

# Lecture 5:

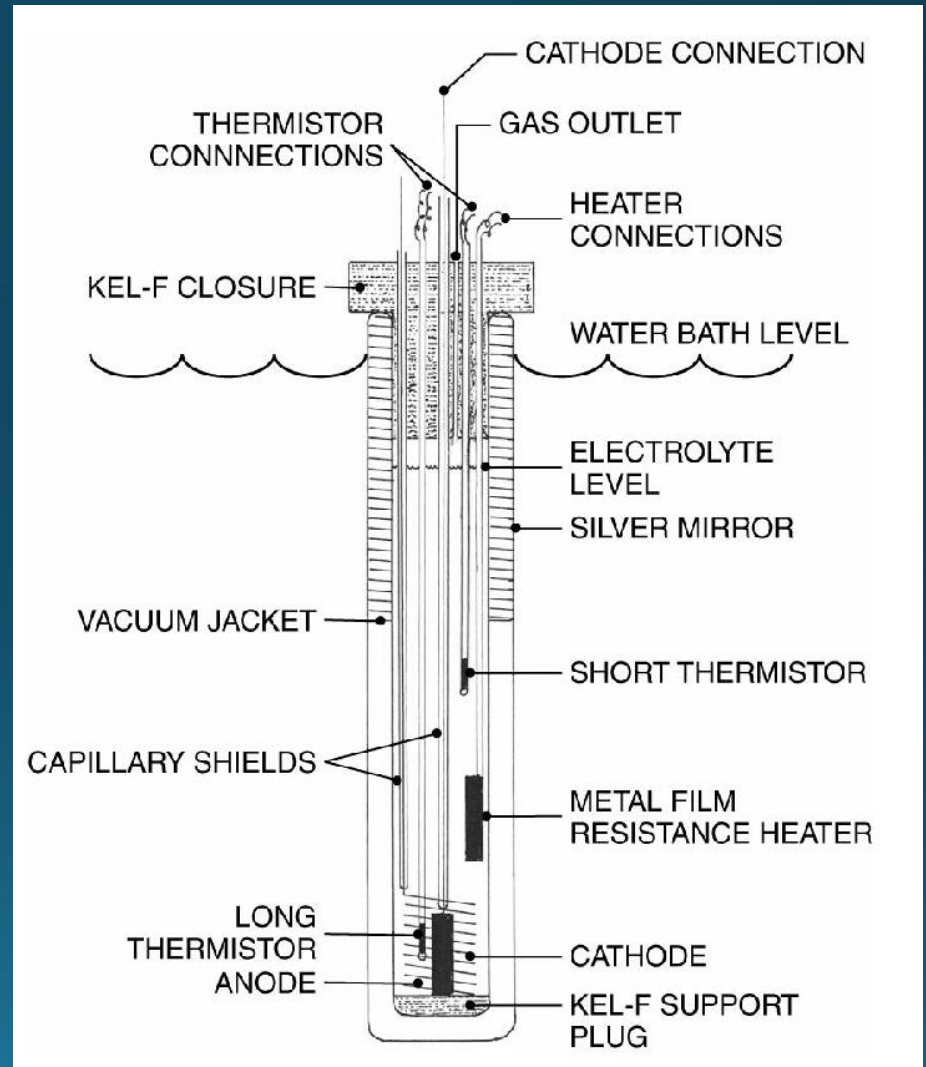
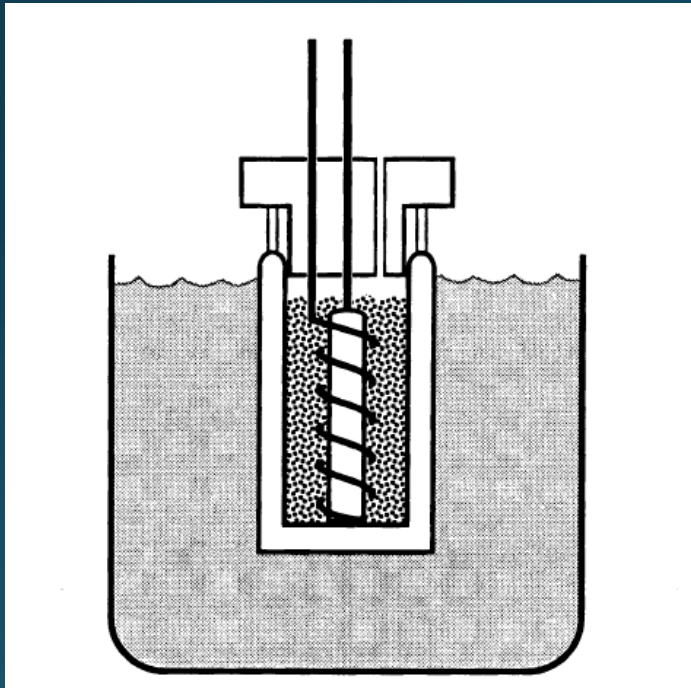
## Scientific Controversies and the Problem of Replication

Course: Science, Technology and Society Studies

# Resolving Scientific Controversies

Cold Fusion: Nuclear reaction that occurs at (or near) room temperatures.

Controversy: Hypothetical or real?



# Resolving Scientific Controversies

## Timeline:

- March 1989 Utah Press Conference: Announcement of successful conduction of cold fusion.
- Publication in *Nature*.
- Huge interest: Massive funds, attempts at replication.
- Reports of successful replication at Texas A&M, Georgia Tech etc.
- May 1989 American Physical Society conference in Baltimore: Refutation of cold fusion.
- *Nature* withdraws original article.
- Reported failures: Texas A&M (heat due to incorrect earthing of temperature sensitive device), Georgia Tech (heat sensitive neutron detector).
- By early 1990s, thoroughly discredited. Hagelstein and threats to his tenure at MIT.

# Resolving Scientific Controversies

3 facets of the drama:

- The problem of replication
- The priority problem (Stanley Pons and Martin Fleischmann *versus* Steven Jones at the Brigham Young University)
- Credibility (or not) of scientists

theoretical justifications seem preposterous. As Koonin told a *New York Times* reporter: 'It is all very well to theorize about how cold fusion in a palladium cathode might take place ... one could also theorize about how pigs would behave if they had wings. But pigs don't have wings!' (quoted in Mallove, 1991, p. 143).

# The Problem of Replication

It has even been suggested that the affair has involved fraud. In 1990, an article in the journal *Science* puts forward fraud as a factor in the Texas A&M tritium measurements. The impasse between proponents and critics, an impasse made worse by each side accusing the other of 'unscientific' behaviour, is typical of scientific controversies. The critics cite a preponderance of negative results as grounds to dismiss the controversial phenomenon and any residual positive results are explained away as incompetence, delusion or even fraud. The proponents, on the other hand, account for the negative results as having arisen from the failure to reproduce exactly the same conditions as used to obtain positive results. Experiments alone do not seem capable of settling the issue.

# The Problem of Replication

Cold fusion: Physics vs chemistry. Skepticism amongst the physics community about grand discoveries around fusion.

Replication:

- How to measure heat generation and how to ascertain that it is because of fusion?
- How to locate the presence of neutrons?

Cited Problems in Replication:

- Questions on controlled conditions (with/without light water).
- Texas A&M and the Georgia Tech fiascos.
- Lack of neutron detection in the MIT study.
- Diffusion and hot spots: Small vs large cell, diffusion takes place naturally, taking care of any hot spots.

The role of credibility.



# The Experimenters' Regress

**Experimenter's regress:** "A loop of dependence between theory and evidence. In order to judge whether evidence is erroneous we must rely on theory-based expectations, and to judge the value of competing theories we rely on evidence"

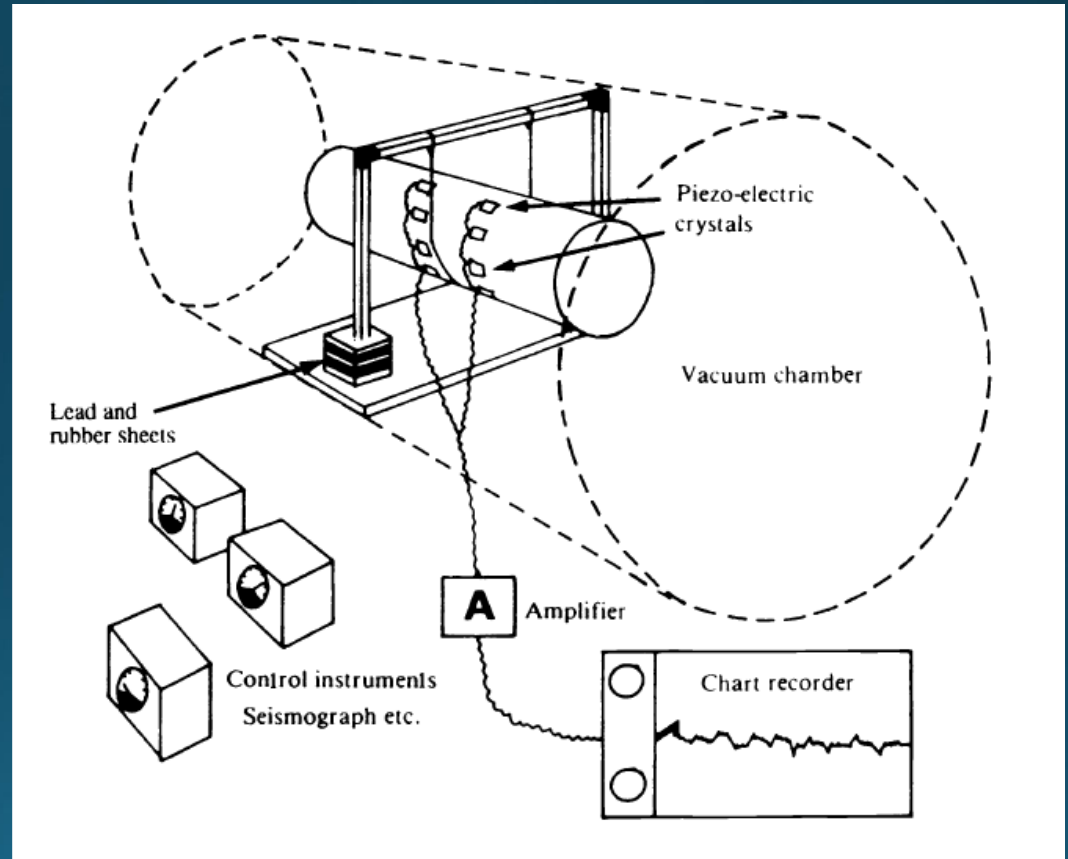
Here the situation is quite unlike that of the school or university student's practical class. The student can have a good idea whether or not he or she has done an experiment competently by referring to the outcome. If the outcome is in the right range, then the experiment has been done about right, but if the outcome is in the wrong range, then something has gone wrong. In real time, the question for difficult science, such as the gravity wave case and the others described in this book, is, '*What is the correct outcome?*'. Clearly, knowledge of the correct outcome cannot provide the answer. Is the correct outcome the detection of gravity waves or the non-detection of gravity waves? Since the existence of gravity waves is the very point at issue, it is

# The Detection (or not) of Gravitational Radiation

Gravitational Radiation:  
Produced when massive  
bodies accelerate.

1969: Joseph Weber in  
Uni of Maryland  
claimed to have found  
evidence of  
gravitational radiation.

Device of his own  
design. Does not really  
detect radiations.  
Detects **VIBRATIONS** in  
a bar of metal (as  
proxies).





# Experimenters' Regress

Problems:

How to differentiate between gravitational radiations and radiations caused by other (acoustic, thermal, magnetic, seismic, electrical) forces?

Weber claimed to detect 7 peaks a day that could not be accounted for by 'noise'.

The problem of persuasion! How to ensure replication/validation?

Some scientists were impressed by "time delay" experiment, some by the fact that calculations were done on a computer.

# Experimenters' Regress

Why was the experiment so controversial?

Several 'mistakes' possible:

- Decision about threshold for 'REAL' peaks could be wrong.
- Amplifier less-than effective, not sensitive enough.
- Bar might not be appropriately supported....

What differentiates a good experimental physicist from an incompetent one?

CATCH: There is NO preexisting set of acceptable, reasonable data (no approximate range of outcomes) to act as judge.

# Technical (and non-technical) arguments

1. Faith in a scientist's experimental capabilities and honesty, based on a previous working partnership.
2. The personality and intelligence of experimenters.
3. A scientist's reputation gained in running a huge lab.
4. Whether or not the scientist worked in industry or academia.
5. A scientist's previous history of failures.
6. 'Inside information'.
7. Scientists' style and presentation of results.
8. Scientists' 'psychological approach' to experiment.
9. The size and prestige of the scientist's university of origin.
10. The scientist's degree of integration into various scientific networks.
11. The scientist's nationality.

# Experimenters' Regress

How to resolve  
the  
experimenters'  
regress?

The 'scientific'  
and the 'social' of  
the process are  
INEXTRICABLE.

Richard Garwin's  
paper and its  
impact. Clinched  
the debate.

At that point it was not doing physics any longer. It's not clear that it was ever physics, but it certainly wasn't by then.

and

We just wanted to see if it was possible to stop it immediately without having it drag on for twenty years.

awfully tentative about it . . . It was all a bit hesitant . . . And then Garwin comes along with this toy. But it's the way he writes it up you see.

Another scientist said:

Garwin . . . talked louder than anyone and he did a very nice job of analysing his data.

And a third:

[Garwin's paper] . . . was done in a very clear manner and they sort of convinced everybody.

With all this Garwin's criticism of the other scientists' work was

# The sex life of the whiptail lizard

Controversy: Can whiptail lizards be gay?

Can reproduction happen from eggs of the female, WITHOUT needing the male to fertilize them?

David Crews (zoologist and psychologist) *versus* Orlando Cuellar and C.J. Cole.

Crews claimed to have documented homosexual behavior. Cuellar and Cole said this was an aberration, an oddity, unnatural and a product of captivity.

Artifact OR essential and previously neglected part of reproductive behavior?

# The sex life of the whiptail lizard

Actors and issues in this controversy:

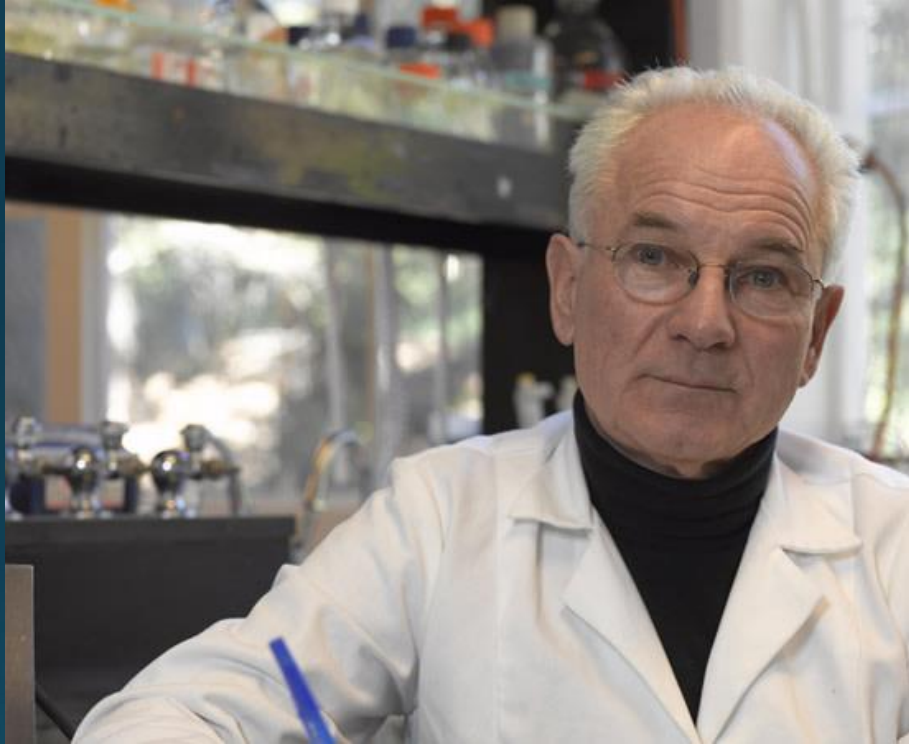
- Skill, competence, dedication of individual researchers. Cole and Cuellar claimed that Crews lacked these qualities.
- 'Young Turks' versus 'Stick-in-the-mud': How else to explain Cuellar's responses?
- Experimenters' Regress: If pseudo-copulation is genuine, Crews is careful and diligent. If not, Crews is careless. But, HOW to settle this debate?





## Robert Charles Gallo

- Big name in Biomedics/Virology
- Well known for work on HIV.
- Director and Co-founder of the Institute of Human Virology
- Co-founder and scientific director of the Global Virus Network.



## Peter Duesberg

- Big name in Molecular and Cell Biology
- Well known for pioneering work on cancer.
- 1986: Appointed to National Academy of Sciences.
- 1986: Received the National Institutes of Health Outstanding Investigator Award
- Was never rejected a public grant in 23 years of work TILL 1987.
- 1987: Published work discounting the HIV thesis.
- 20 grant proposals after 1987 were rejected.
- Lab depleted, socially ostracized.



## Martin Delaney

- Advocate for HIV/AIDS treatments.
- 1985: Founded *Project Inform*. Lead until 2008.
- Well known for efforts to streamline the US Food and Drug Administration's drug approval process.
- Hailed as “public health hero” by the US National Institute of Allergy and Infectious Diseases (NIAID).



## Anthony Fauci

- Physician and immunologist.
- Director of the US National Institute of Allergy and Infectious Diseases (NIAID) since 1984.
- Contributed to HIV/AIDS research as a scientist and as Head of NIAID.

## APOCALYPSE – OR PANIC? WHAT THE EXPERTS SAY



**Robert Gallo**

“HIV is the sole primary cause of the epidemic called Aids.”



**Luc Montagnier**

“A very strong case that HIV has something to do with Aids.”



**Robert Root-Bernstein**

“We are open to the risk of making a colossal blunder.”



**Harvey Bialy**

“The virus theory has produced nothing.”



**Peter Duesberg**

“Aids is not and cannot even be an infectious disease.”



# Controversy

The HIV hypothesis: HIV virus causes AIDS, put forward by virologists.

- Ratified by biomedical institutions, public health organizations and governmental bodies, the mainstream media, and grassroots AIDS organizations.
- Ratification occurred BEFORE all the evidence was available.  
WHY?
  - Because the hypothesis was plausible.
  - Claimants were credible.
  - It satisfied the interests of various players, both "insiders" AND "outsiders".

Scientists, mass media and voices within the AIDS movement led to the 'knowledge' about AIDS and its causes.

# Trajectory of the AIDS vaccine

## Efficacy of anti-retroviral drugs:

- Certainty and uncertainty about the drugs remained.
- Principal investigators of clinical trials made claims and counterclaims.
- Government agencies and advisory bodies assessed risks and benefits.
- Physicians believed or disbelieved and conveyed their assessments to patients.
- Patients complied with study protocols or disobeyed them. Demanded drugs or rejected them.
- Grassroots publications bypassed the 'traditional' pathways of publication in science and spread information.
- Treatment activists became "lay experts" and helped to change the rules governing the kinds of evidence required to determine efficacy.



# Claims OR Claimants?

Multiple scientific claims, multiple interpretation of results.

- Are Koch's postulates valid?
- Is there is a relevant animal model for AIDS?
- Is the clinical trial 'definitive'?

"INTERPRETATIVE FLEXIBILITY" of scientific findings.

*"Their data are perfectly true, its just that they are irrelevant, and they're asking the wrong question"* – Douglas Richman responding to the Concorde study

The problem of credibility -> focus on claimants rather than on the claims:

- NO "definitive" clinical trial. Establishing 'definitiveness' is a NEGOTIATED process, where actors' positions and credibility are crucial.

# Opponents of the HIV thesis

Peter Duesberg and his theory.

- ❑ Work ignored TILL it was picked up OUTSIDE the scientific community.
- ❑ Came to light with the help of media and his (non-scientific) supporters.
- ❑ Struggled to establish credibility.

The problem of credibility:

- Social and scientific factors: Duesberg was a brilliant chemist, but NO medical training. No personal ties with AIDS-affected communities.
- Treatment activists: Combination of scientific knowledge + moral credibility.
- Fauci, NIAID and links with *Project Inform* -> Credibility for the HIV thesis.

Treatment activists as the kingmakers in settling controversy.

# Treatment activists, clinical trials and credibility

Combination of scientific knowledge + moral credibility.

- Imbibing vocabulary and culture of science.

*"Martin Delaney is one of the most impressive persons I've met in my life, bar none, in any field...I am not the only one around here who's said we could use him in the labs"*

- DEMOCRATISING clinical trials.

—Was it a truly scientific necessity to exclude potential research subjects with abnormal lab test values?

—Can one prevent (from a statistical point of view) patients from enrolling in more than one kind of clinical trial?

Inclusion of women/racial minorities in scientific studies.

Role of treatment activists: 'Cleaning up' science by removing biases, OR 'Changing/replacing' existing science by adding epistemological and ethical questions? Or BOTH?