

27-07-18

Scientific research

IPP Seminar 1

Amandine Elchinger

Scientific research

- ❖ **What is research?**
- ❖ **The scientific method; a solid basis**
- ❖ **Documentary research (sources)**
- ❖ **Organising and storing your data**
- ❖ **Read, read, read!**
- ❖ **State of the art**

What is research?

By research, we mean an effort to answer questions which remain unmined.

- ❖ **Discovering new knowledge**
- ❖ **Collection and analysis of data**
- ❖ **Experimentation**

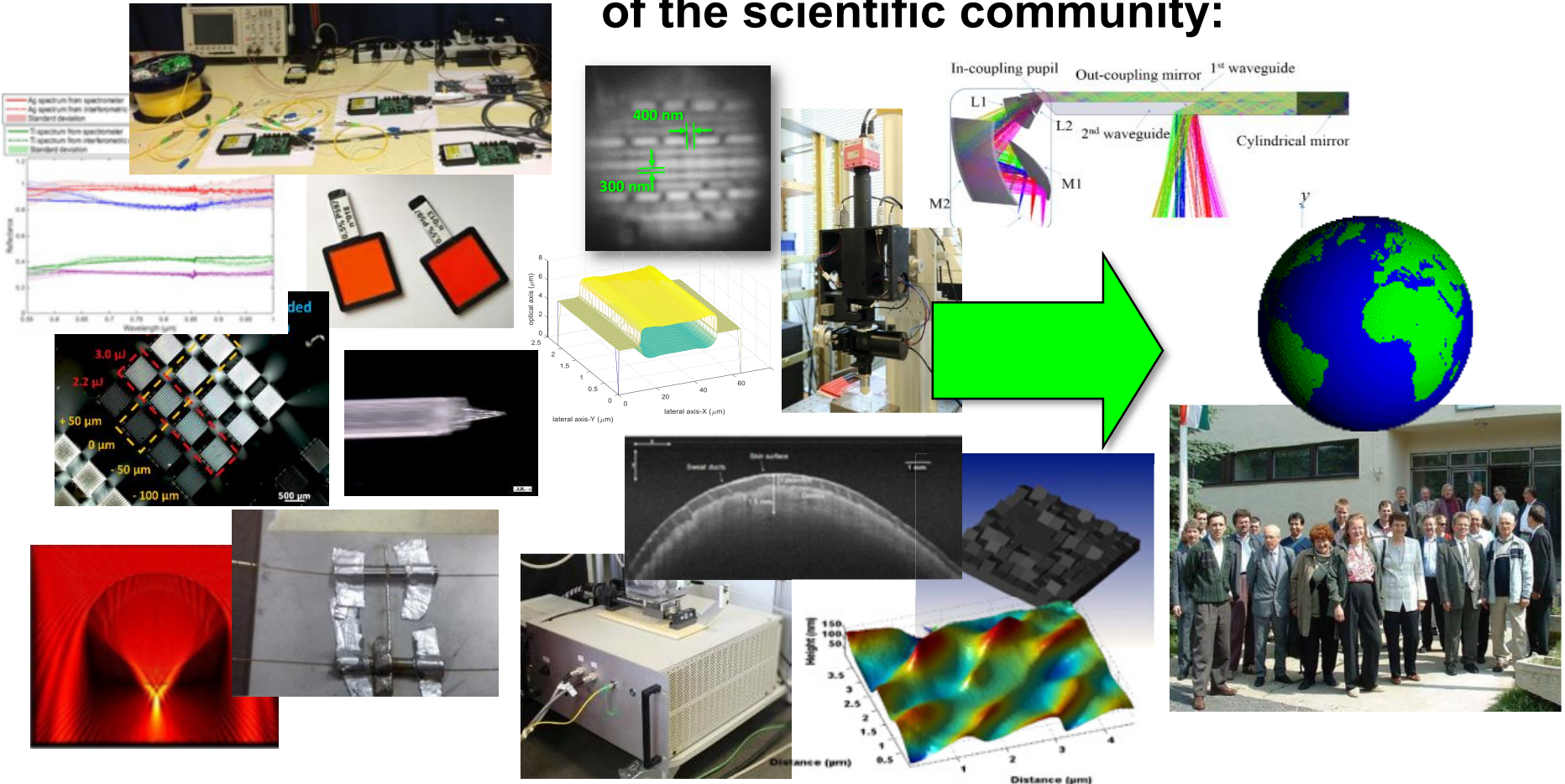
The scientific method: a solid basis

Paul Montgomery

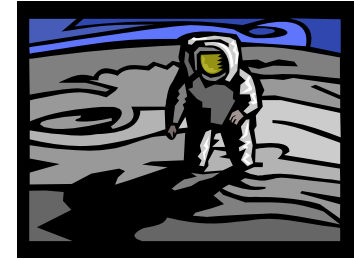
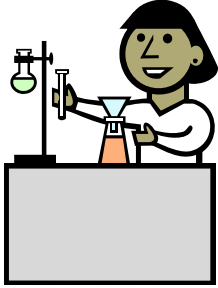
The scientific method

❖ The goal of publishing:

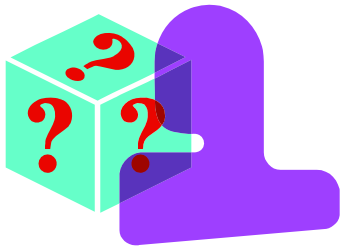
To communicate our results to the rest of the scientific community:



The scientific method



What is science?



The scientific method

❖ Back to basics :

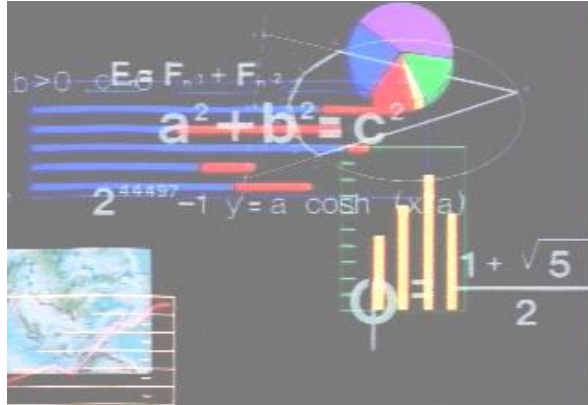
Q1. What is the scientific method?

(Today's science has evolved over many centuries).

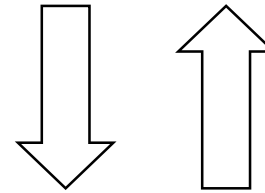
Q2. What are the basic assumptions on which modern science is based?

(Before you can do any science you have to start with some basic assumptions).

The scientific method

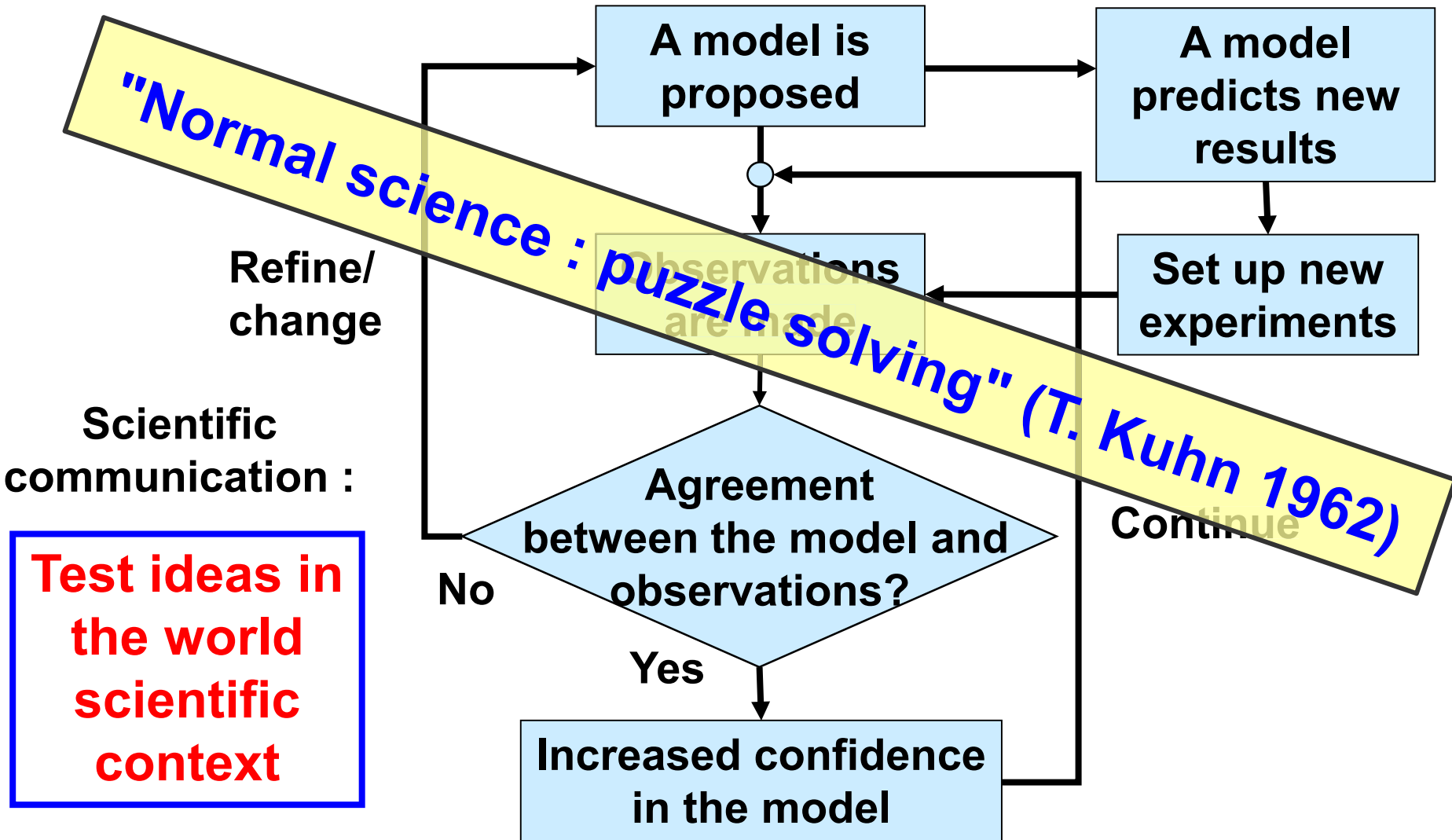


Model

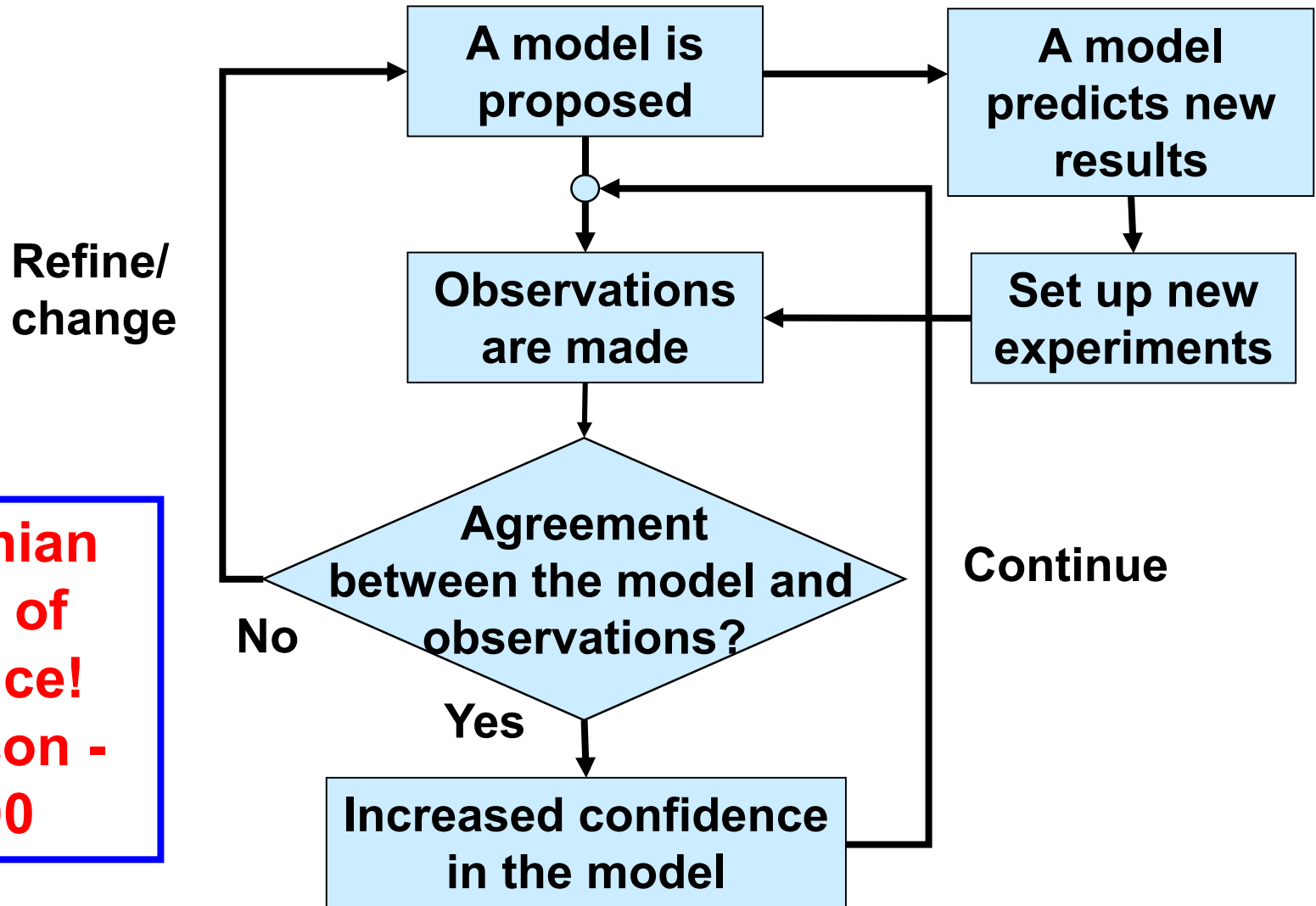


Observations

The scientific method



The scientific method



**Baconian
view of
science!
F. Bacon -
1600**

The scientific method

Problems :

- **Can we have certainty?** (D. Hume, 1750)
- **Are we entirely objective?** (T. Kuhn, 1962)
- **Does it really represent reality?** (B. d'Espagnat, 1994)

Example :

- "Caloric" (heat is a fluid) proposed by Carnot (1824):**
- **Very successful empirically (heat engines...)**
...but false! (vibrations of atoms).

The scientific method

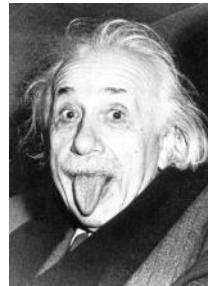
We can benefit a lot from the lessons learned in the history and philosophy of science :

- There will always be an element of uncertainty in science.
(D. Hume – 1750, B. Russell - 1950's)



... So we need to be cautious in what we write!

- Science is a human activity– people are subjective!
(P. Feyerabend - 1950's, T. Kuhn – 1970's)



- Reporting of results can be biased – financial/political influences
... so we need to be as objective as possible!



The scientific method

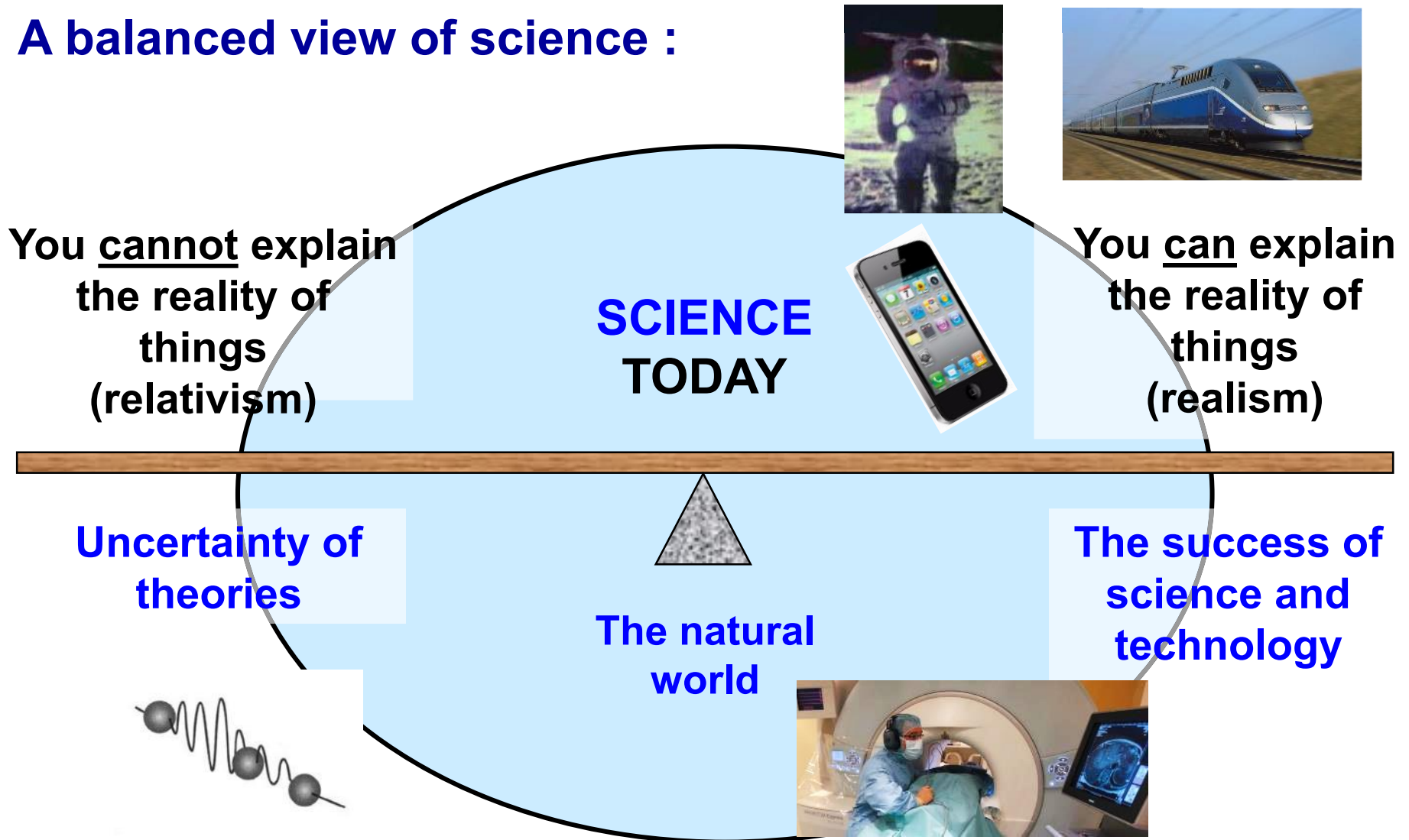
Challenges of studying the philosophy of science:

- Facing post-modernism (relativism, « there is no truth »): can undermine personal convictions.
 - ... Need to take the bull by the horns and understand PM in the overall context of philosophy.
- Getting a handle on the overall subject (where to start?).
 - ... Begin with introductions, well-known scientific writers, then well-known names in philosophy of science

**See : "Understand Philosophy of Science (A Teach Yourself Guide)"
M. Thompson, Hodder Education (UK) 2012**

The scientific method

A balanced view of science :



The scientific method

A balanced, reasonable view of science is very healthy :

- **While science is very successful in:**
 - **Helping us to better understand nature.**
 - **Leading to some very useful technology...**

...We need to remember that science is limited and cannot answer certain questions:

- **ethical questions**
- **value questions**
- **deep meaning questions...**



The scientific method

Some major questions :



- Climate change??
- Shale gas??
- "Big data"??
- The nuclear/renewable energy debate??
- Environmental pollution??
- Genetically modified cells??
- Cloning??
- Nanotechnologies??



Ethical committees – CNRS, European Union...

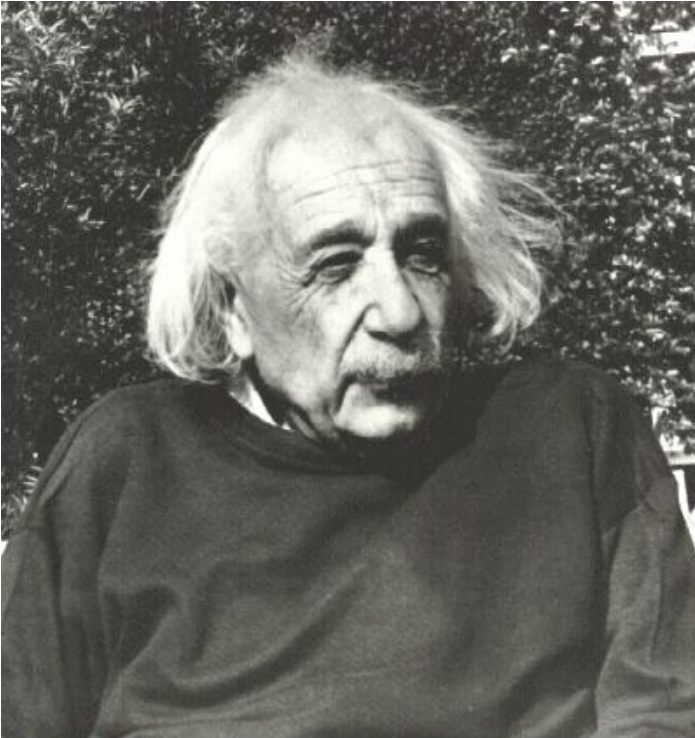
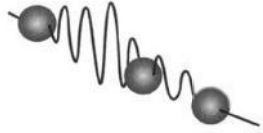
The scientific method

Good rules for scientific communication :

- Be as objective as possible – are we under :
 - economic pressure (the need for grants and contracts)?
 - political pressure (lab, national)?
 - personal pressure (fame, vanity, fear of the boss)?
- Are the results reproducible?
- Be cautious in what we write –
 - We might be wrong (we might not have the "right" model)!

Be aware of the lessons from the history and philosophy of science

The scientific method

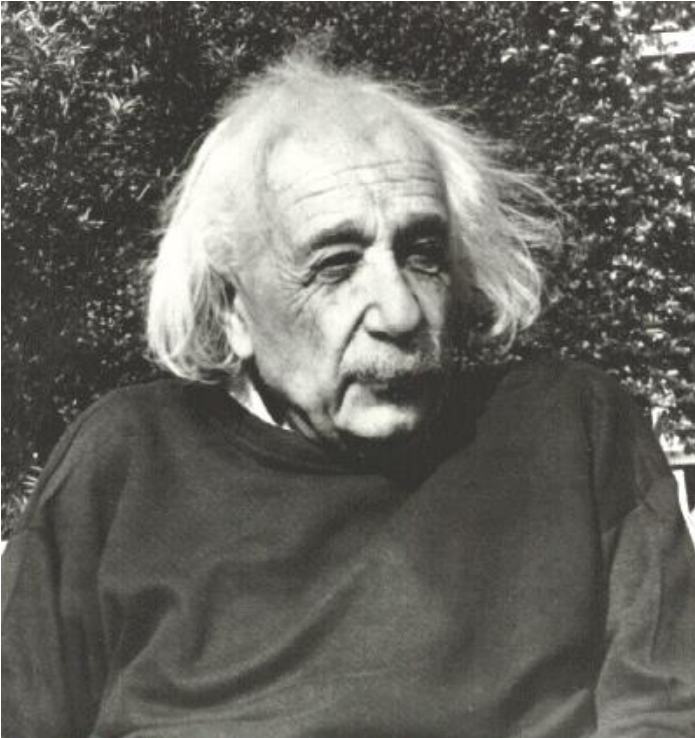
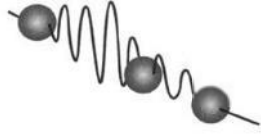


"All these fifty years of conscious brooding have brought me no nearer to the answer to the question, 'What are light quanta?' Nowadays every Tom, Dick and Harry thinks he knows it, but he is mistaken!"

(Albert Einstein, 1954)

Modesty is the mark of great scientists!

The scientific method



"50 années de réflexion laborieuse ne m'ont pas rapproché de la réponse à la question: 'Que sont les quanta de lumière?' Aujourd'hui tout le monde pense qu'il le sait, mais ils ont tort"

(Albert Einstein, 1954)

Modesty is the mark of great scientists!

The scientific method

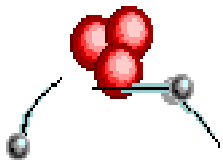
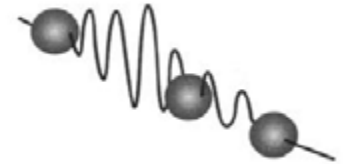
"Who discovers the new paradigm?"

The young researcher

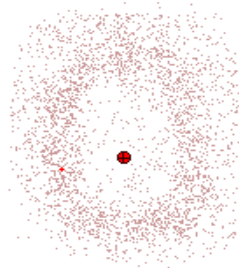
...new to the field

...immersed in the crisis"

(Thomas Kuhn, 1962)

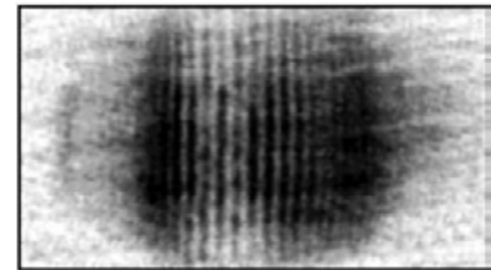


**Electron cloud
(1911)**



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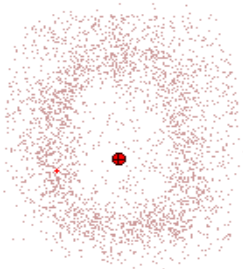
**Probabability of
presence (today)**



**Interference of
atoms (1991)**

The scientific method

"Who discovers the new paradigm?"

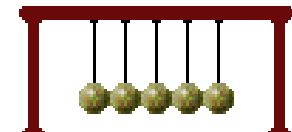
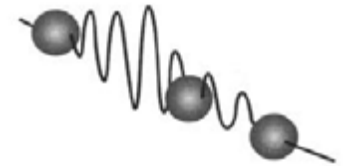


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**IT COULD BE
YOU!**

NEAREST RECRUITING STATION



Aim of scientific research

The aim is **always** to make a contribution to the development of new scientific theory:

- ❖ confirm a theory
- ❖ disconfirm a theory
- ❖ support a hypothesis
- ❖ test a claim
- ❖ add to accumulating knowledge in an area

Documentary research

Sources: primary and secondary

Written sources:

- ❖ **Scientific articles in journals (databases)**
- ❖ **Google search (smart search)**
- ❖ **Google Scholar**
- ❖ **Books, letters, contributions, proceedings of conferences**

Documentary research

Visual and oral sources:

- ❖ Read presentations
- ❖ Attend conferences
- ❖ Watch documentaries
- ❖ Interview experts

Secondary sources

- ❖ Popular science documents

Documentary research

Important criteria for research sources:

❖ Authenticity

- the origin is genuine and unquestionable

❖ Credibility

- accuracy of the information

❖ Relevance

- to your field, your research question

Storing your data

Purpose of storing your data:

- ❖ **save files for future use**
- ❖ **some resources not always available online**
- ❖ **useful for your References**
 - **Zotero, a reference management software**
<https://www.zotero.org/>

Renaming

❖ Rename your folder



❖ Rename your files (rightaway!)

- by field
- by author

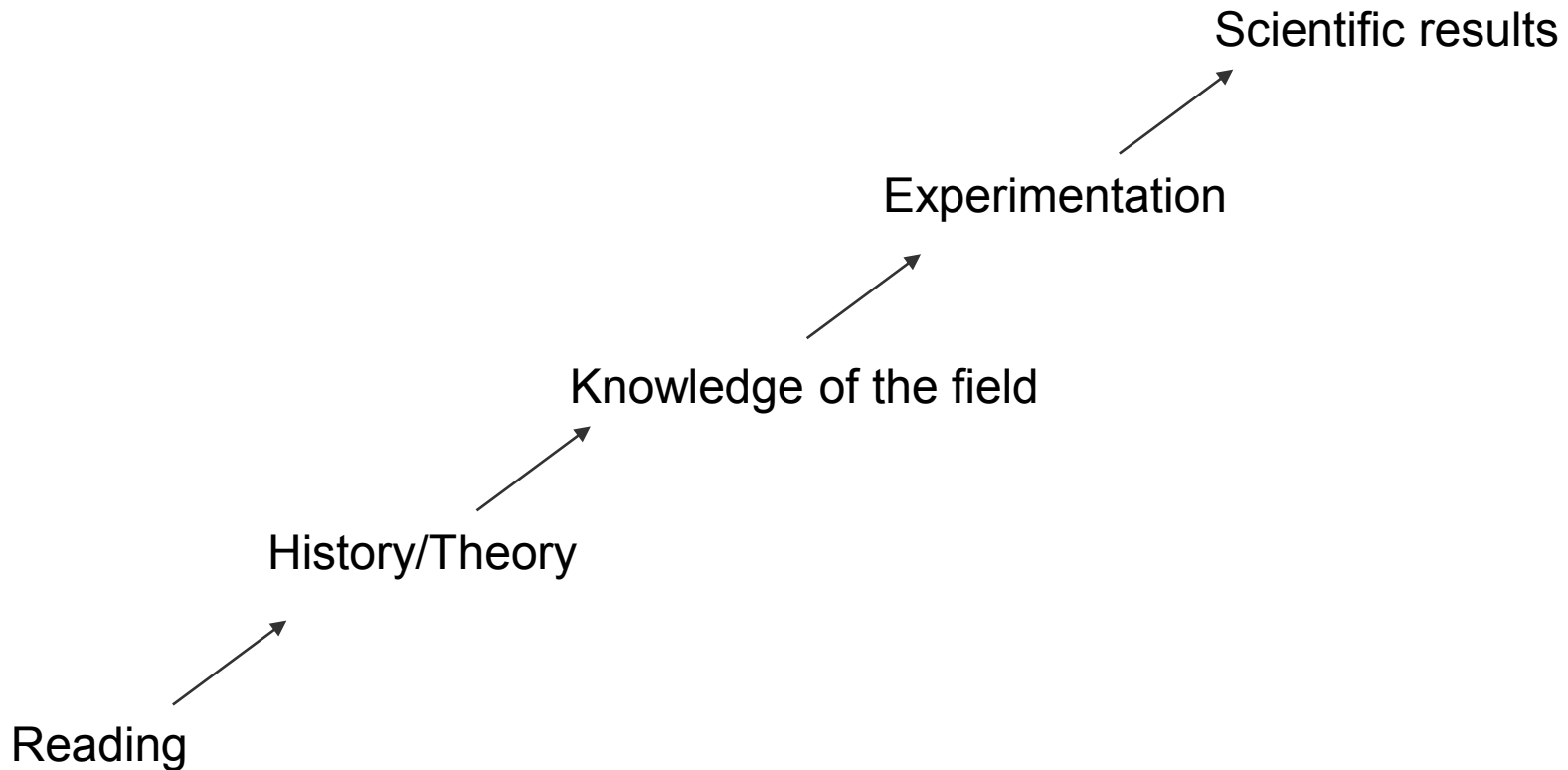
Nom	Type
Terminologie	folder
Variation terminologique	folder
Etude diachronique	folder
Apparition de termes	folder
Foisonnement terminologique	folder
Obsolescence de termes	folder
Remplacement lexical	folder
Stabilisation lexicale	folder
Etude synchronique	folder

READ, READ, READ!



Read, read, read!

By definition, reading is the main element of research.



Read, read, read!

Is reading easy?

What do you do to read efficiently?

What are the difficulties you encounter when you have to read?

Persevere!

Read, read, read!

What do you achieve by reading?

- ❖ **become familiar with scientific documents**
- ❖ **learn how a thesis/article is written**
- ❖ **learn the terminology (and keywords)**
- ❖ **learn the language/style**
- ❖ **narrow down your research, question, hypothesis**

State of the art

What is a state of the art?

- ❖ **the level of knowledge and development in a field**
 - what has been done?
 - what is the current situation?
 - what has not yet been done?

- ❖ **the theoretical background**

State of the art

- ❖ **Who is/are THE author/s of your field?**
- ❖ **What has contributed to existing theories?**
- ❖ **This knowledge determines the rest of your research**

Useful references

- **Booth, W. C., Colomb, G. G & Williams, J. M. (1995).** The craft of research. *The University of Chicago press*, 1995, ISBN: 0-226-06584-7.
- **Thompson, M. (2012) Understand Philosophy of Science (A Teach Yourself Guide).** *Hodder Education (UK)*.