Experiment in Physics

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压电源
kV
放大器
0.5-1.5
CAKE
560
定时单道
阈值
道宽
开始
微分
积分
输入
输出
单 道
阈值
CAKE
611
放大器
0.5-1.5
高压电源
kV
0-1kV
0-2kV
0-3kV
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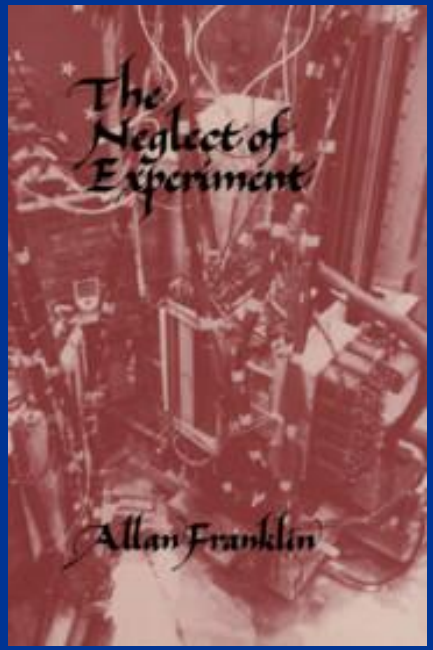
Problems:

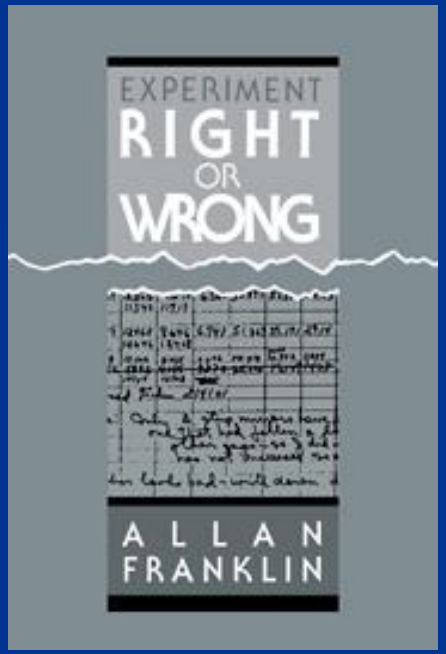
How do we come to believe in an experimental result obtained with a complex experimental apparatus?

How do we distinguish between a valid result and an artifact created by that apparatus?

A. Franklin's Epistemological Strategies (1.2.2)



Franklin (1986)



Franklin (1990)

1) Experimental checks and calibration in which the experimental apparatus reproduces known phenomena

2) “Reproducing artifacts that are known in advance to be present” (unlike (1), we do not measure pure known material, but for example unknown samples superimposed on known material)

3) Elinimation of plausible sources of error and alternative explanations of the result

4) When an experiment produces some pattern which can be explained by the existence of some theoretical entities, and which is hardly possible to occur without the existence of such entities, it seems that the results are valid.

(Example: Galileo's observations of moons of Jupiter)

5) When an experiment produces some pattern which can be explained by a well-corroborated theory, it seems that the results are valid.

(Example: the discovery of $W^{\pm}$)

(Question: Must such theory be well-corroborated?)

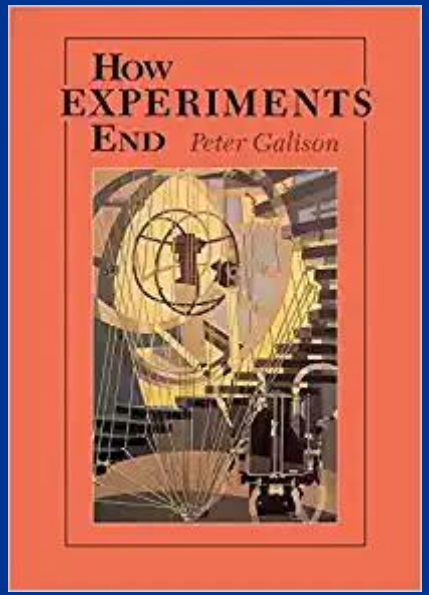
6) Using an apparatus based on a well-corroborated theory. In this case the support for the theory inspires condifence in the apparatus based on that theory.

(Example: the use of electron microscope and the radio telescope)

7) Using statistical arguments

(Remark: this cannot avoid system errors)

Galison's more complicated situations

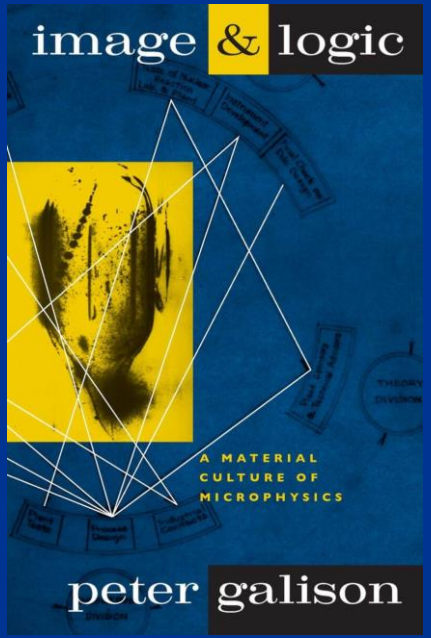


Galison (1987)

Scientists from different experimental traditions form different epistemic and linguistic groups which rely on different forms of argument.

Example: Scientists within visual tradition tend to prefer "golden events" (in cloud chamber or bubble chamber) that clearly demonstrate the phenomenon in question, while those in electronic tradition tend to find statistical arguments more persuasive and important than individual events. (1.2.3)

Galison's more complicated situations



Galison (1997)

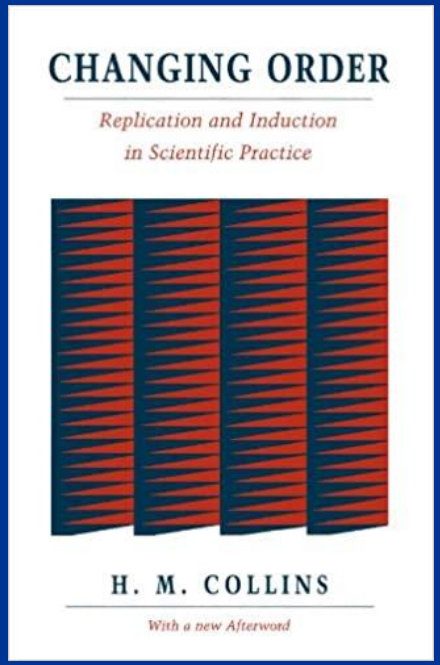
Then,

Major changes in theory and in experimental practice and instruments do not necessarily occur at the same time.

Theory may influence what is considered to be a real effect, demanding explanation, and what is considered background.

Theoretical presuppositions of experimenters may enter into the decision to end an experiment and report the result.

Collins's Experimenters' Regress



Collins (1985)

(A) What scientists take to be a correct result is one obtained with a properly functioning experimental apparatus.

(B) A properly functioning experimental is simply one that gives correct results.

(C) Conclusion: There are no formal criteria to decide whether or not an experimental apparatus is working properly.

Question: So how do we tell whether an apparatus functions properly? Holism of experiment?

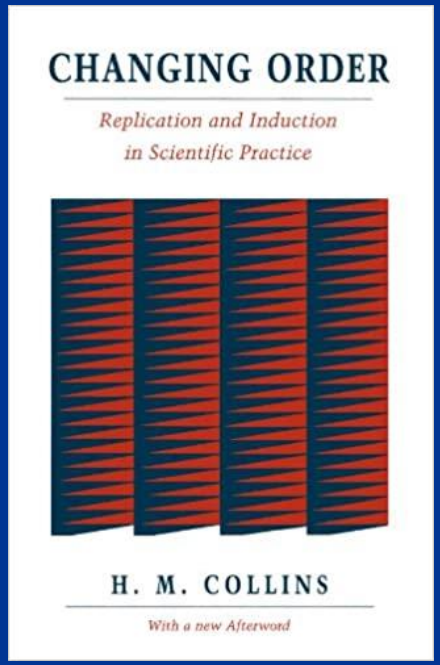
Collins's Experimenters' Regress

Collins's example: the detection of "gravitational wave" from Weber's.
The physics community compared Weber's claims that he had observed gravity waves with the reports from six other experiments that failed to detect them.

Collins argues that the decision between these conflicting experimental results could not be made on epistemological or methodological grounds.

Franklin's response: the results had been carefully cross-checked. The groups had exchanged both data and analysis programs and confirmed their results. They had also calibrated their experimental apparatuses by inserting acoustic pulses of known energy and finding that they could detect a signal.
Hence, the judgement is rational, though there might not be formal rules to apply.

Collins's Experimenters' Regress



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Morpurgo's Search for Free Quarks

Morpurgo used a modern Millikan-type apparatus and initially found a continuous distribution of charge values. And Morpurgo believed that the apparatus worked improperly and tinkered the apparatus.

Pickering: the material procedure (including the experimental apparatus itself along with setting it up, running it, and monitoring its operation), the theoretical model of that apparatus, and the theoretical model of the phenomena are all plastic resources and need mutal support.

Ackermann: the experimental apparatus itself is less plastic than either the theoretical model of the apparatus or that of the phenomenon