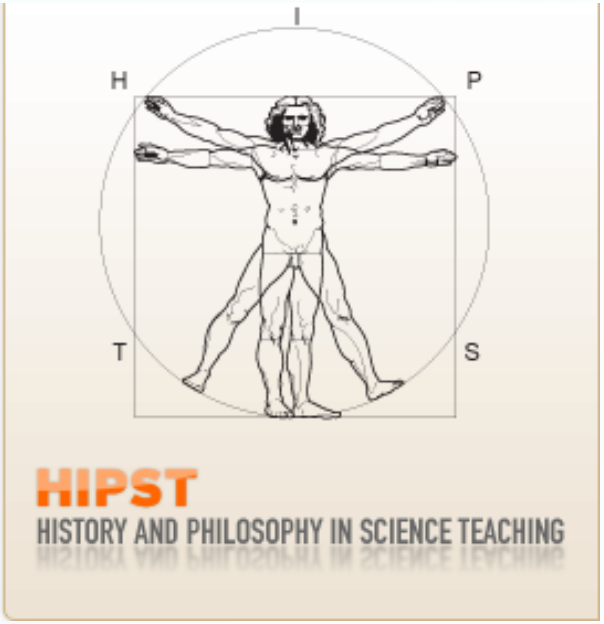


Constructing HPS-Based Case Studies for Teaching and Learning Science

Dietmar Höttecke[1] and Andreas Henke[2]

[1]University of Hamburg
[2]University of Bremen

HIPST 2008-2010

GTZ Berlin (technical lead)

University of Hamburg: Höttecke (scientific lead)

University of Oldenburg: Rieß

Nicolaus Copernicus University Torun: Jozefina Tourlo

Budapest University of Technology and Economics: Gábor Zemplén

The University of Reading: John Oversby

EU-Project

The University of Lisbon: Ricardo Coelho

Univeridade Lusófona de Hunanidades e Echnologia: Clara Pinto Correia (subc.)

Aristotle University of Thessaloniki: Fanny Seroglou

University of Patras: Dimitris Koliopoulos (subc.)

The Hebrew University of Jerusalem: Igal Galili

Istituto Tecnico Toscano and Fondazione Scienza e Tecnica: Paolo Brenni

UO/UB: Basic Assumptions for the Development of Case Studies

- Case studies constructed as a set of **modules**
- **Variance** of materials
- Advice and guidance for teachers **not too strictly**
- Content has to be **appealing** to teachers and students
- Content (form history and physics) has to be **reconstructed** for teaching and learning purposes
- Materials and activities enable students **doing philosophy and reconstructing history**
- **Inquiry learning** with and without **replicated instruments**

Easy Access for Teachers

- Abstract and brief description
- Historical background information
- Addressing NoS-aspects explicitly
- Curricular relevance & how standards are met
- Activities, methods, materials
- Obstacles for teaching & learning
- Pedagogical skills
- Research evidence
- Further user professional development
- several languages
- Wikiplattform

Methods of Learning and Students‘ Activities

- **Staged reading**
  of adapted or scenic dialogs
- **Role play activities / freeze sculptures**
  reenactment of controversies / social sit.
- **Inquiry activities**
  with and without historical replicas
- **Creative writing activities**
  Interviews, Letters to the Editor etc.
  involving reflection on NoS/PoS
- **„Reflection Corner“**
  Guiding and scaffolding explicit reflection
  onto various NoS tenets
  (questioning, discussions, tasks, activities)

Case Studies - History of Electricity

- William Gilbert - Separating Electric from Magnetic Effects (with Video)
- Otto von Guericke - Analogies, Forces & the Quality of Scientific Instruments (with Video)
- Carles du Fay - Explorative Experiments: Describing and Explaining Electrical Phenomena
- **Stephen Gray - Electrical Conduction on the wrong track (with Video)**
- Travelling Showmen - Electricity, Entertainment and the Construction of Scientificality

Stephen Gray – Electric Conduction on the Wrong Track

Experiments have a life on its own.

Ian Hacking (1983)

Experiments, like experimentalists, have biographies.

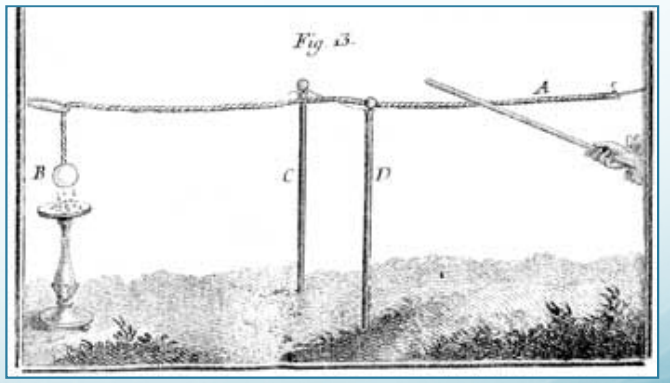
David Gooding (1985)

Experimenters can not tell their stories in advance.

Hans-Jörg Rheinberger (2000)

To have a more realistic depiction of scientific discovery we need to give up the notion that creativity is an act and try to fathom it as a process.

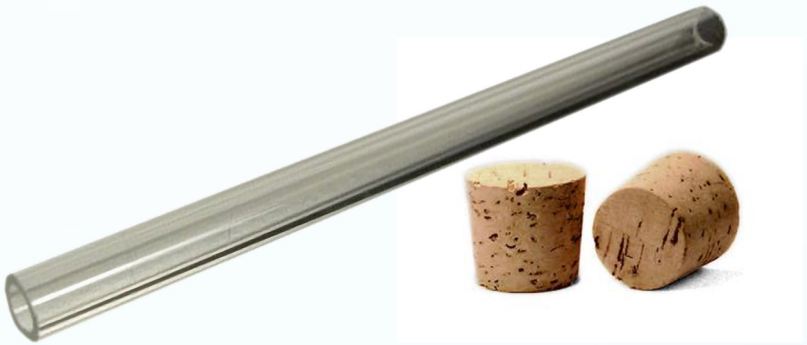
Nancy Nersessian (1992)



Stephen Gray – Electric Conduction on the Wrong Track

Variation of a glass tube

The glass tube is corked from one or both sides and rubbed afterwards. It is evident that not only the tube, but also the corks are electrified since a down-feather can be attracted and repelled by them.



Variation of the character of the rubbed tube.

Stephen Gray – Electric Conduction on the Wrong Track

Propagating electric forces through wooden rods

A rod is stuck into a cork, and an ivory ball is attached to the end of the rod. If the cork is then stuck into the glass tube, the ball becomes electrified as well.

Variation of the length of the rod (max. 32 ft).

Stephen Gray – Electric Conduction on the Wrong Track

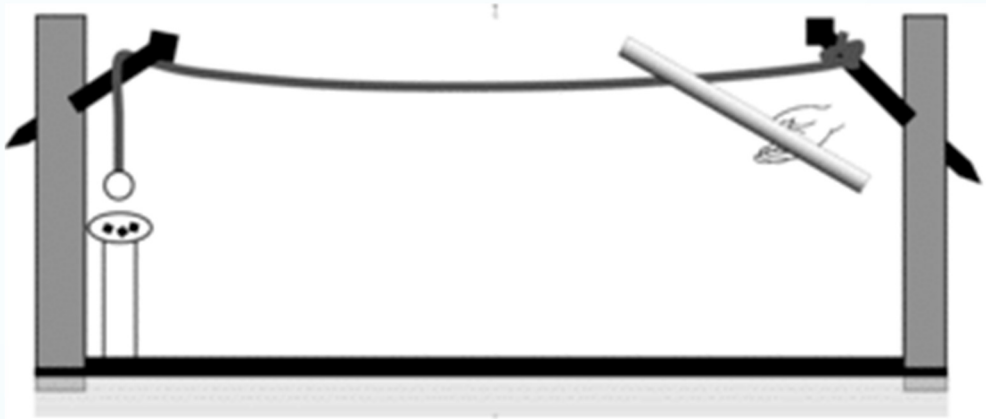
Electric conduction under scrutiny

Hemp cord suspended from an electrified glass tube conducts the “electric vertue” along a “line of communication”.

Variation of the length (max. 765 ft) , direction and suspension of the cord.

Stephen Gray – Electric Conduction on the Wrong Track

Suspending the hemp cord from a beam fixed with a nail

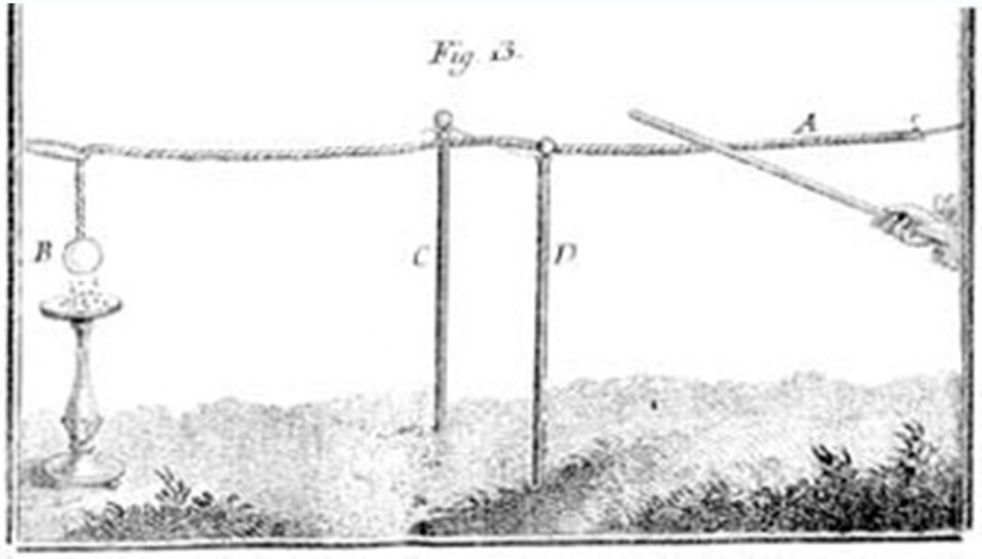


Gray: "I concluded, that when the Electrick Vertue came to the Loop that was suspended on the Beam, it went up the same to the Beam."

Stephen Gray – Electric Conduction on the Wrong Track

Electric properties of materials of different diameter crucial, but estimated as a side-effect!

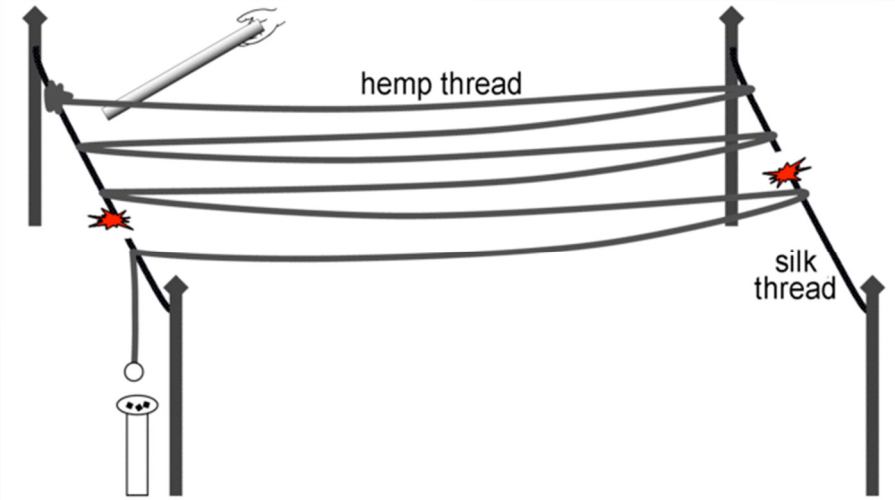
Gray: "…it might do better upon the Account of its Smallness…"



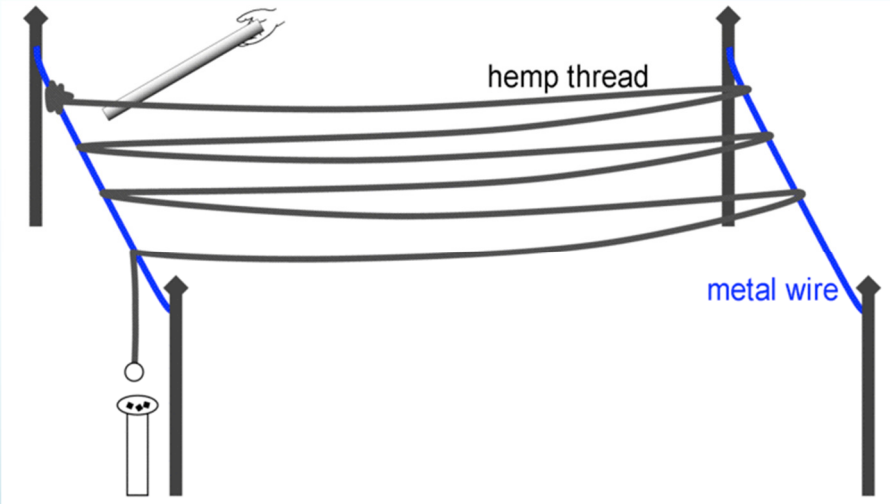
A wrong idea finally gives way to experimental success.

Stephen Gray – Electric Conduction on the Wrong Track

Electric properties of materials of different diameter crucial, but regarded as a side-effect!



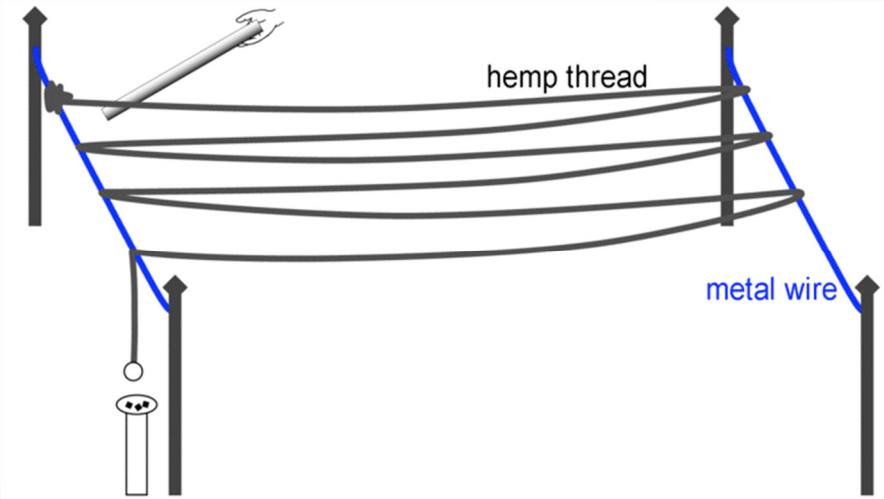
"Upon this, having brought with me both Brass and Iron Wire, instead of Silk we put up small Iron Wire…"



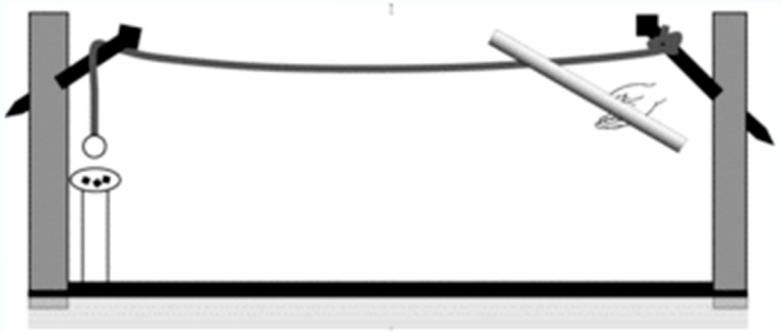
Stephen Gray – Electric Conduction on the Wrong Track

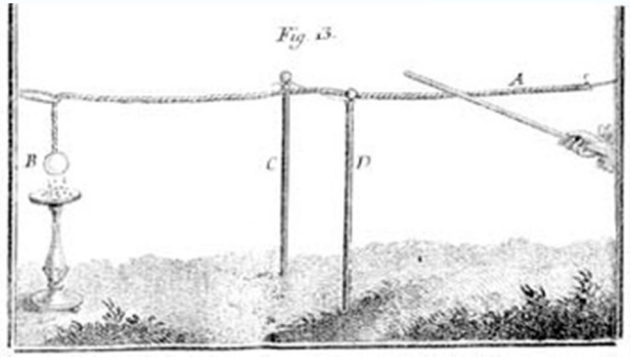
Material properties now regarded as crucial for electric conduction

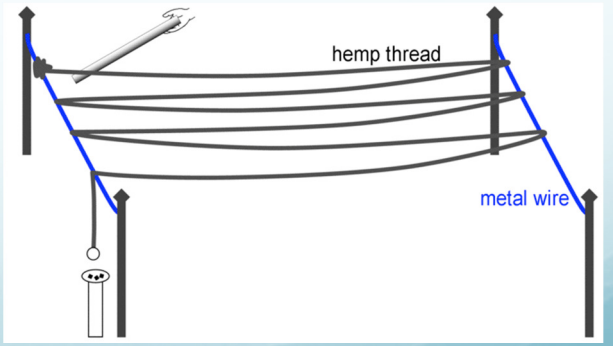
"By which we were now convinced, that the Success we had before, depended on the Lines that supported the Line of Communication, being Silk, and not upon their being small, as before Trial I imagined it might be".



Stephen Gray – Electric Conduction on the Wrong Track

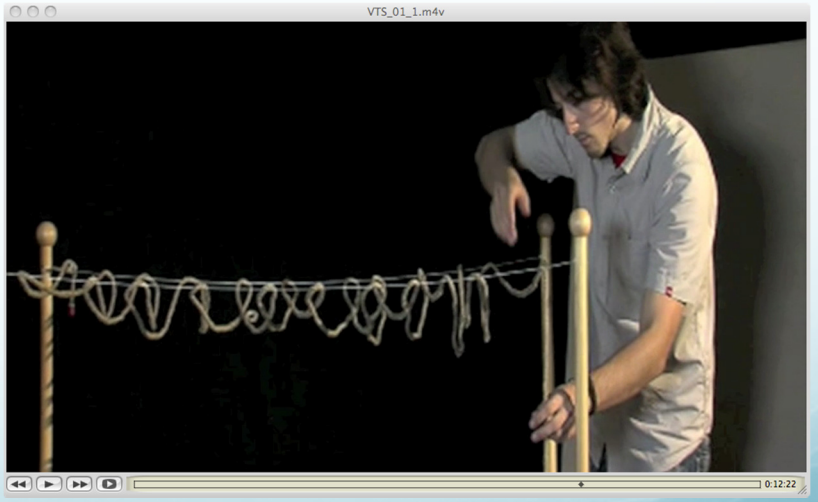






Stephen Gray – Electric Conduction on the Wrong Track

- Students **inquriy activities are guided** by the work of Gray and Wheler.
- Phase of explicit reflections on the nature of science direct attention on **key issues of experimental practice in science as situated, contingent, and creative** (NoS-aspects!)
- Teacher supported by several materials including a **video**



Stephen Gray – Electric Conduction on the Wrong Track

Encyclopedia Entry: International Online Encyclopedia

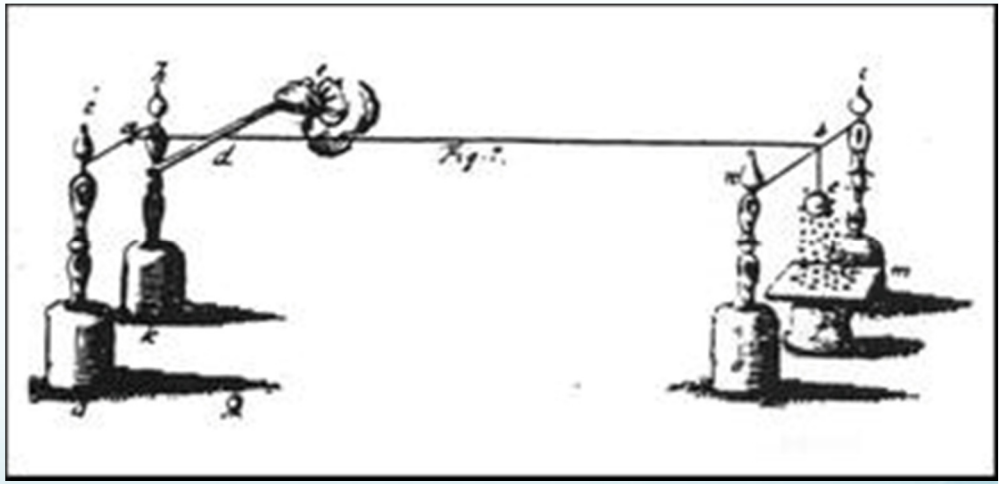
Stephen Gray (born December 1666 in Canterbury; died 7. February 1736 in London) was an English scientist.

… …

Stephen Gray's work is a good example of how scientific research is conducted. He made all his experiments using the setup displayed below, which he created at the very beginning of his experimentation.

In his research, Stephen Gray was always cautious not be too certain about his research results. His research was, in fact, so brilliant, that he needed no extra help. Therefore he drew his conclusion straight forward, that there are two different kinds of materials – conductors and non-conductors.

It is only through Gray's research that we can be certain of this once and for all.



Thank you very much for your attention!

www.hipst.eu -> case studies

Youtube: search for “hipsttube”