Events & Conferences

From October 15, 2025 to October 17, 2025

XL Trobades Científiques de la Mediterrània-Josep Miquel Vidal: Ciència i Tecnologies Quàntiques a...

Teaching History of Physics (to physicists)

Enric Pérez Canals
Faculty of Physics
Universitat de Barcelona

UNIVERSITAT DE BARCELONA

- Against *Quasi-history* (M. A. B. Whitaker)
- Historical experiments of quantum physics

Crucial experiments of Quantum Physics

with Joan Manel Hernández

1.	Mass to charge ratio for electron	(1897)	*Electron*
2.	Measurement of the electronic charge	(1910)	
3.	Wien's displacement law. Planck's law	(1893-1900)	*Thermal radiation*
4.	Photoelectric effect	(1905-1916)	
5.	Golden foil experiment	(1909)	*Atomic models*
6.	Balmer series of atomic hydrogen	(1884-1913)	
7.	Franck-Hertz experiment	(1914)	
8.	Electron difraction	(1927)	*Electron*

Historical experiments of Quantum Physics

with Joan Manel Hernández

1. Mass to charge ratio for electron (1897)
2. Measurement of the electronic charge (1910)

Electron

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Atomic models

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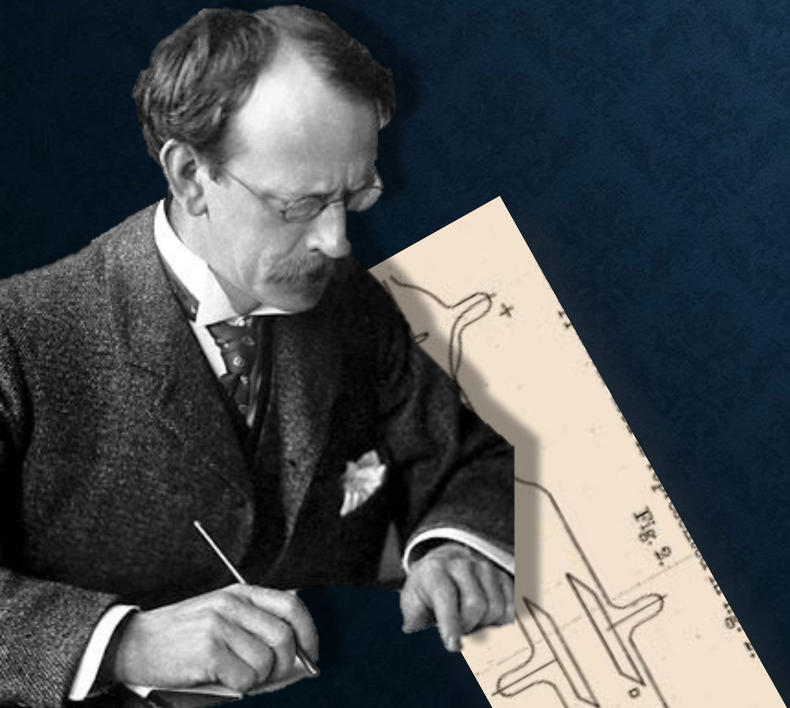
8. Electron difraction (1927)

Electron

J.J. Thomson

Cathode Rays, 1897



THE

LONDON, EDINBURGH, AND DUBLIN

PHILOSOPHICAL MAGAZINE

AND

JOURNAL OF SCIENCE.

[FIFTH SERIES.]

OCTOBER 1897.

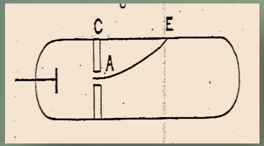
XL. *Cathode Rays.* By J. J. THOMSON, *M.A., F.R.S., Cavendish Professor of Experimental Physics, Cambridge**.

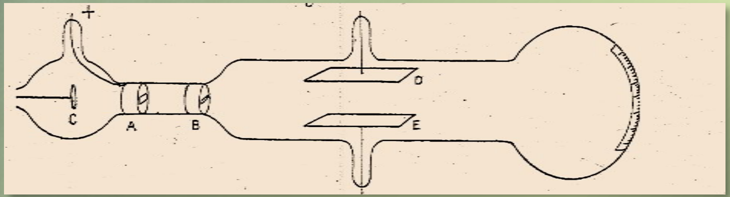
THE experiments† discussed in this paper were undertaken in the hope of gaining some information as to the nature of the Cathode Rays. The most diverse opinions are held as to these rays; according to the almost unanimous opinion of German physicists they are due to some process in the æther to which—inasmuch as in a uniform magnetic field their course is circular and not rectilinear—no phenomenon hitherto observed is analogous: another view of these rays is that, so far from being wholly ætherial, they are in fact wholly material, and that they mark the paths of particles of matter charged with negative electricity. It would seem at first sight that it ought not to be difficult to discriminate between views so different, yet experience shows that this is not the case, as amongst the physicists who have most deeply studied the subject can be found supporters of either theory.

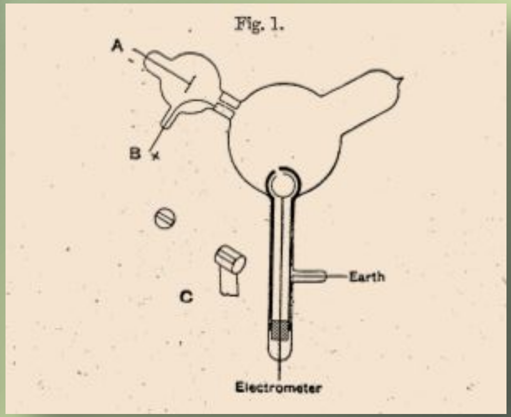
The electrified-particle theory has for purposes of research a great advantage over the ætherial theory, since it is definite and its consequences can be predicted; with the ætherial theory it is impossible to predict what will happen under any given circumstances, as on this theory we are dealing with hitherto

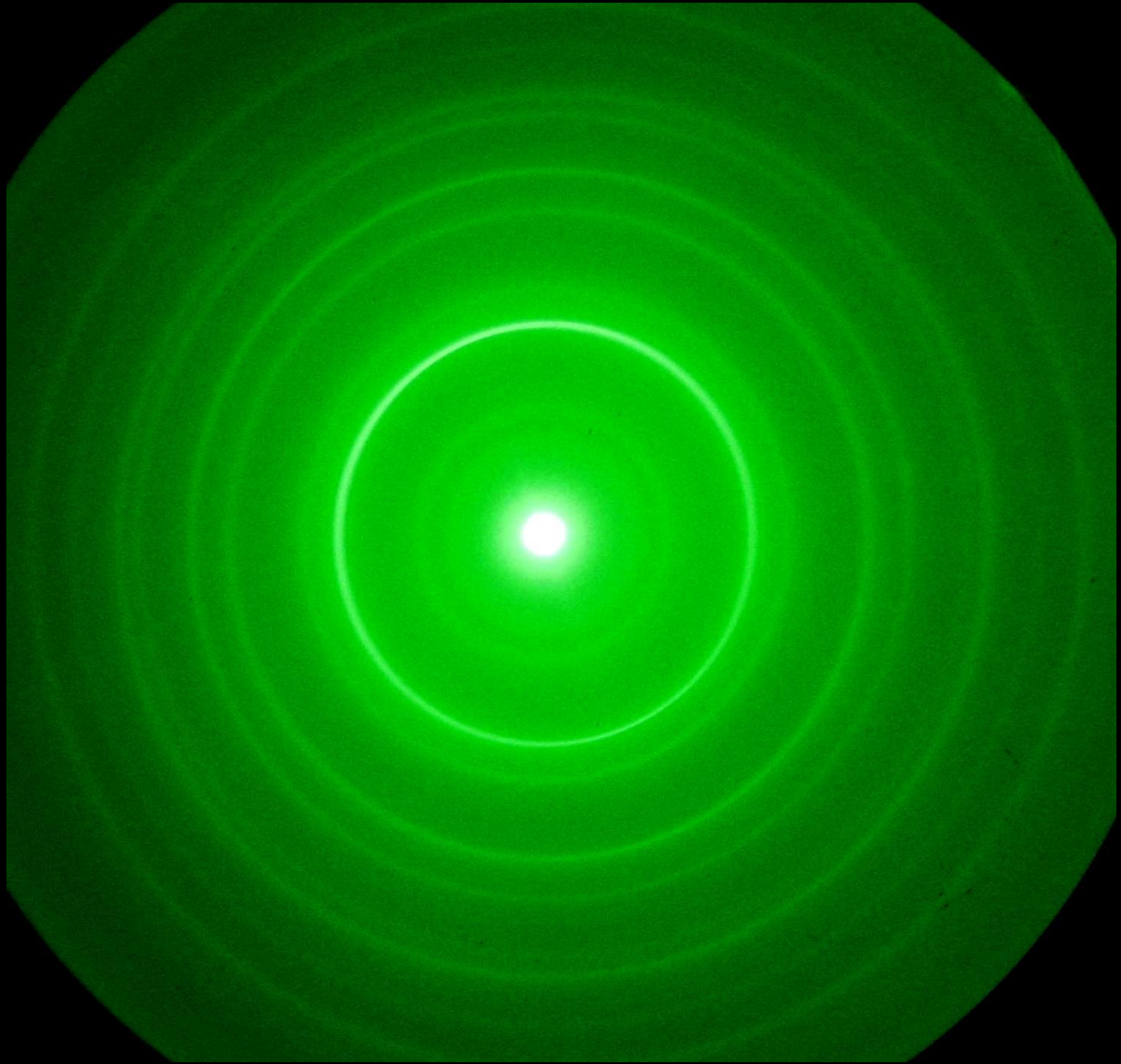
* Communicated by the Author.

† Some of these experiments have already been described in a paper read before the Cambridge Philosophical Society (Proceedings, vol. ix. 1897), and in a Friday Evening Discourse at the Royal Institution ('Electrician,' May 21, 1897).







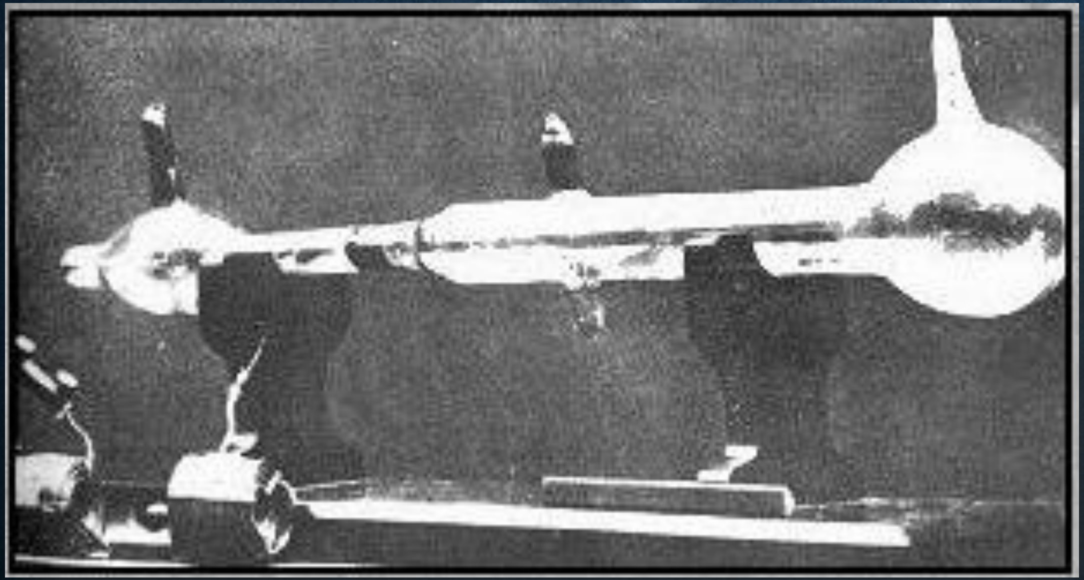




G.P. Thomson (1892-1975)
ca. 1937

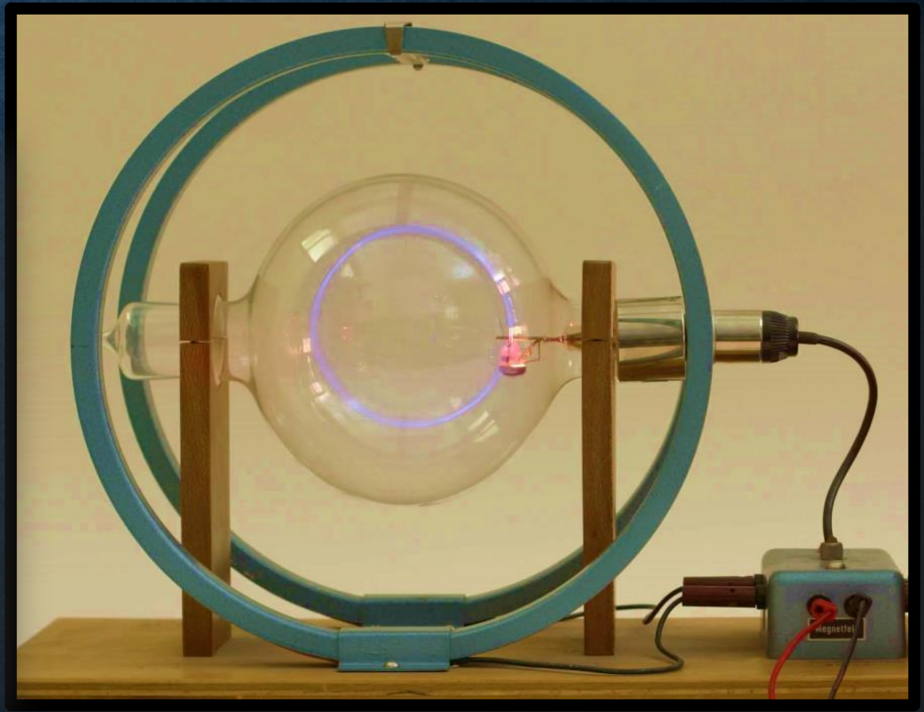
G. Davisson (1881-1958) & L. Germer (1896-1971)
ca. 1927

J.J. Thomson
Cathode Rays, 1897

Original experiment of J.J. Thomson



Didactic experiment



Phys. Perspect. 16 (2014) 293–343

1422-6944/14/030293-51
DOI 10.1007/s00016-014-0139-3

Physics in Perspective

The Franck-Hertz Experiments, 1911–1914 Experimentalists in Search of a Theory

With an appendix, "On the History of our Experiments on the Energy Exchange between Slow Electrons and Atoms" by Gustav Hertz

Clayton A. Gearhart*

In 1911, James Franck and Gustav Hertz began a collaboration to investigate the nature of collisions of slow electrons with gas molecules that led to a series of carefully planned and executed experiments, culminating in their discovery of inelastic collisions of electrons with mercury vapor atoms in 1914. This paper tells the story of their collaboration and the eventual reinterpretation of their results as a confirmation of Niels Bohr's new atomic theory, largely as a result of experiments done in North America during the Great War.

Key words: James Franck; Gustav Hertz; John Sealy Edward Townsend; J. J. Thomson; Niels Bohr; Robert Pohl; Wilhelm Westphal; Lise Meitner; Ernest Rutherford; electron; ion; mobility; ionization; affinity; resonance.

Introduction

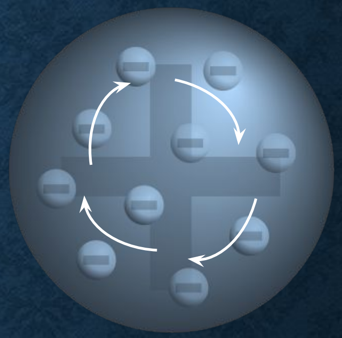
In 1914, James Franck (1882–1964) and Gustav Ludwig Hertz (1887–1975), working at the Physical Institute of the Friedrich Wilhelm University of Berlin, published two papers that described their experiments bombarding mercury vapor atoms with slow electrons. These papers were the culmination of a collaboration that began in 1911 and won for its authors the 1925 Nobel Prize. Today, textbooks tell us that these experiments confirm the existence of the quantized atomic energy levels that Niels Bohr (1885–1962) first postulated in 1913. But in 1914, Bohr's atomic model was barely a year old. Franck and Hertz did not so much as mention it (figures 1, 2).

They undertook their experiments to investigate the nature of ionization by collision, and particularly the theory developed around the turn of the twentieth

Gustav Hertz, Lise Meitner
and James Franck. Berlin (East), 1964

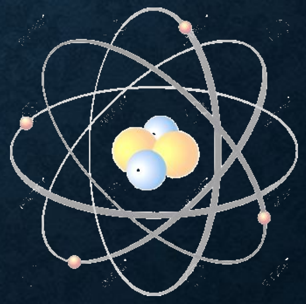
Atomic models

Thomson model (1901-1906)



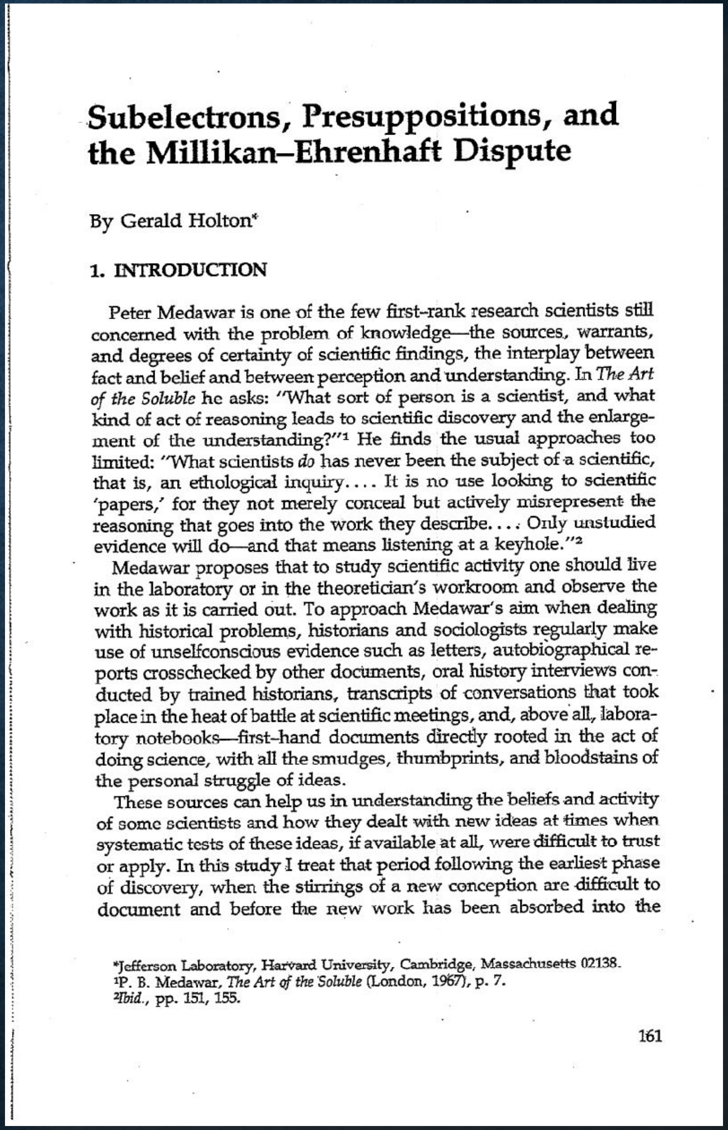
¿ Rutherfords' atomic model (1911) ?

Bohr's atomic model (1913)



Felix Ehrenhaft

Robert A. Millikan



Subelectrons, Presuppositions, and the Millikan–Ehrenhaft Dispute

By Gerald Holton*

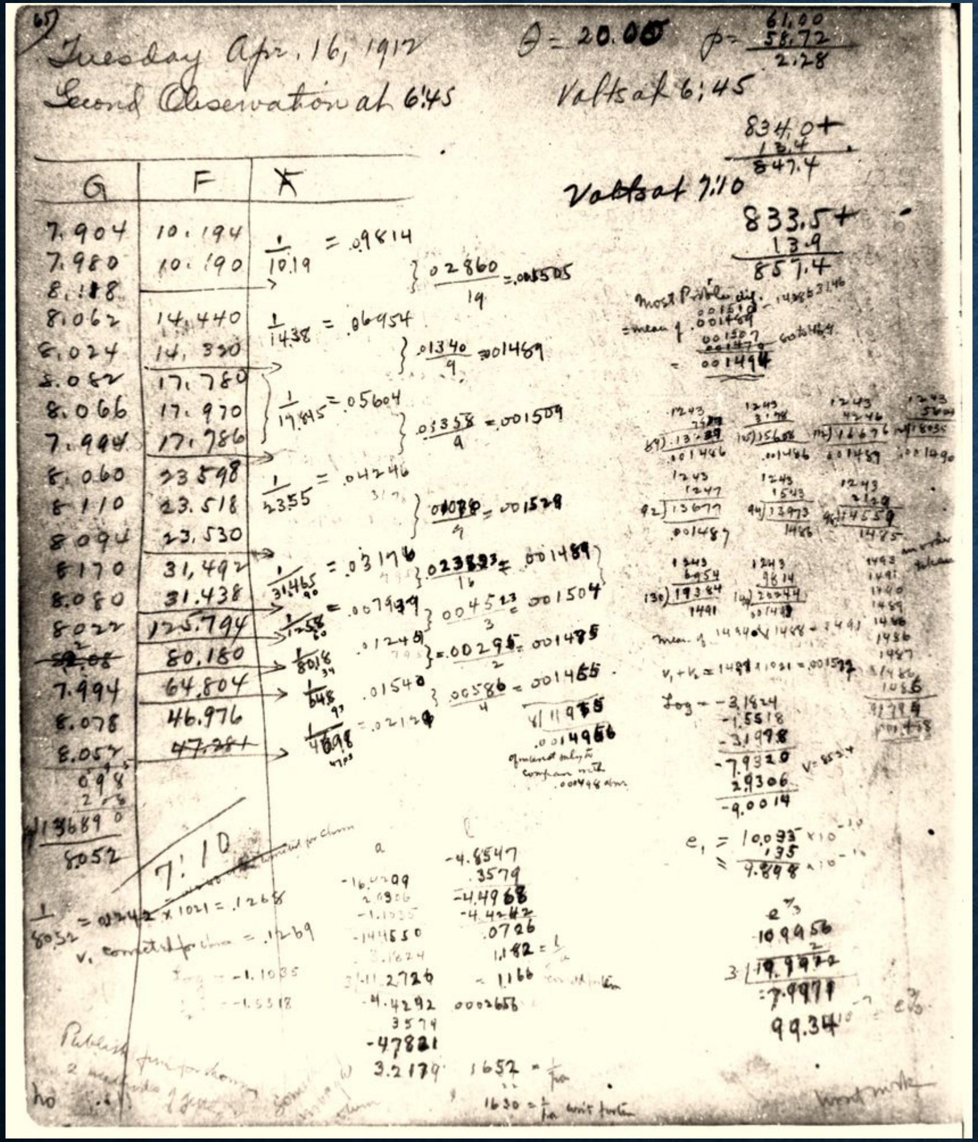
1. INTRODUCTION

Peter Medawar is one of the few first-rank research scientists still concerned with the problem of knowledge—the sources, warrants, and degrees of certainty of scientific findings, the interplay between fact and belief and between perception and understanding. In *The Art of the Soluble* he asks: "What sort of person is a scientist, and what kind of act of reasoning leads to scientific discovery and the enlargement of the understanding?"[1] He finds the usual approaches too limited: "What scientists *do* has never been the subject of a scientific, that is, an ethological inquiry. . . . It is no use looking to scientific 'papers,' for they not merely conceal but actively misrepresent the reasoning that goes into the work they describe. . . . Only unstudied evidence will do—and that means listening at a keyhole."[2]

Medawar proposes that to study scientific activity one should live in the laboratory or in the theoretician's workroom and observe the work as it is carried out. To approach Medawar's aim when dealing with historical problems, historians and sociologists regularly make use of unselfconscious evidence such as letters, autobiographical reports crosschecked by other documents, oral history interviews conducted by trained historians, transcripts of conversations that took place in the heat of battle at scientific meetings, and, above all, laboratory notebooks—first-hand documents directly rooted in the act of doing science, with all the smudges, thumbprints, and bloodstains of the personal struggle of ideas.

These sources can help us in understanding the beliefs and activity of some scientists and how they dealt with new ideas at times when systematic tests of these ideas, if available at all, were difficult to trust or apply. In this study I treat that period following the earliest phase of discovery, when the stirrings of a new conception are difficult to document and before the new work has been absorbed into the

*Jefferson Laboratory, Harvard University, Cambridge, Massachusetts 02138.
[1]P. B. Medawar, *The Art of the Soluble* (London, 1967), p. 7.
[2]*Ibid.*, pp. 151, 155.



Millikan notebooks

Beauty Publish this surely, beautiful
Error high, will not use
Perhaps publish
Publish. Fine for showing two mehods of getting v...
Possible a double drop
This seems to show clearly that the field is not exactly uniform
This drop flickered as ho [sic] unsymmetrical
Very low Something wrong
Something the mater
Agreement poor

Einstein's argument, 1905

$$\varphi(\rho,\nu) = -\frac{E}{\beta\nu}\left(\ln\frac{E}{\alpha\nu^3 V d\nu} - 1\right) = S_\nu$$

Radiation

$$S - S_o = \frac{E}{\beta\nu}\ln\frac{V}{V_o}$$

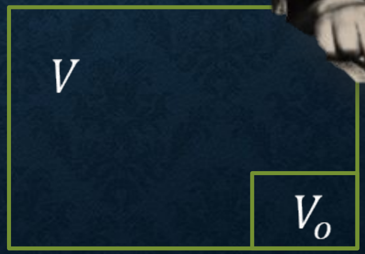
Mater
[Ideal gas]

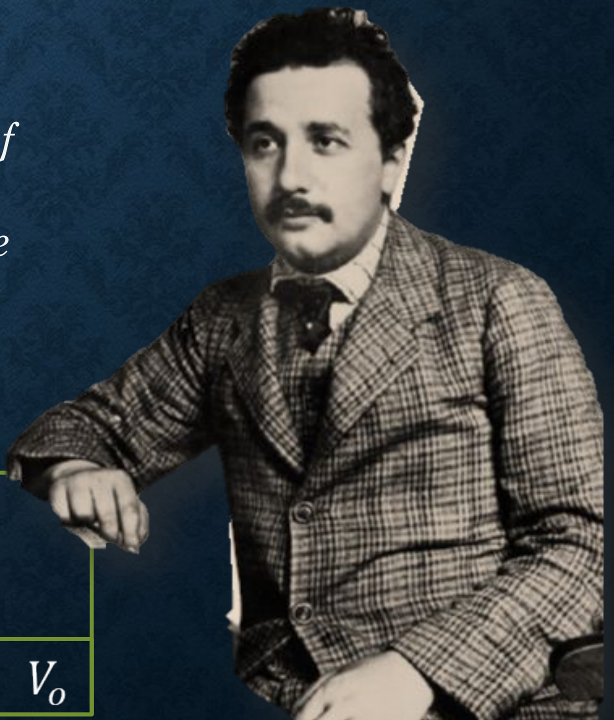
$$S - S_o = \frac{R}{N_A} N \ln\frac{V}{V_o}$$

"Monochromatic radiation of low density (within the validity of Wien's radiation formula) behaves thermodynamically as if it consisted of mutually independent energy quanta of magnitude $R\beta\nu/N$"

And the mean energy is:

$$\bar{E} = 3\frac{R}{N}T = 3\kappa T$$





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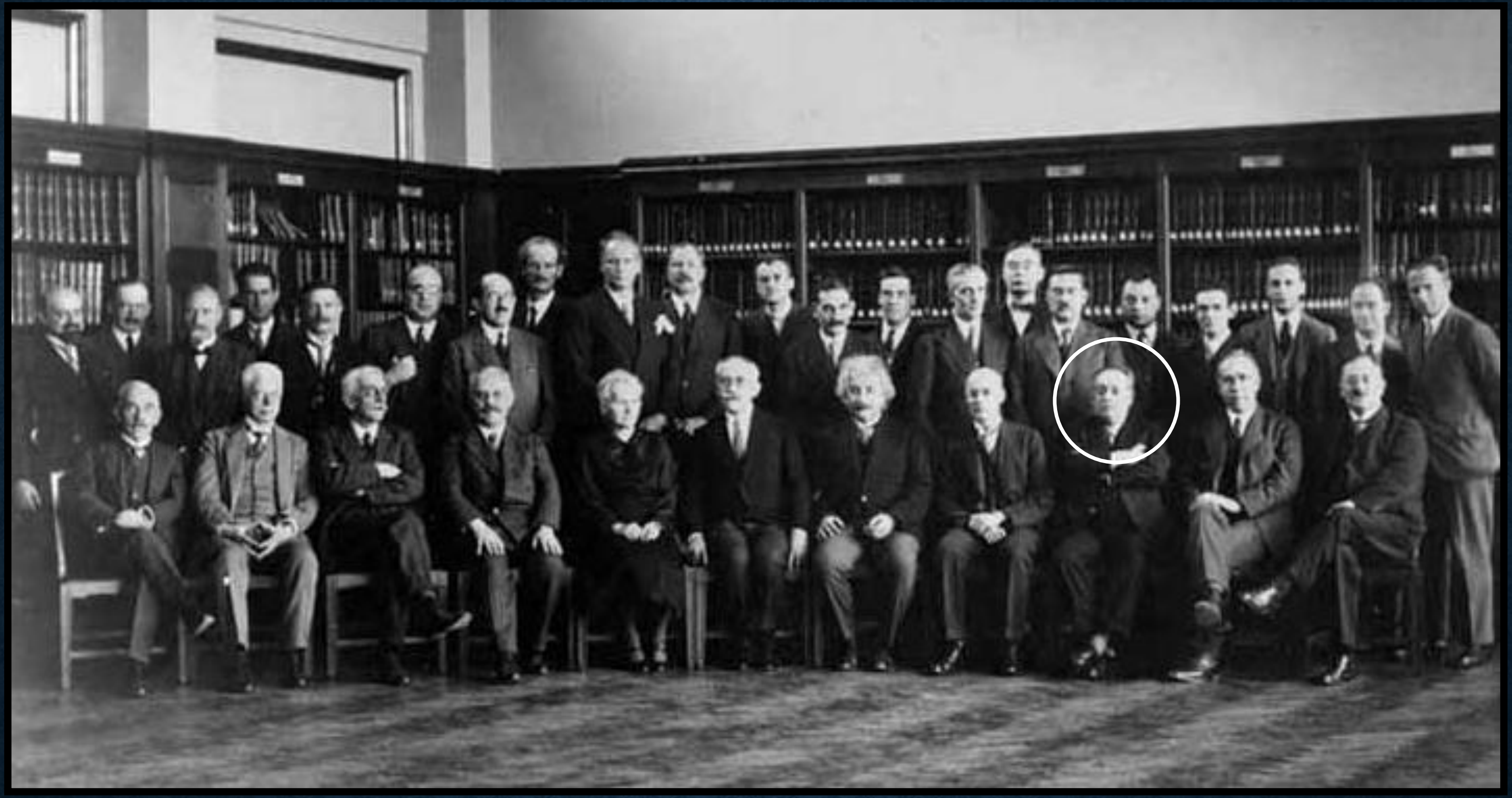


Sixth Solvay Conference, Brussels, autumn of 1930

Brussels, 1932

Structure et propriétés des noyaux atomiques

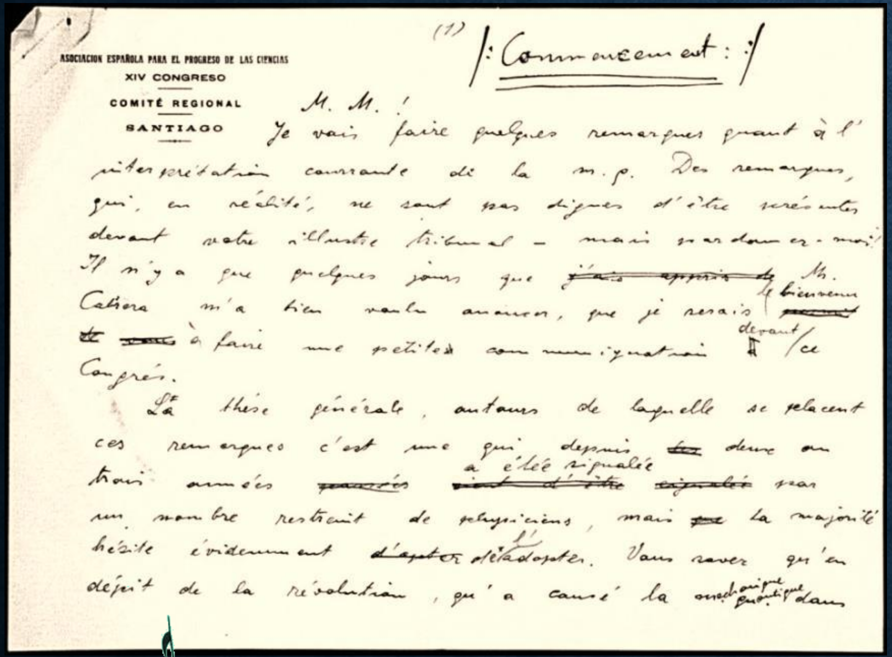
Seventh Solvay Conference, 1933

Schrödinger’s cat in Spain

Santiago de Compostela, 3 August 1934

Schrödinger's cat in Spain

Santiago de Compostela (3 August)
Comunication XIV AEPC "Quelques remarques sur l'interprétation de la mecanique quantique"

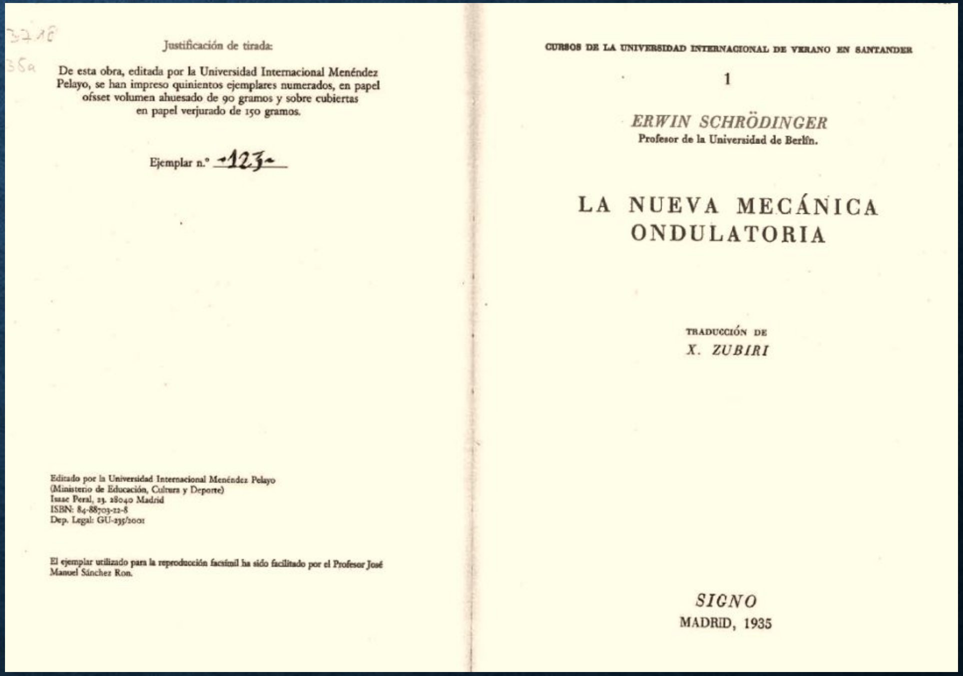

(1) /: Commencement :/

ASOCIACION ESPAÑOLA PARA EL PROGRESO DE LAS CIENCIAS
XIV CONGRESO
COMITÉ REGIONAL
SANTIAGO

M. M.!
Je vais faire quelques remarques quant à l'interprétation courante de la m. q. Des remarques, qui, en réalité, ne sont pas dignes d'être présentées devant votre illustre tribunal – mais pardonnez-moi! Il n'y a que quelques jours que ~~j'ai appris de~~ M. Cabrera m'a bien voulu annoncer, que je serais le bienvenu à faire une petite communication devant ce Congrès.

La thèse générale, autour de laquelle se placent ces remarques c'est une qui depuis deux ou trois années ~~passées~~ ~~vient d'être signalée~~ a été signalée par un nombre restreint de physiciens, mais la majorité hésite évidemment ~~d'adopter~~ de l'adopter. Vous savez qu'en dépit de la révolution, qu'a causé la mécanique quantique dans

Santander (13-15 August)
Three lectures at the UIS *The new wave mechanics*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CURSOS DE LA UNIVERSIDAD INTERNACIONAL DE VERANO EN SANTANDER

1

ERWIN SCHRÖDINGER
Profesor de la Universidad de Berlín.

LA NUEVA MECÁNICA ONDULATORIA

TRADUCCIÓN DE
X. ZUBIRI

SIGNO
MADRID, 1935

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The *Silver age* of Spanish physics

Blas Cabrera
(1878-1945)

Miguel Catalán
(1894-1957)

Enrique Moles
(1883-1953)

Julio Palacios
(1891-1970)