybody Else

Lui Lam

Contents Summary

Science: Living with Uncertainty

- Only simple systems in the classical world is certain (e.g., stone falling).

- The quantum world is inherently probabilistic (even though the equation is deterministic).

- The human world, though classical, is inherently stochastic (due to unaccountable factors).

We are thus living with uncertainly, no matter how much science we know or can know.

- Learn basic probability.

- Prepare for the "worse".

- Be humble as scientists !

Physics Nobelist David Gross (2013):

A scientific "frontier" is defined as a state of confusion. … The public generally equates uncertainty with a wild guess. Whereas, for a scientist, a theory like the Standard Model is incredibly precise and probabilistic. In science, it is essential never to be totally certain. … Living with uncertainty is an essential part of science, and it is easily misunderstood.

What science will rejuvenate the country?　　Need 内外兼修！

功夫
- 内功
- 外功

Science
- Scimat
- "Natural science"
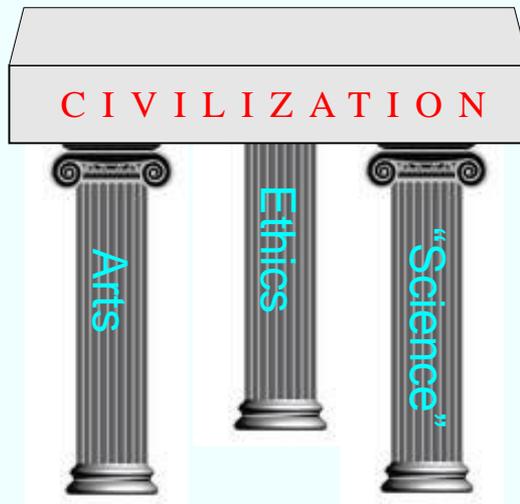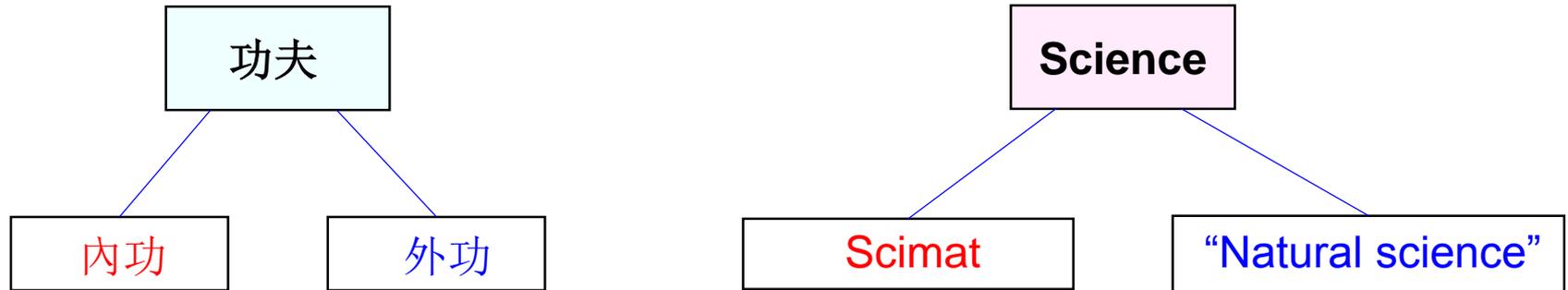
- Ethics (a branch of scimat), when broken, will cause instability of the civilization.

- To strengthen the ethics pillar, one has to strengthen all the humanities, by admitting and treating it as part of science.

Concept and Social Progress

Friedrich Hayek, Economics Nobelist (1974):

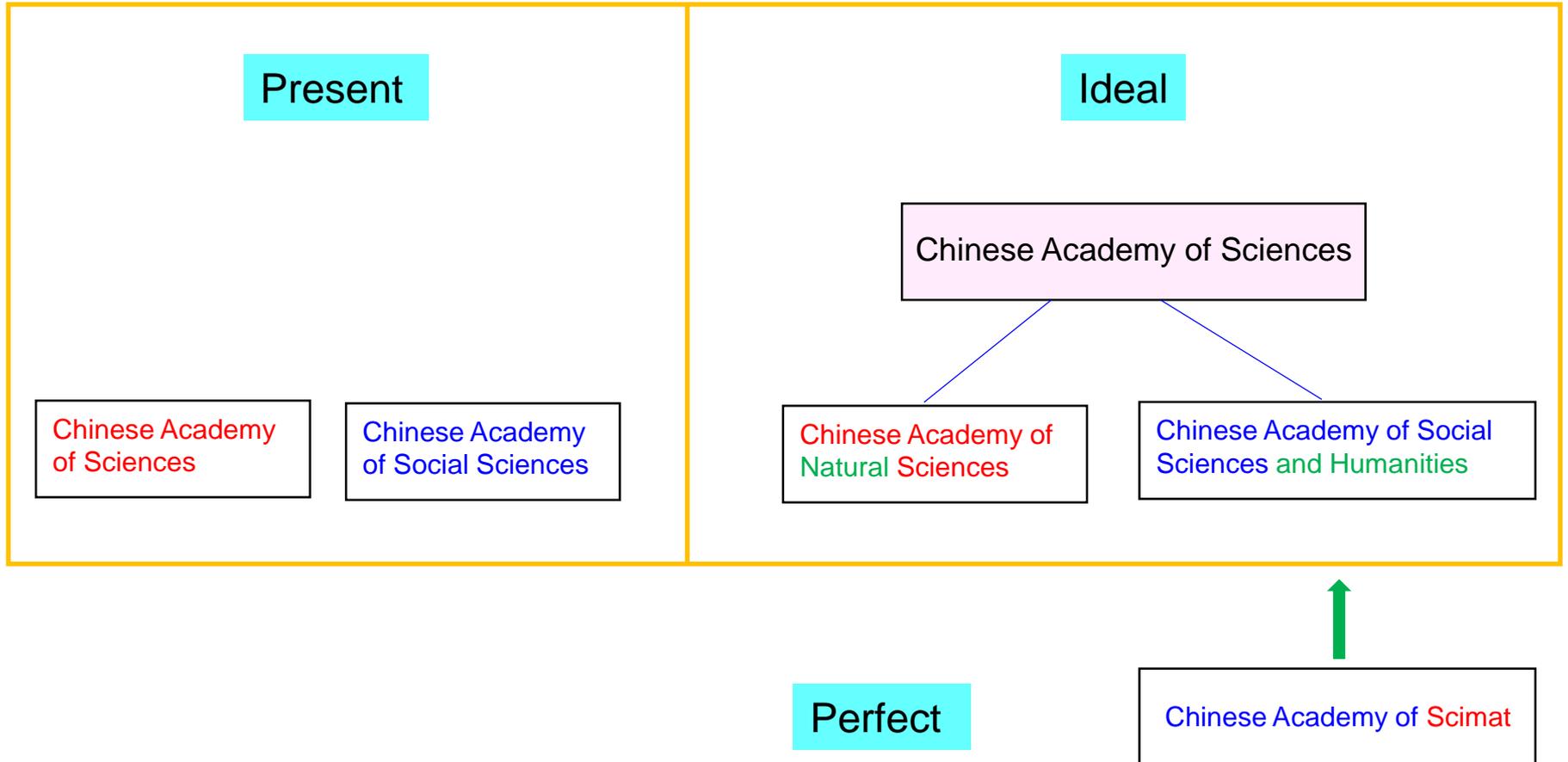Humanity advances through new concepts.

Examples

- "All men are born free" brings down slavery.

- "All men are born equal" eliminates royalties and totalitarian regimes.

- "All women are born equal, too" removes restrictions on women's rights in education, employment and voting.

Raising the scientificity of the humanities will make China the world's leader academically and immediately, the best way to show its "soft power".

Get the Names Straight

《论语 子路篇第十三》

It is imperative to get the names straight (必也正名乎) !

Present

Chinese Academy of Sciences

Chinese Academy of Social Sciences

Ideal

Chinese Academy of Sciences

Chinese Academy of Natural Sciences

Chinese Academy of Social Sciences and Humanities

Perfect

Chinese Academy of Scimat

Conclusion

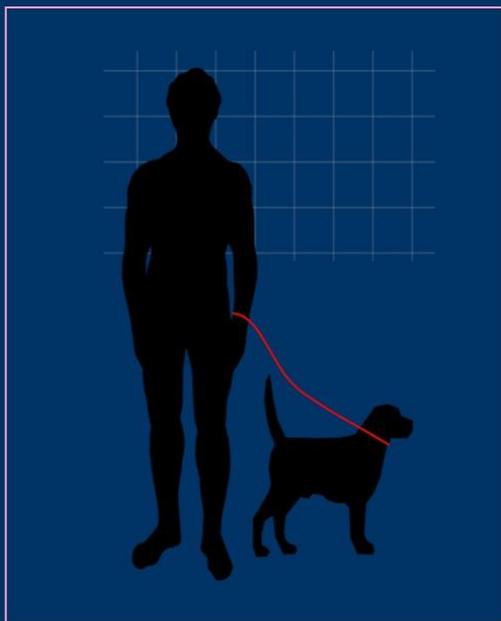1. Science is humans' pursuit of knowledge about all things in Nature without bringing in God or any supernatural.

2. Humanities are part of science.

3. The proper image of science is:
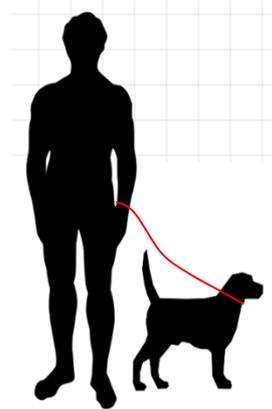
(not test tubes or nuclear symbol…)

ALL ABOUT SCIENCE

PHILOSOPHY, HISTORY, SOCIOLOGY & COMMUNICATION

MARIA BURGUETE AND LUI LAM

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Science Matters Humanities as Complex Systems

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