Theory and Methods: Literature, Science and Medicine
Event 4: Philosophy and Sociology of Science
for Literature and History Students

Session 1: Introduction to the Philosophy of Science

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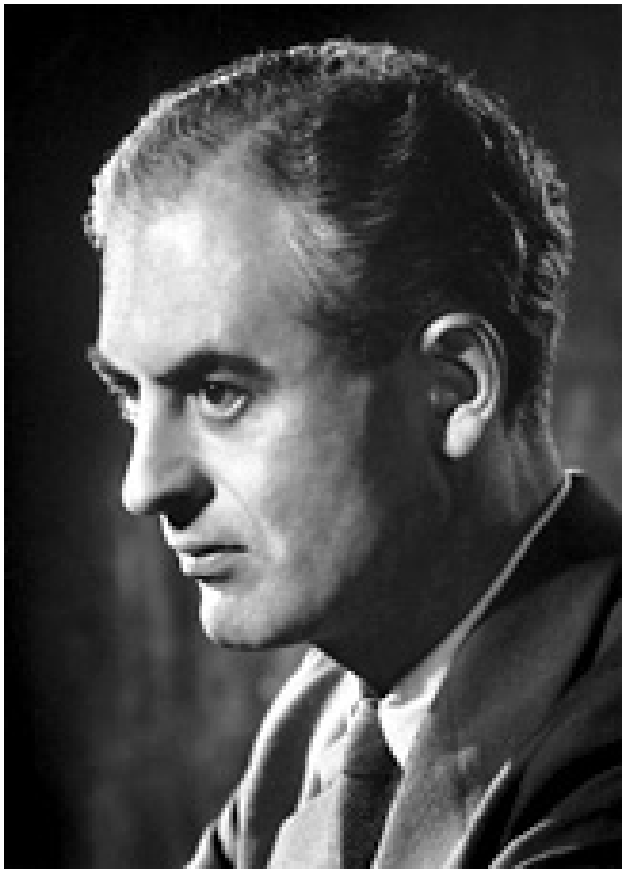
Sir Peter Medawar

- **Nobel Prize 1960**
- **UCL 1951-1962**
- **Early research on penicillin in Howard Florey's lab**
- **Research in immunology (skin grafts, tolerance)**



Medawar on the scientific method

- **"Ask a scientist what he conceives the scientific method to be, and he will adopt an expression that is at once solemn and shifty-eyed: solemn because he feels he ought to declare an opinion; shifty-eyed because he is wondering how to conceal the fact that he has no opinion to declare."** (Induction and Intuition in Scientific Thought (London: Methuen, 1969), p. 11)

- **“Is the scientific paper a fraud?”** (comments against inductivism)

What do scientists do when they do science? Four philosophical answers

- **Inductivism**
- **Falsificationism**
- **Normal science (Thomas Kuhn)**
- **Methodological anarchism (Paul Feyerabend)**

Our discussion today: shift of focus from methodology to practice

Illustrations of inductivism

Anatomy, Physiology, Surgery, Medicine, Pharmacy, Chemistry, &c.

Illustrations of inductivism

An Account of a monstrous Calf. By the Hon. ROBERT BOYLE.
Nos 1 and 2, pp. 10 and 20.

This monstrous production was found in the uterus of a cow, killed by a butcher at Limington, in Hampshire. Its hinder legs had no joints: its feet were parted, so as to resemble the claws of a dog, [No. 2, p. 20]: and its tongue was triple, one to each side of the mouth, and one in the middle. Between the fore legs and hind legs was a great stone,* on which the calf rode, weighing 20 lbs. The outside of the stone was of a greenish colour, but, some small parts being broken off, it appeared a perfect free-stone.

In the further account, inserted in the second number, it is added, that the surface of the stone was full of little cavities, and that when broken, it exhibited a great number of small pebble stones of an oval figure. Its colour (internally) was grayish, like free-stone, but intermixed with veins of yellow and black.

* As this remarkable concretion was not subjected to chemical analysis, its real nature must remain unknown. It might be a deposition of osseous matter, (phosphate of lime); but it is more probable that it was similar in its composition to the urinary calculi of herbivorous quadrupeds, and that it was formed either from the water of the allantois or of the amnios.

must be supplied, which is the very *key of interpretation*. And one must begin at the end and move backwards to the rest.

XI

The investigation of forms proceeds as follows: first, for any given nature one must make a *presentation*[4] to the intellect of all known *instances* which meet in the same nature, however disparate the materials may be. A collection of this kind has to be made historically, without premature reflection or any great subtlety. Here is an example in the inquiry into the form of heat.

[Table 1]

Instances meeting in the nature of heat

1. **the sun's rays, especially in summer and at noon**

Instances meeting in the nature of heat

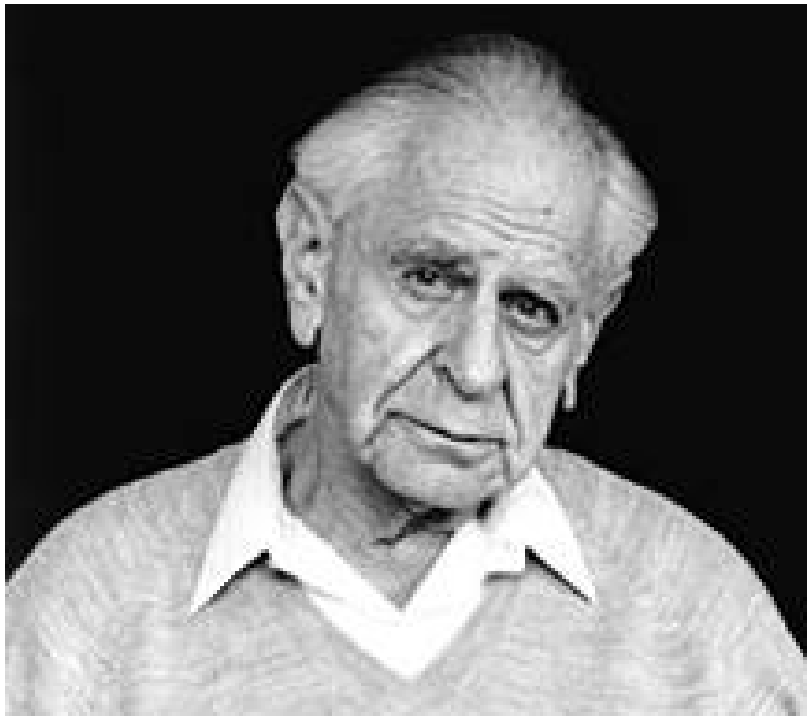
1. the sun's rays, especially in summer and at noon
2. the sun's rays reflected and concentrated, as between mountains or through walls, and particularly in burning glasses
3. flaming meteors
4. lightning that sets fires
5. eruptions of flame from hollows in mountains etc.
6. any flame
7. solids on fire
8. natural hot baths
9. heated or boiling liquids
10. steam and hot smoke, and air itself, which is capable of a powerful, furious heat if compressed, as in reverse furnaces[5]
11. some spells of weather which are clear and bright through the actual constitution of the air without regard to the time of the year
12. air shut up underground in some caverns, especially in winter
13. all fibrous fabrics, such as wool, animal hides and plumage, have some warmth
14. all bodies, solid and liquid, thick and thin (like the air itself) brought

21. horse shit, and similar animal excrement, when fresh
22. strong oil of sulphur and of vitriol give the effect of heat in scorching linen
23. oil of marjoram and suchlike give the effect of heat when they burn the gums
24. strong distilled spirit of wine gives the effect of heat; so that if the white of an egg is dipped in it, it solidifies and goes white, almost like a cooked eggwhite; and bread dipped in it dries up and goes crusty like toast
25. spices and hot plants, like *dracunculus*, old nasturtium[6] etc., though they are not hot to the hand (neither whole nor powdered), but with a little bit of chewing are felt as hot to the tongue and palate, and almost burning
26. strong vinegar and all acids cause a pain which is not much different from the pain of heat if applied to a skinless part of the body, like the eye or the tongue, or any other part where there is a wound and the skin has been wounded and the skin has been broken
27. even sharp, intense cold induces a kind of burning sensation: for 'the penetrating cold of the North Wind burns'[7]
28. other things.

We call this *the table of existence and presence.*

Karl Popper and falsificationism

- **Interwar Vienna: Marx v. Einstein**
- **Falsifiability as a demarcation criterion**
- **Falsification v. induction**
- **Critical attitude in science, and society**



Popper's "great men" defence

"with all the respect for the lesser scientists, I wish to convey here a heroic and romantic idea of science and its workers: men who humbly devoted themselves to the search for truth, to the growth of our knowledge; men whose life consisted in an adventure of bold ideas." (Popper, in P. A. Schilpp, ed., *Philosophy of Karl Popper*, p. 977.)

The complex case of Einstein

Einstein's prediction from special relativity on the variation of (apparent) mass according to velocity

→ Falsified by Walter Kaufmann's experiment with electrons

→ H. A. Lorentz, who had made the same predictions as Einstein's, gave up his theory ("at the end of my Latin")

→ Einstein refusal to give up

→ Fault found and admitted in Kaufmann's experiment

Einstein's prediction from general relativity on the bending of light passing by heavy masses

→ Confirmed by A. S. Eddington's solar eclipse observation

→ Einstein unimpressed, despite the worldwide media attention

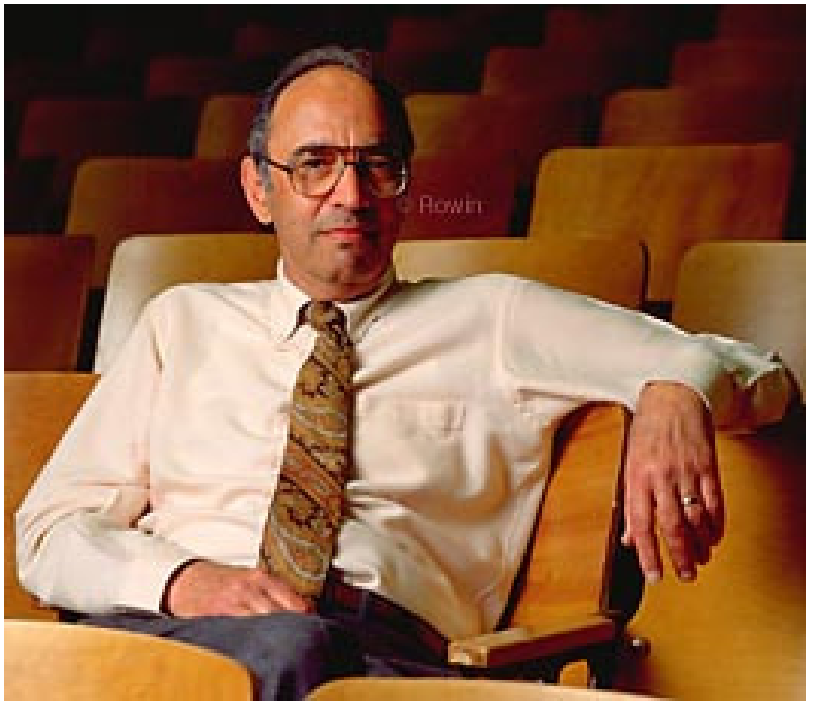
→ What if the test had come out against GR? "The theory *is* correct." (Ilse Rosenthal-Schneider, *Reality and Scientific Truth: Discussions with Einstein, von Laue, and Planck*, p. 74)

Thomas Kuhn and “normal science”

- ***The Structure of Scientific Revolutions* (1962)**
- **Revolution =**

  paradigm shift
- **Normal science =**

  puzzle-solving



What goes on in normal science

- **Generation of facts**
- **Increasing the fit between theory and observation**
- **Paradigm articulation**

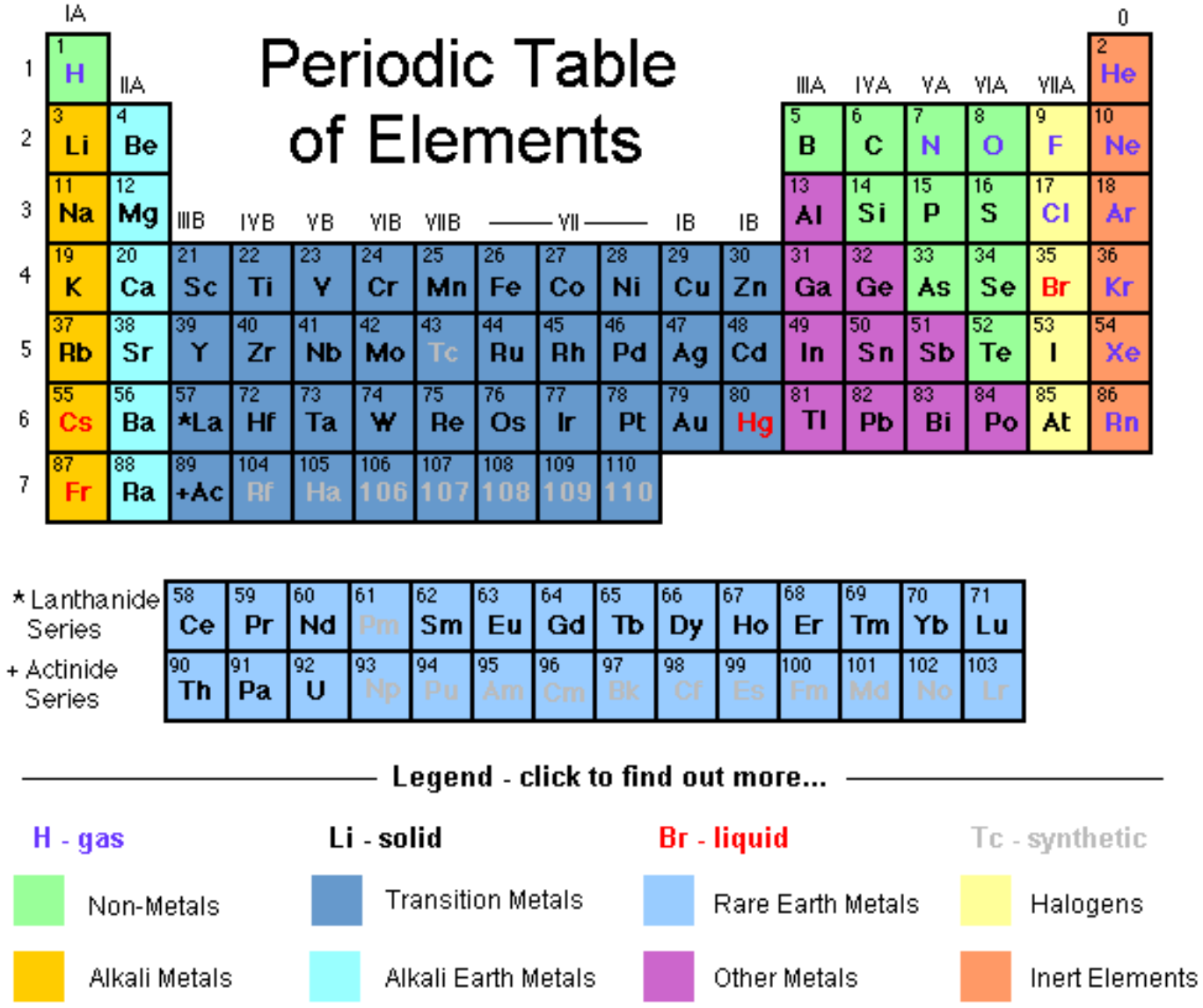
What normal science is NOT interested in

- **Genuine novelties**
- **Critique of the paradigm**
- **Aimless gathering of facts**

Is normal science boring?

“Mopping-up operations are what engage most scientists throughout their careers.”

(Kuhn, *Structure*, p. 24)


Periodic Table of Elements
IA
IIA
IIIB
IVB
VB
VIB
VIIB
VII
IB
IB
IIIA
IVA
VA
VIA
VIIA
0
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
57 *La
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
89 +Ac
104 Rf
105 Ha
106 106
107 107
108 108
109 109
110 110
* Lanthanide Series
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
71 Lu
+ Actinide Series
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No
103 Lr
Legend - click to find out more...
H - gas
Li - solid
Br - liquid
Tc - synthetic
Non-Metals
Transition Metals
Rare Earth Metals
Halogens
Alkali Metals
Alkali Earth Metals
Other Metals
Inert Elements

Ueber die Beziehungen der Eigenschaften zu den Atomgewichten der Elemente. Von D. Mendelejeff. — Ordnet man Elemente nach zunehmenden Atomgewichten in verticale Reihen so, dass die Horizontalreihen analoge Elemente enthalten, wieder nach zunehmendem Atomgewicht geordnet, so erhält man folgende Zusammenstellung, aus der sich einige allgemeinere Folgerungen ableiten lassen.

			Ti = 50	Zr = 90	? = 180
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W = 186
			Mn = 55	Rh = 104,4	Pt = 197,4
			Fe = 56	Ru = 104,4	Ir = 198
			Ni = Co = 59	Pd = 106,6	Os = 199
H = 1			Cu = 63,4	Ag = 108	Hg = 200
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112	
	B = 11	Al = 27,4	? = 68	Ur = 116	Au = 197?
	C = 12	Si = 28	? = 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79,4	Te = 128?	
	F = 19	Cl = 35,5	Br = 80	J = 127	
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207
		? = 45	Ce = 92		
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		?In = 75,6	Th = 118?		

1. Die nach der Grösse des Atomgewichts geordneten Elemente zeigen eine stufenweise Abänderung in den Eigenschaften.

2. Chemisch-analoge Elemente haben entweder übereinstimmende Atomgewichte (Pt, Ir, Os), oder letztere nehmen gleichviel zu (K, Rb, Cs).

3. Das Anordnen nach den Atomgewichten entspricht der *Werthigkeit* der Elemente und bis zu einem gewissen Grade der Verschiedenheit im chemischen Verhalten, z. B. Li, Be, B, C, N, O, F.

4. Die in der Natur verbreitetsten Elemente haben *kleine* Atomgewichte

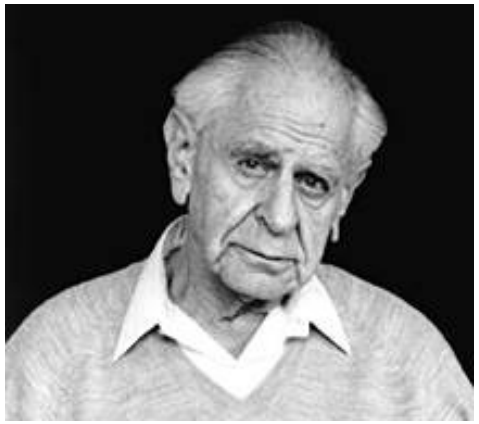
Popper: “normal science and its dangers”

"Normal science, in Kuhn's sense, exists. It is the activity of . . . the not-too-critical professional: of the science student who accepts the ruling dogma of the day; who does not wish to challenge it; and who accepts a revolutionary theory only if almost everybody else is ready to accept it — if it becomes fashionable by a kind of bandwagon effect. . . . In my view the 'normal' scientist, as Kuhn describes him, is a person one ought to be sorry for. . . . The 'normal' scientist, in my view, has been taught badly. . . . He has been taught in a dogmatic spirit: he is a victim of indoctrination." (pp. 52-53.)

"I admit that this kind of attitude exists. . . . I can only say that I see a very great danger in it . . . a danger to science and, indeed, to our civilization." (p. 53)

Karl Popper, “Normal Science and Its Dangers”, in Imre Lakatos and Alan Musgrave, eds., *Criticism and the Growth of Knowledge*

Popper vs. Kuhn



- **Karl Popper: “Criticism is the lifeblood of all rational thought.”**

- **Thomas Kuhn: “To turn Sir Karl’s view on its head, it is precisely the abandonment of critical discourse that marks the transition to a science.”**

Paul Feyerabend: what qualifies as (normal) science?

"[According to Kuhn] it is the existence of a puzzle-solving tradition that *de facto* sets the sciences apart from other activities… But if the existence of a puzzle-solving tradition is so essential…I do not see how we shall be able to exclude, say, …*organized crime* from our considerations. For organized crime…is certainly puzzle-solving *par excellence*. Every statement which Kuhn makes about normal science remains true when we replace 'normal science' with 'organized crime'…."

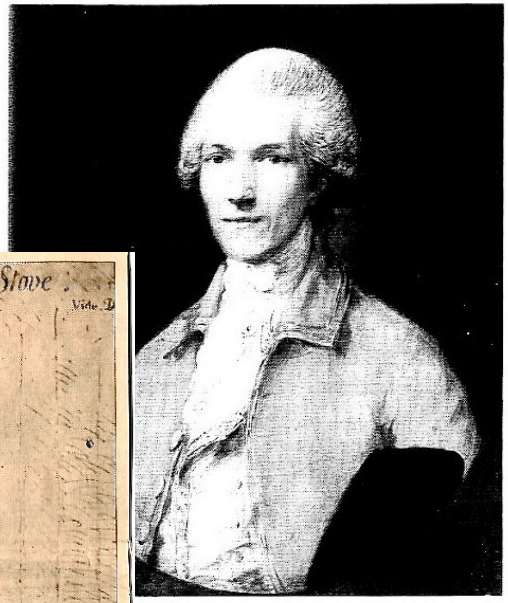
"Organized crime certainly keeps foundational research to a minimum…. The safebreaker 'largely ceases to be an explorer…. [etc., etc.]"

(Paul Feyerabend, "Consolations for the Specialist", in I. Lakatos and A. Musgrave, eds., *Criticism and the Growth of Knowledge*, pp. 199-200).

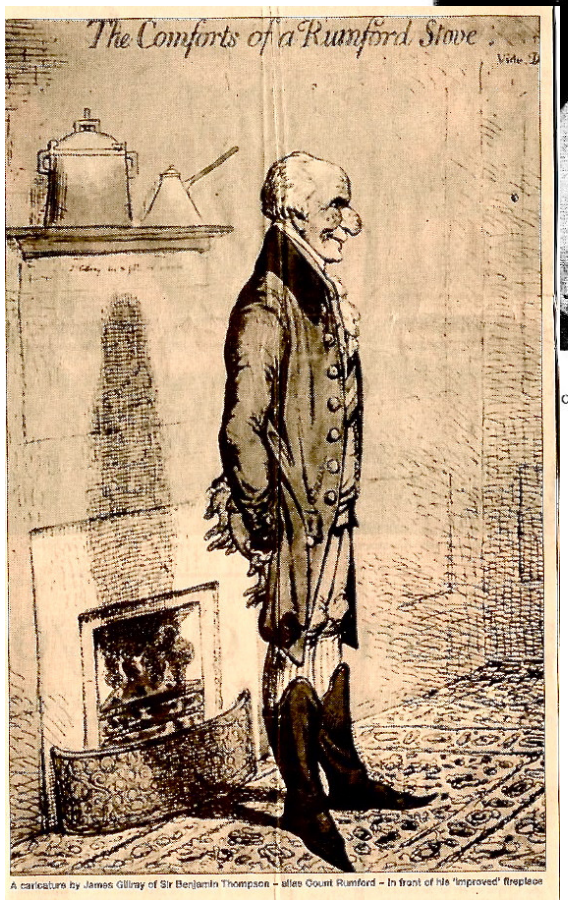
Paul Feyerabend: “methodological anarchism”

- **There is no method in science that is always effective.**
- **“Anything goes” is the only universal rule.**
- **Pluralism helps the progress of science.**
- **Science should have no special authority over other systems of thought.**

Count Rumford vs. the Caloric Theorists



orough's portrait of Colonel Thompson at the age of thirty.



A caricature by James Gillray of Sir Benjamin Thompson – alias Count Rumford – in front of his 'improved' fireplace

Caloric

- the fluid of heat
- all-pervasive
- self-repulsive
- responsible for melting and evaporation
- weightless

Rumford's cannon-boring experiment

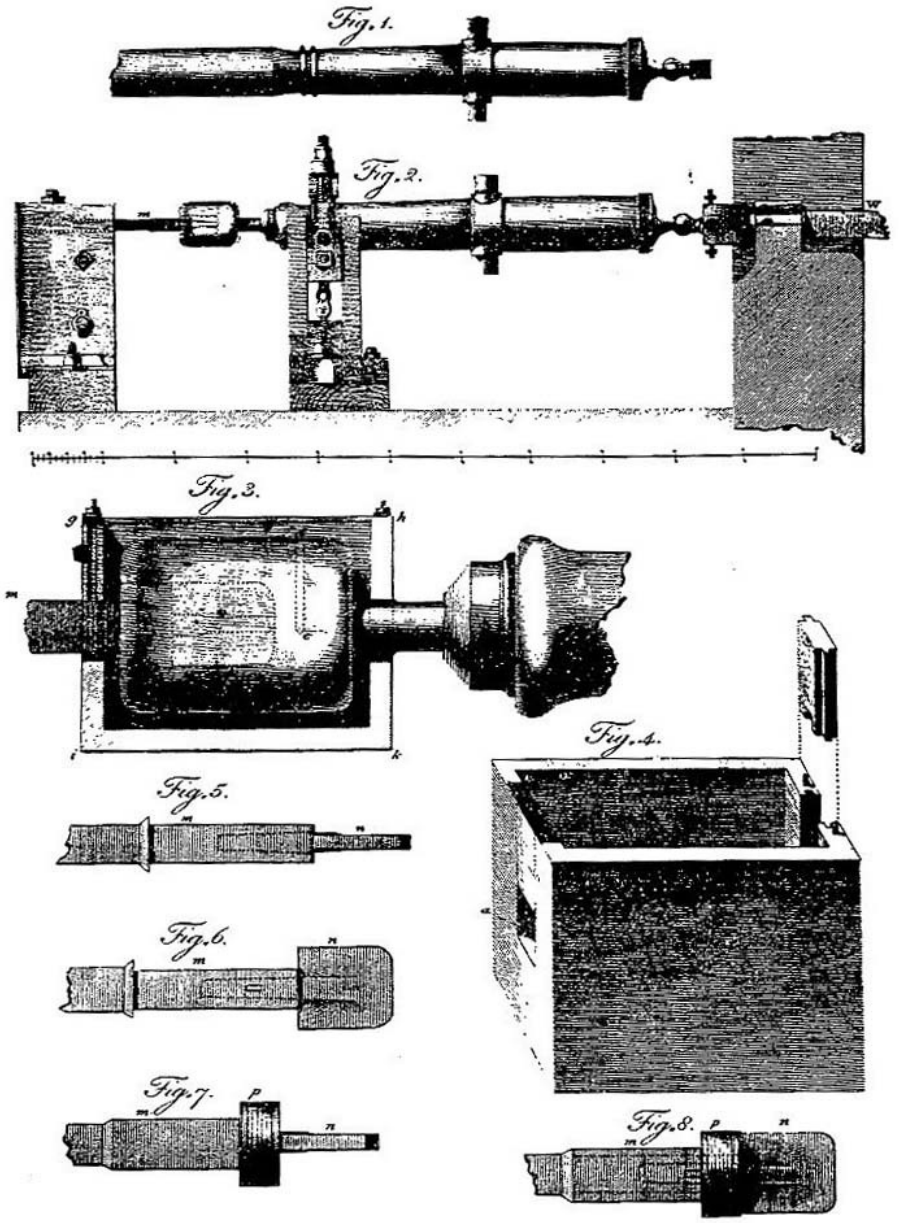


PLATE II. Rumford's diagrams of his apparatus.