Reflections

Shining light on matter and mind
Cambridge, MA, 15 November 2014

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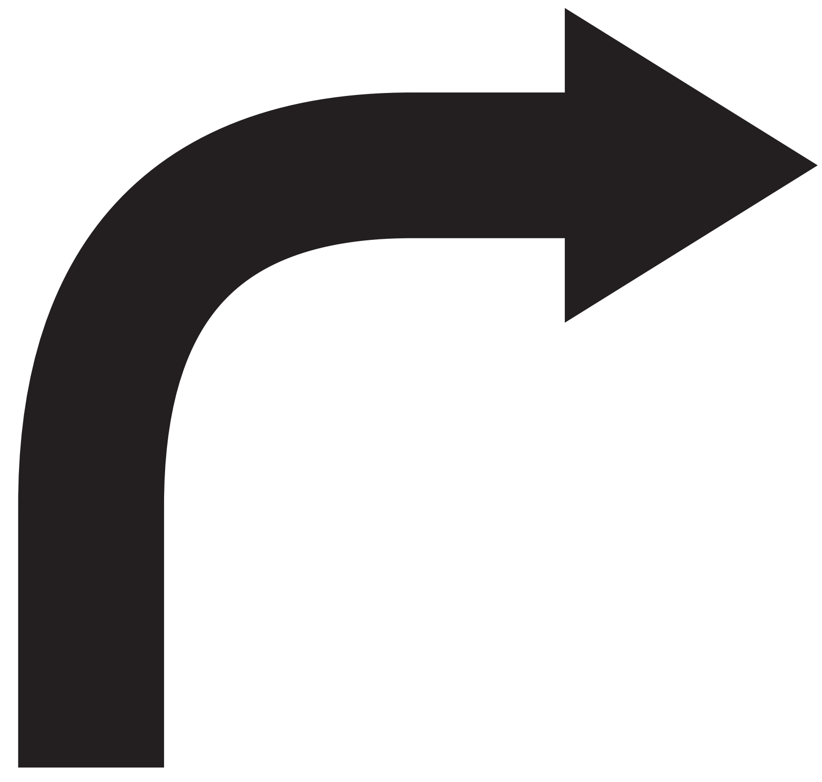
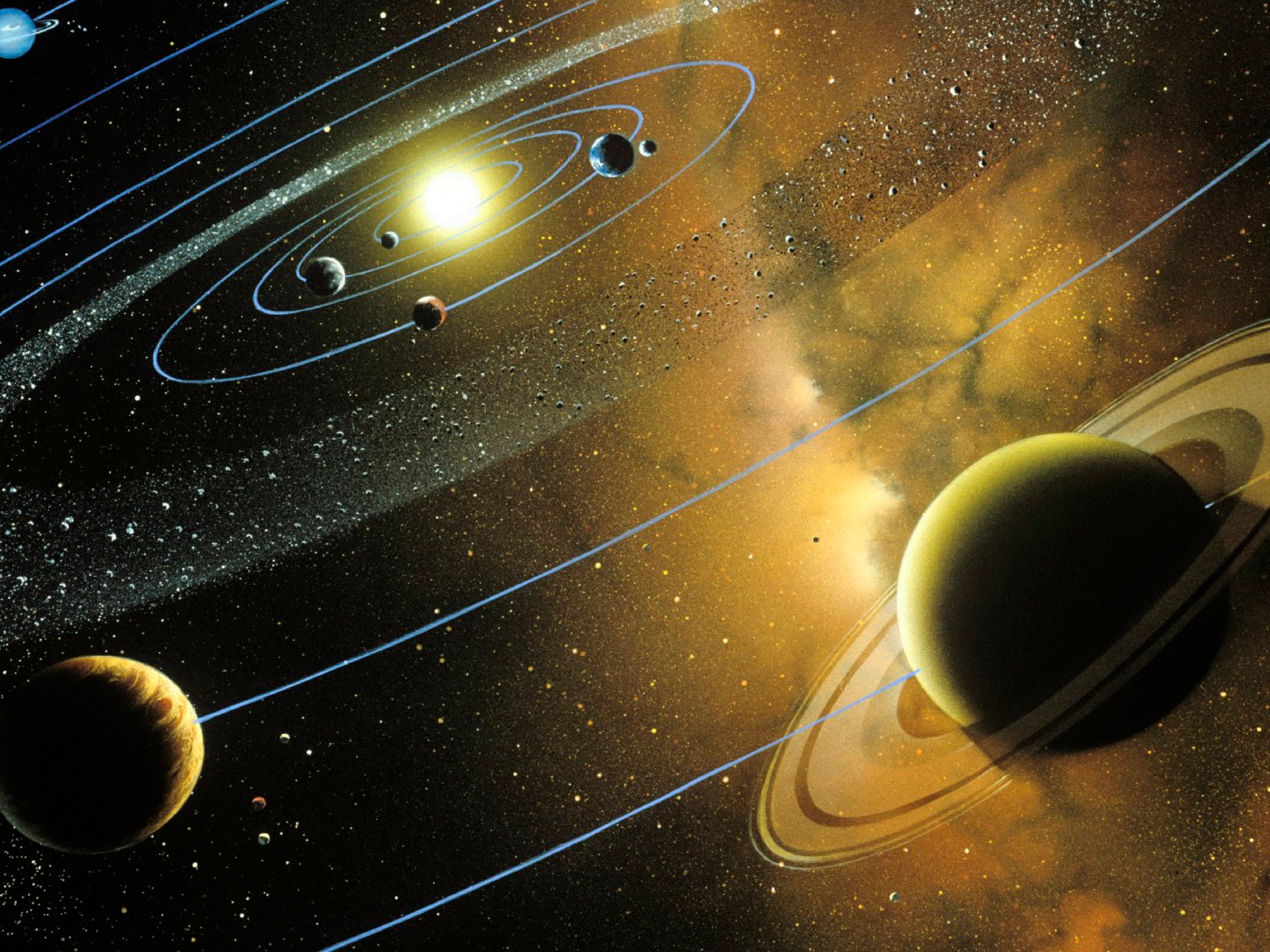
Shining light on matter and mind
Cambridge, MA, 15 November 2014


GOAL

GOAL



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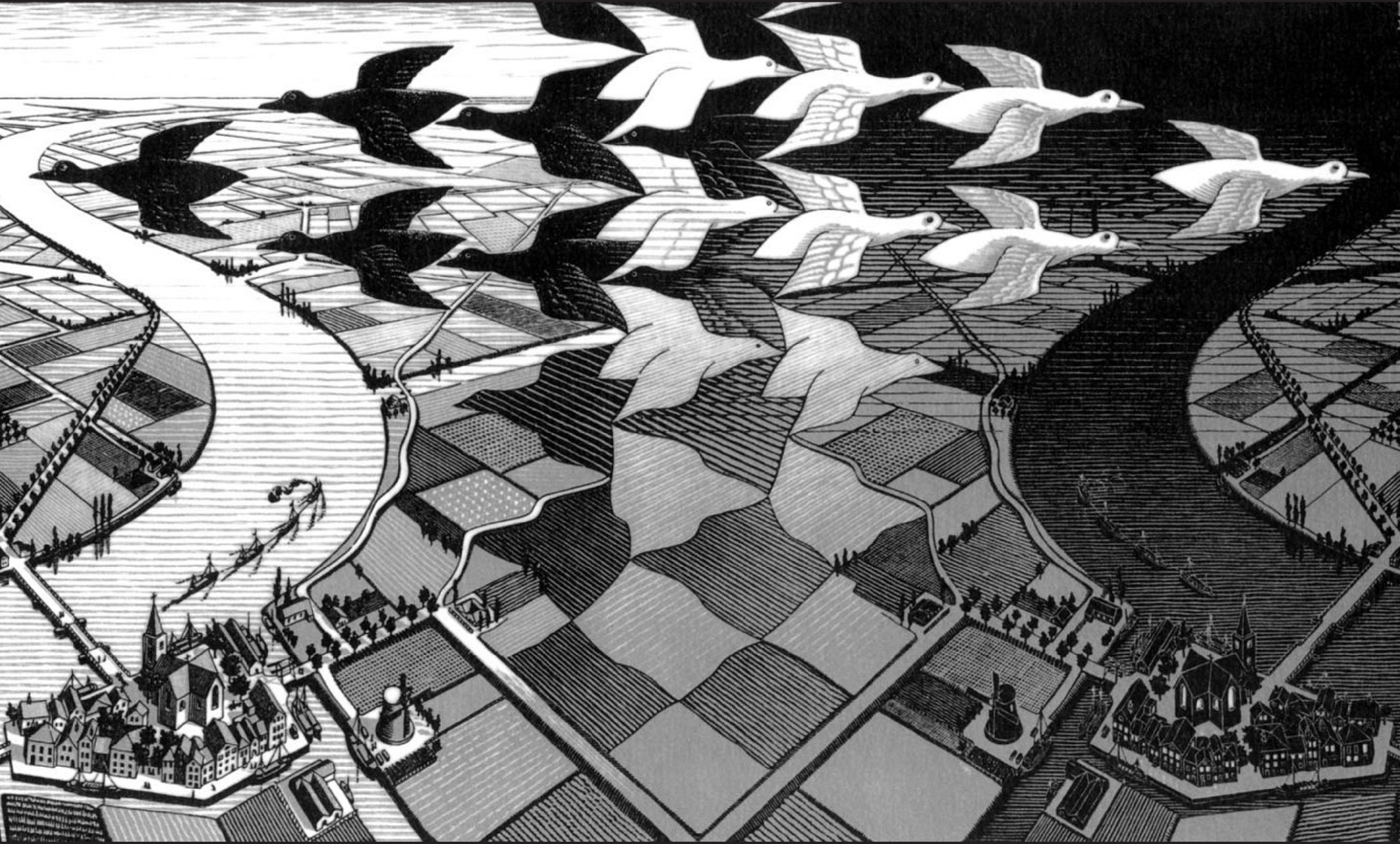
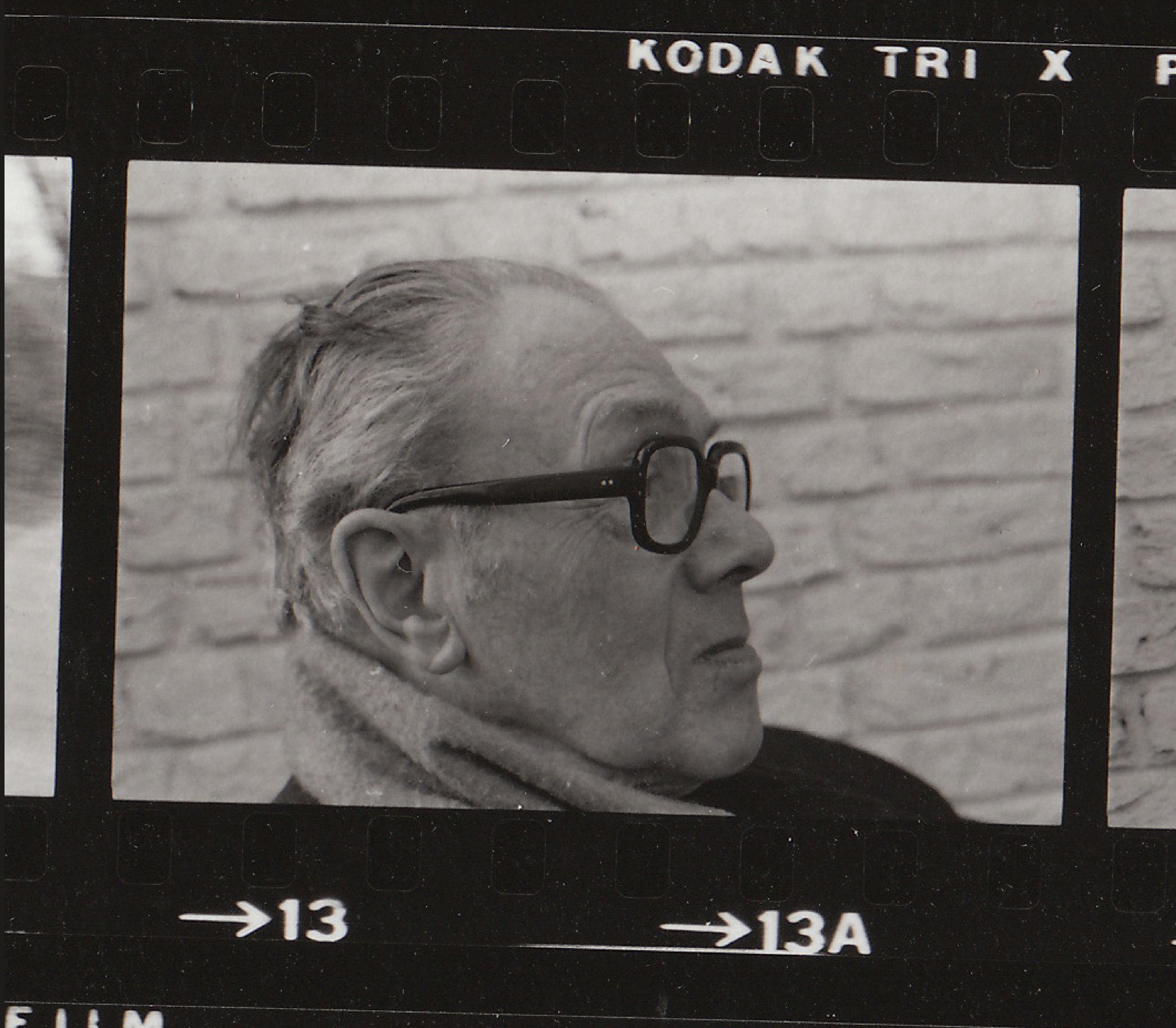
Why am I I?

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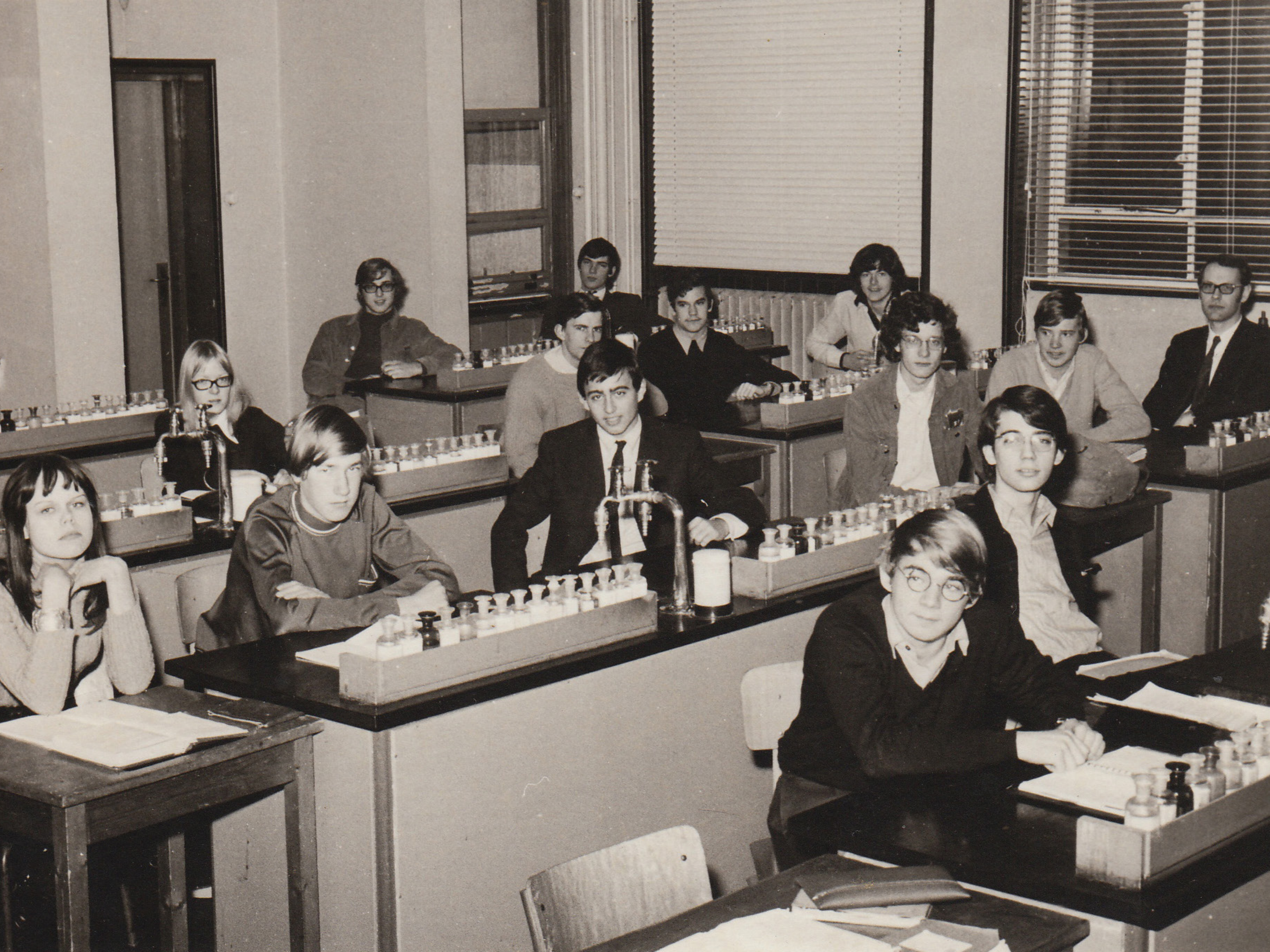

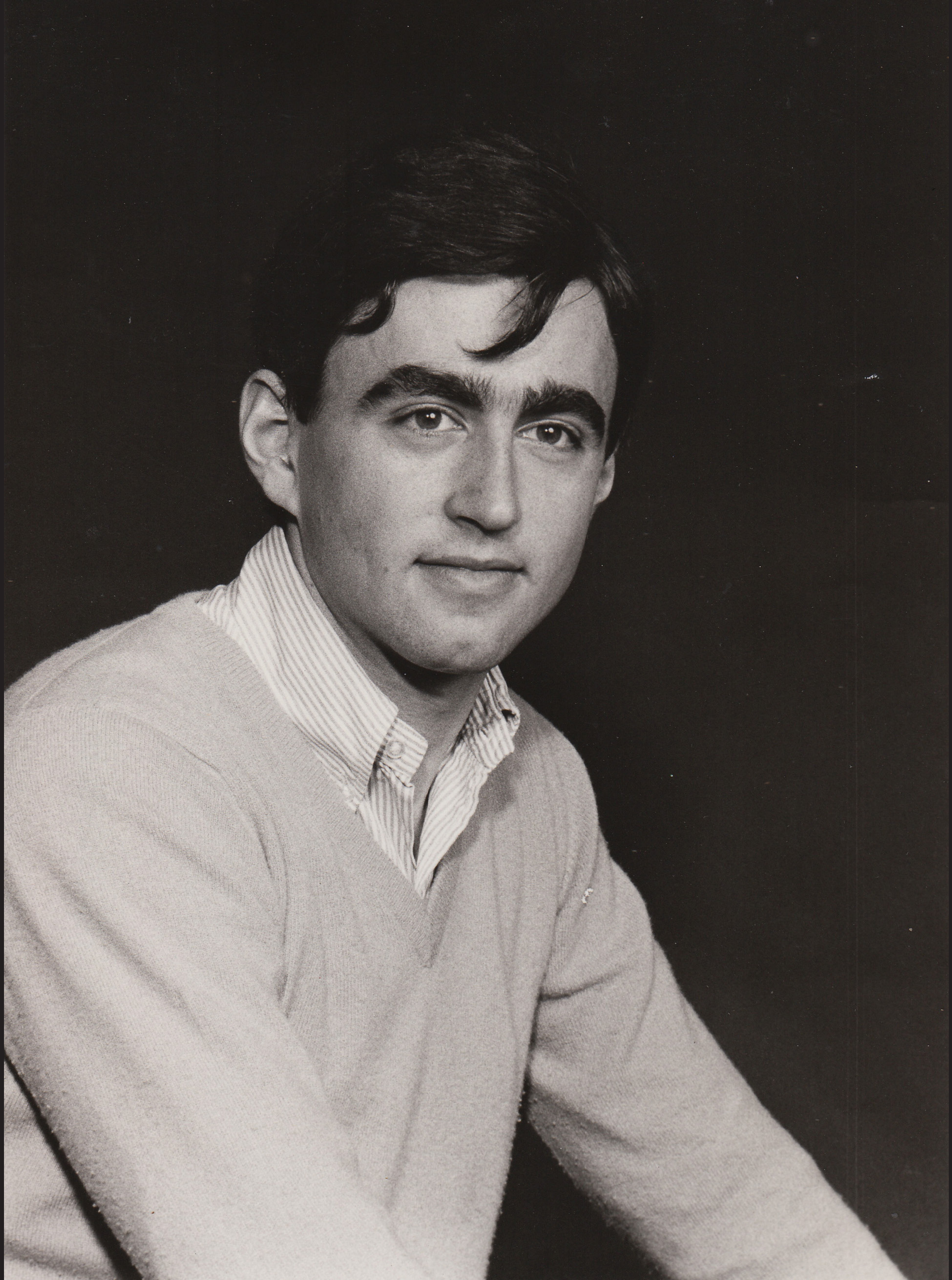

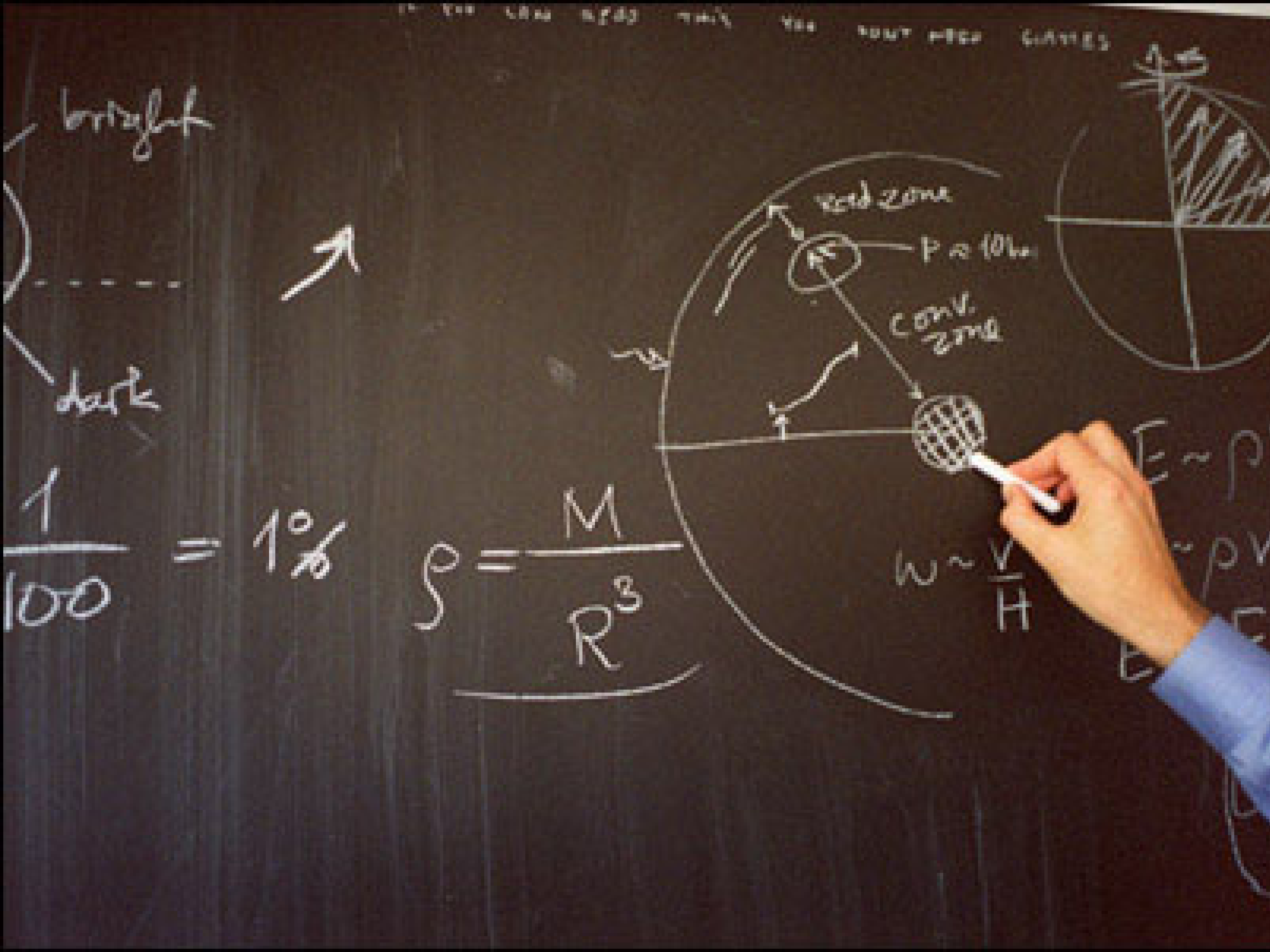
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1/100 = 1%
ρ = M/R³
rad zone
conv. zone
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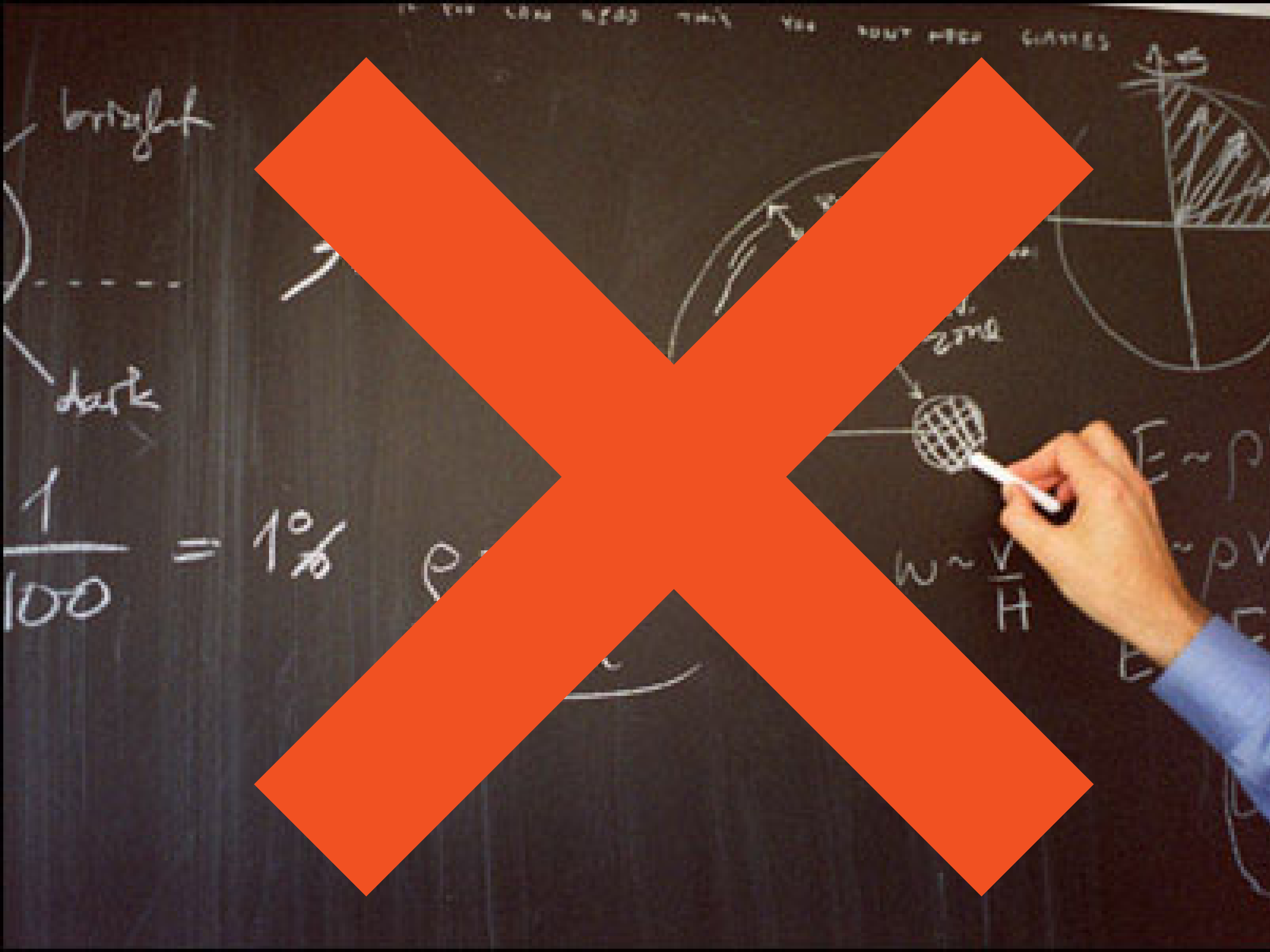
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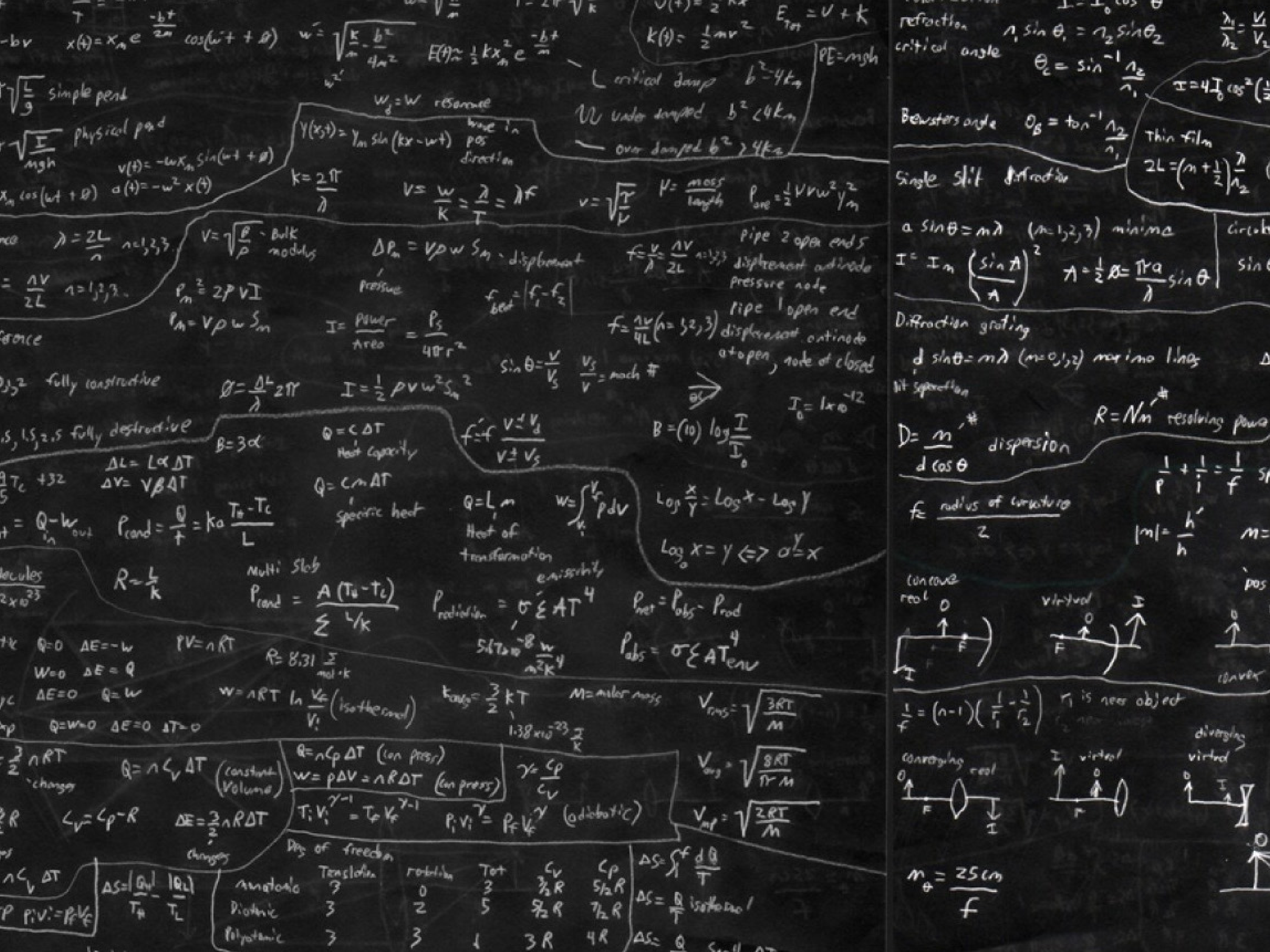

simple pend
physical pend
resonance
critical damp
under damped
over damped
wave in pos direction
Bulk modulus
displacement
pressure
Pipe 2 open ends
displacement antinode
pressure node
pipe 1 open end
displacement antinode at open, node at closed
mach #
fully constructive
fully destructive
Heat capacity
specific heat
Heat of transformation
Multi Slab
emissivity
isothermal
molar mass
constant Volume
con press
adiabatic
changes
Deg of freedom
Translation
rotation
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monatomic
Diatomic
Polyatomic
isothermal
refraction
critical angle
Brewsters angle
Thin film
Single slit diffraction
minima
Diffraction grating
maxima lines
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r1 is near object
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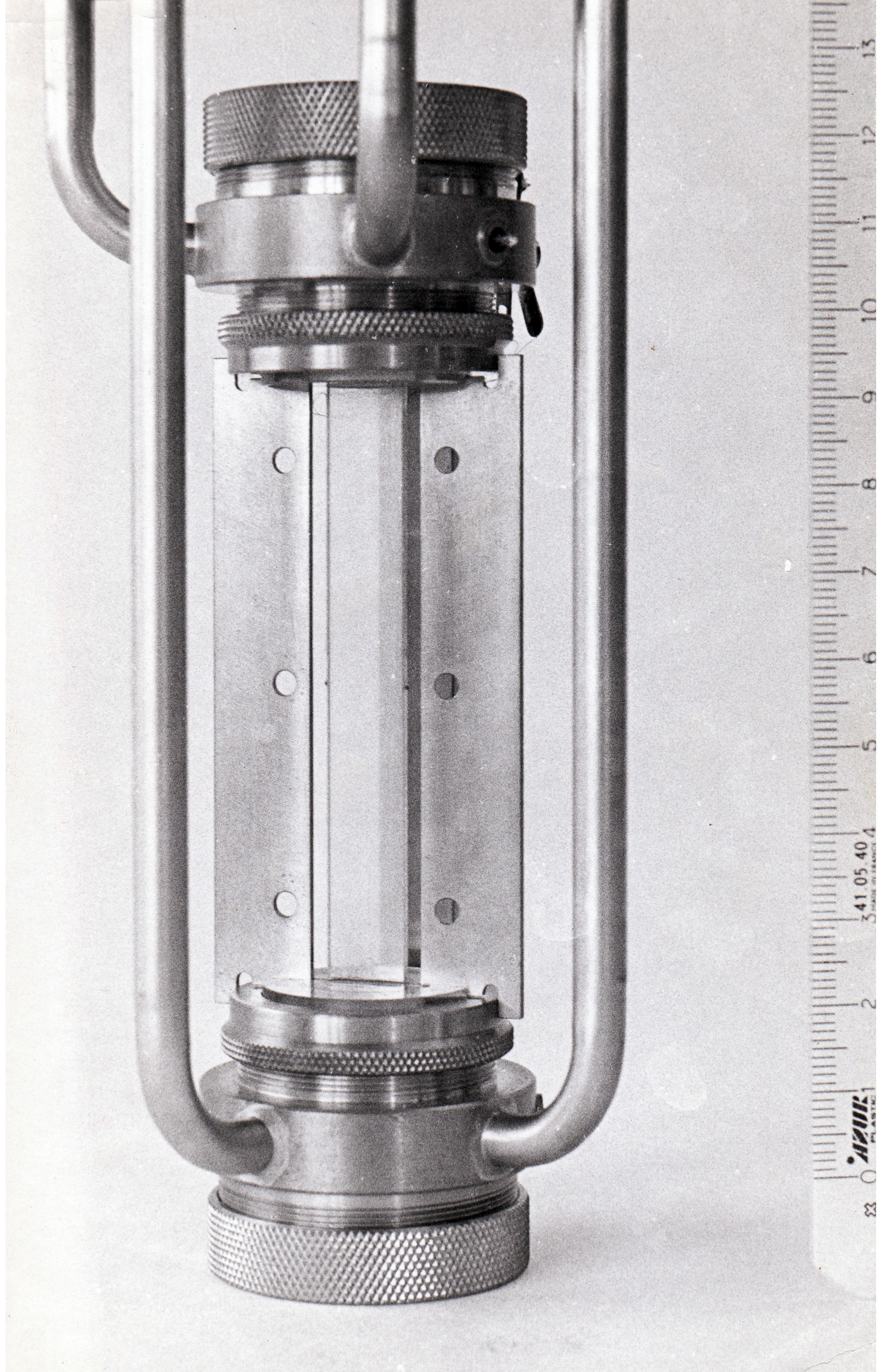
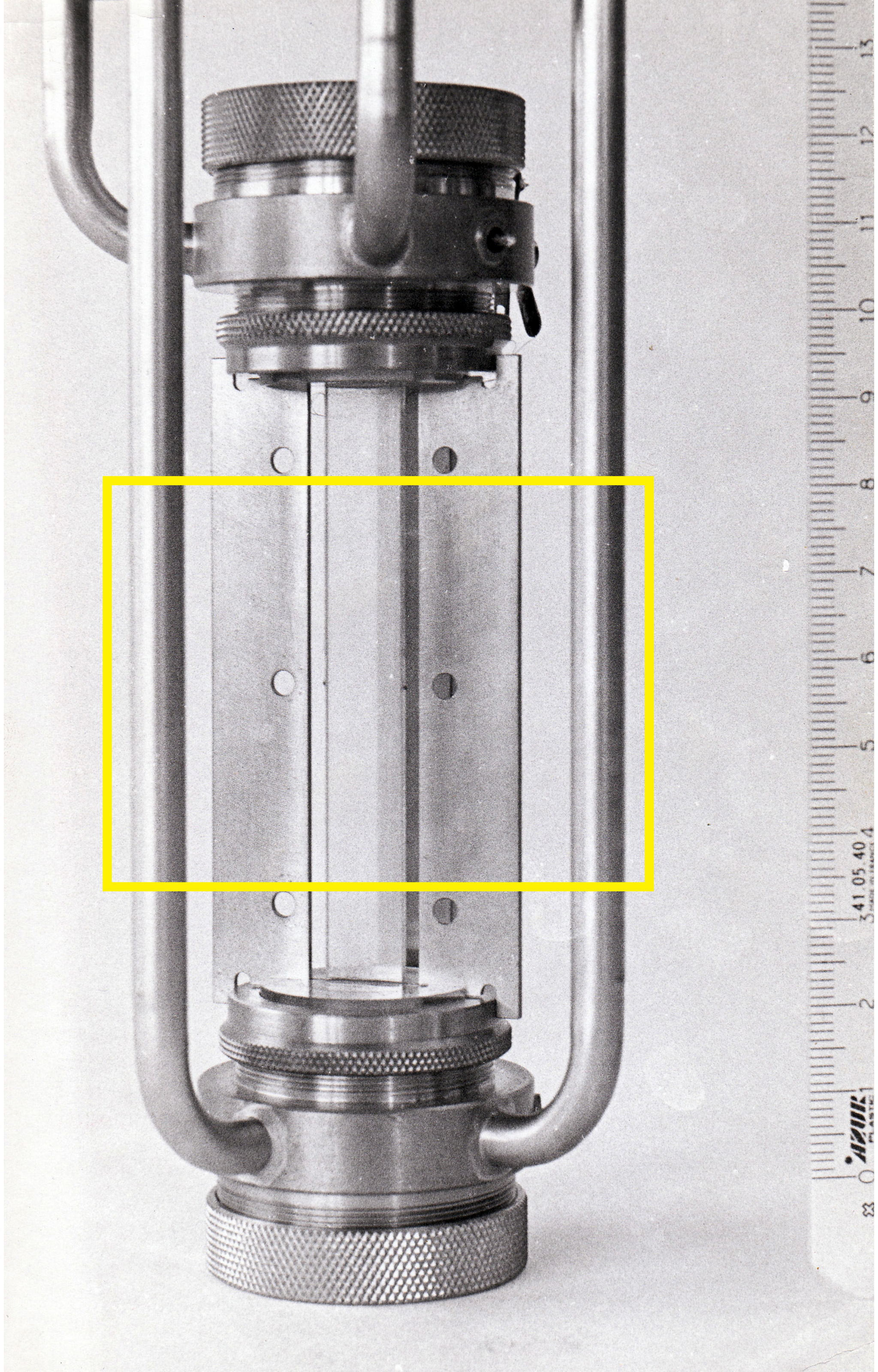
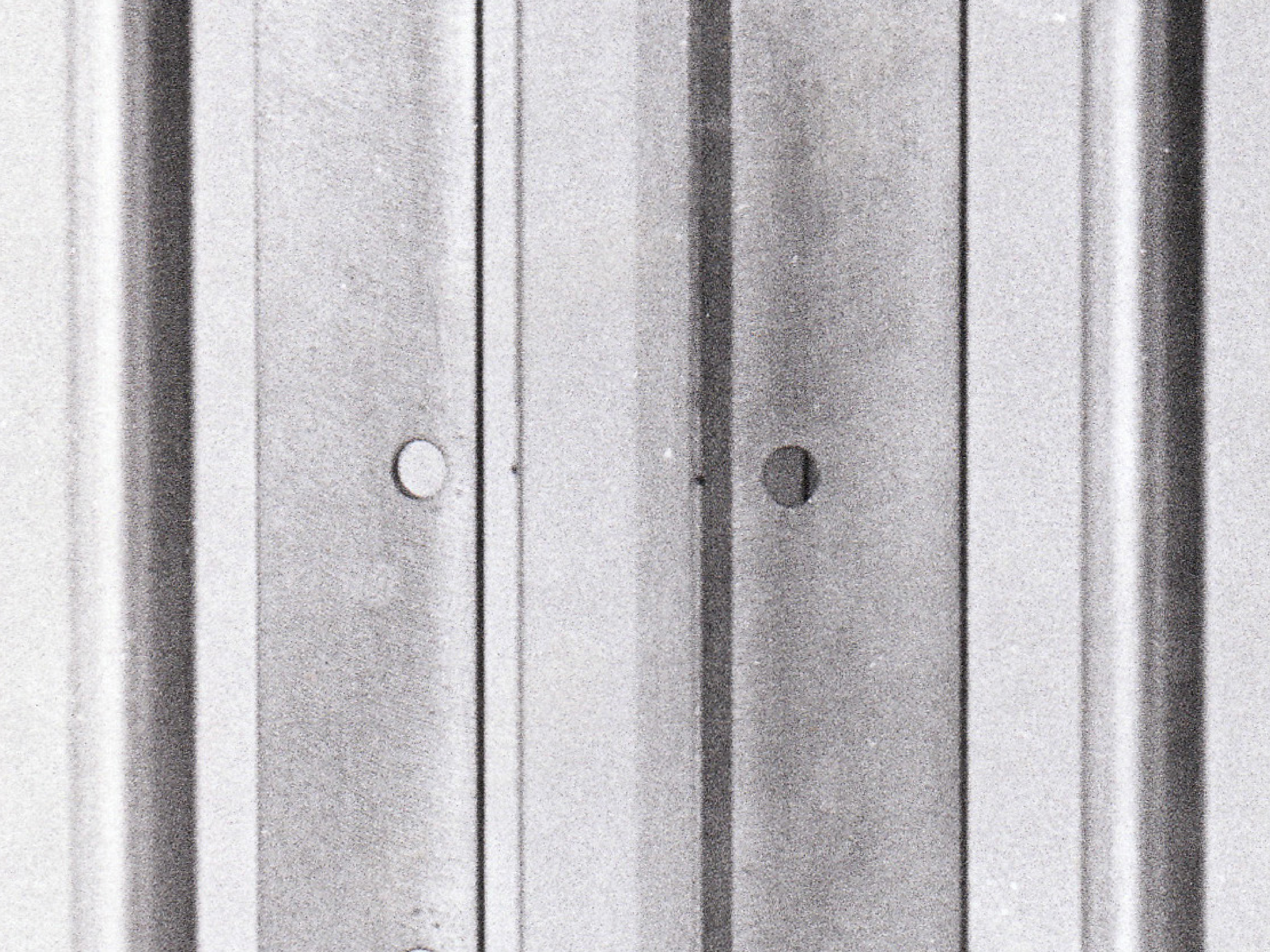
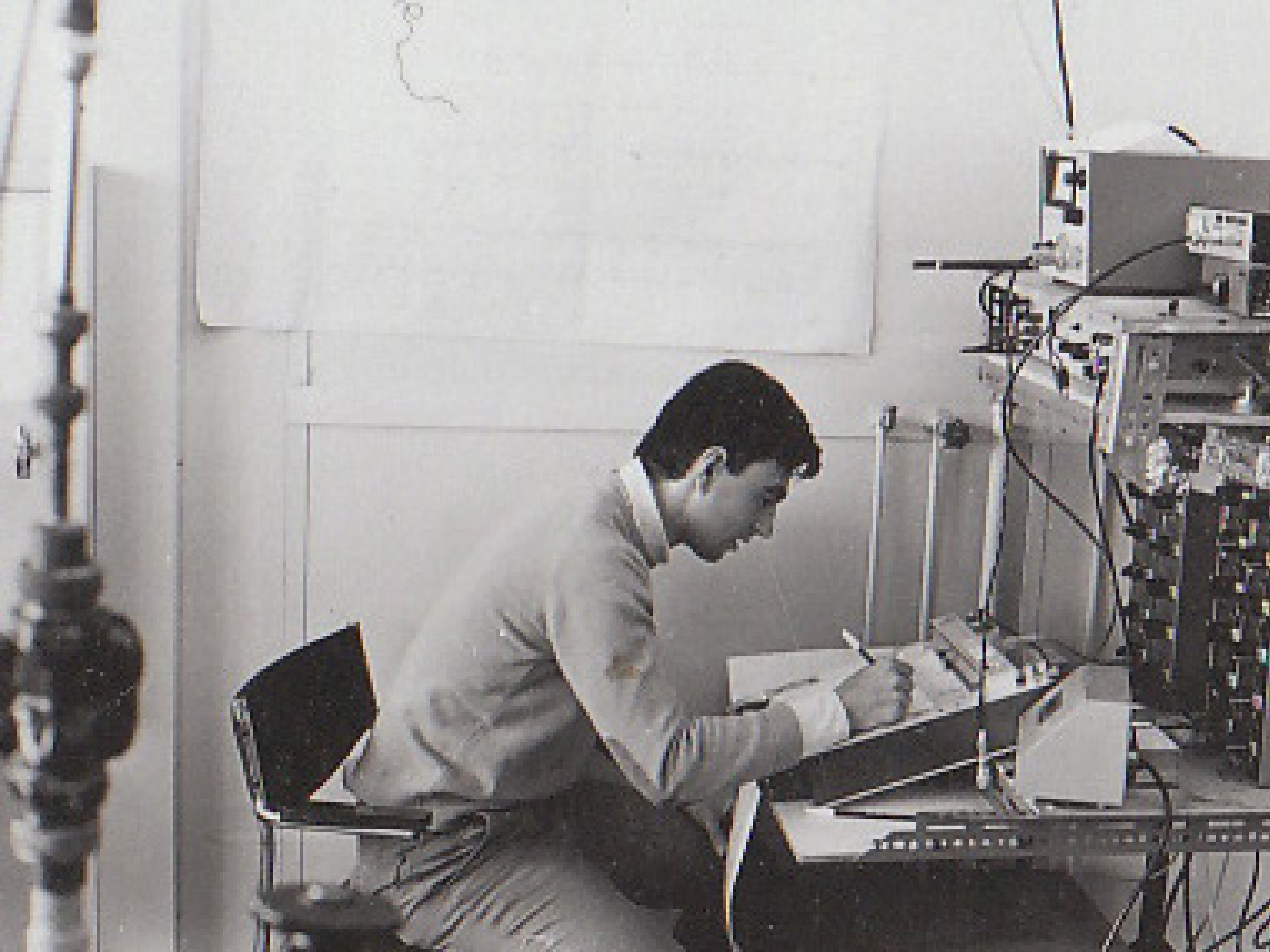
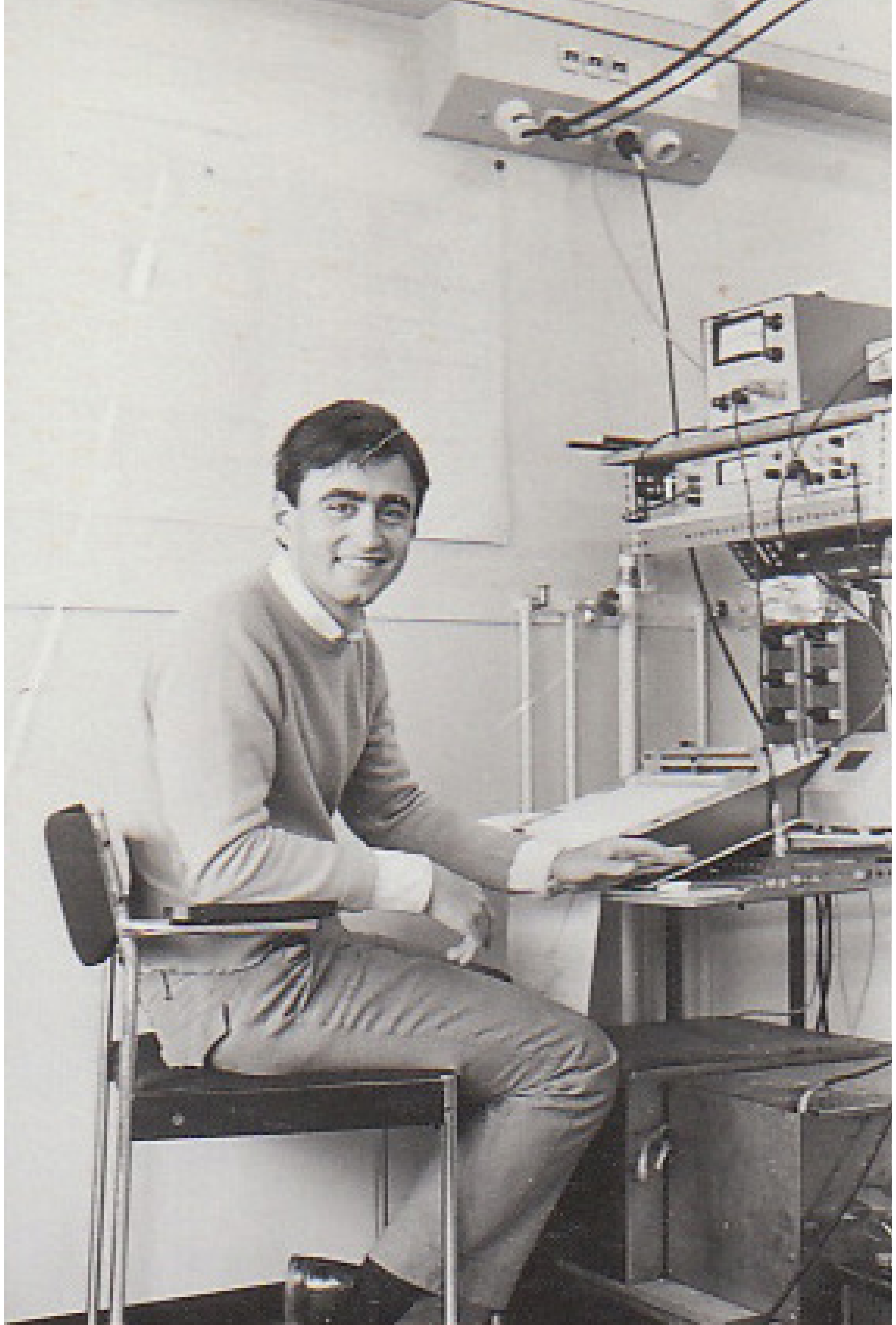










EXPERIMENTS ON THE INFLUENCE OF A MAGNETIC FIELD ON THE DUFOUR-EFFECT IN POLYATOMIC GASES: CONFIRMATION OF AN ONSAGER RELATION

E. MAZUR, G.W. 't HOOFT and L.J.F. HERMANS
Huygens Laboratorium der Rijksuniversiteit, Leiden, The Netherlands

Received 21 September 1977

Experimental data are reported on the influence of a magnetic field on the Dufour-effect, the reciprocal phenomenon of thermal diffusion, in an equimolar N_2–Ar mixture at room temperature. An Onsager relation in the presence of a magnetic field is confirmed.

In the absence of a magnetic field the Onsager relation between the Dufour and the thermal diffusion coefficient has been experimentally confirmed by Waldmann thirty years ago [1]. For transport phenomena occurring in polyatomic gases under the influence of an external field (Senftleben–Beenakker effects) [2], such a relation has not been verified to date. Recently [3], experiments were performed on the influence of a magnetic field on thermal diffusion: transverse thermal diffusion was measured and preliminary results for the system N_2–Ar were reported. ... present paper experiments will be described on ... t, viz. the transverse heat flux ... Ar mixture under the

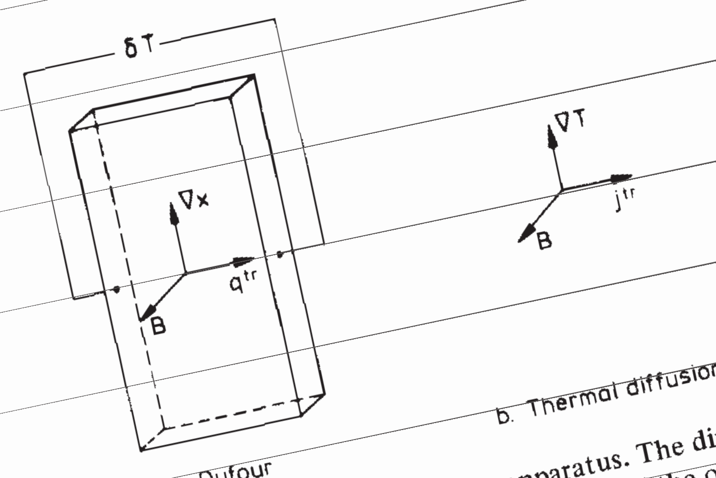
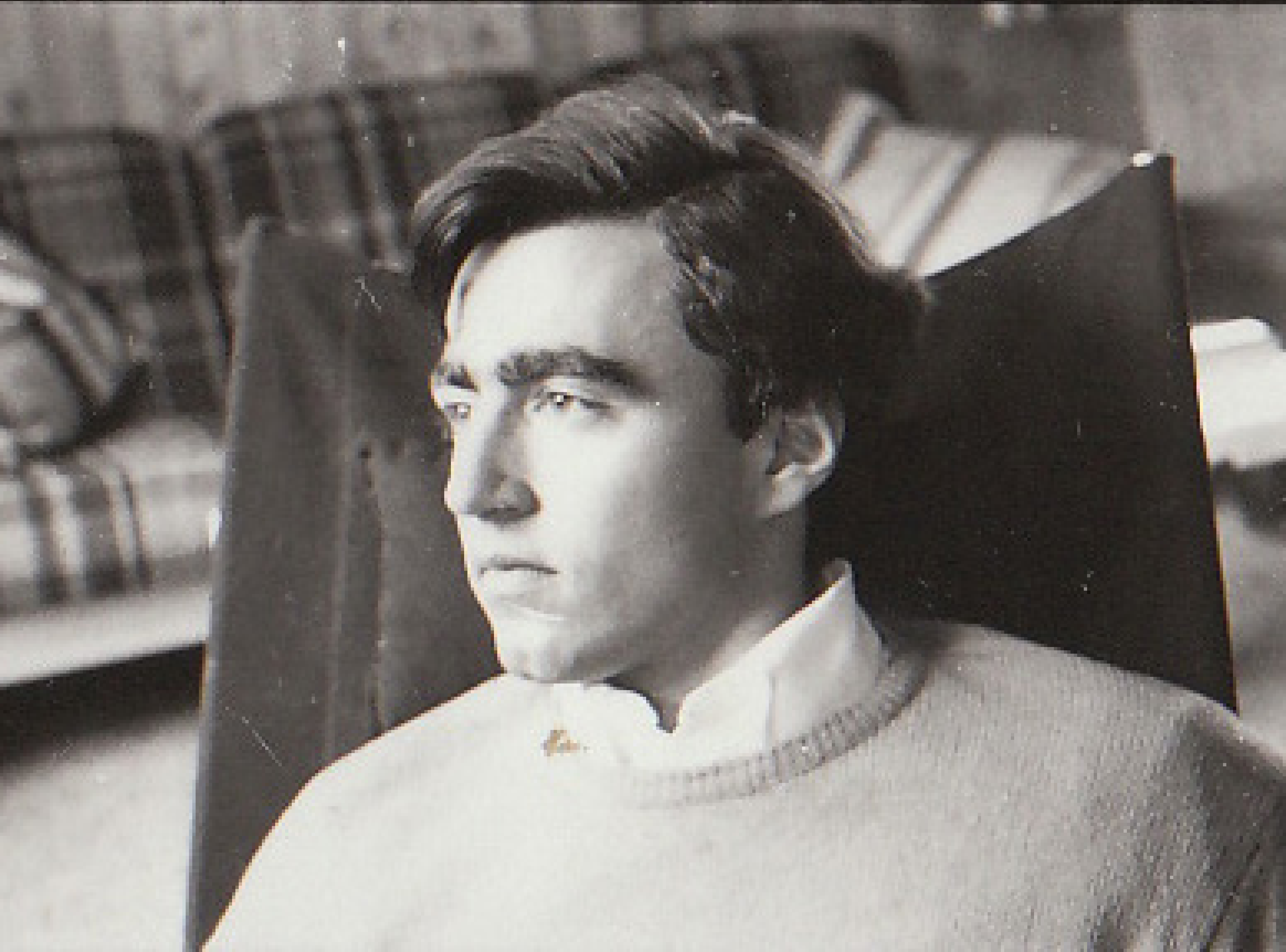


Fig. 1. (a) Schematic diagram of the apparatus. The directions of the applied N_2 concentration gradient and of the observed heat flux are indicated. (b) Direction of the observed N_2 flux in the thermal diffusion experiment (ref. [6]).

... the narrow walls of the ... in ∇x and odd



Eindhoven
Nederland

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N.V. Philips' Gloeilampenfabrieken

De heer E. Mazur
Voordorp 90
2352 BW Leiderdorp

afd. dept. abt./ref. zeichen
personeelzaken
TT/MR

datum, date
24 november 1981

doorkiesnummer in-dialling
accès intern dir. durchwahl
(040) 7 55850

onderw. re.
conc. betr.

Geachte heer Mazur,

Van Prof. Knaap vernamen wij dat u mogelijkerwijs geïn-
teresseerd bent in een bezoek aan het natuurkundig labo-
ratorium.

In verband hiermede nodigen wij u uit op 15 januari 1981
om 9.00 uur bij de afdeling personeelzaken, Willemstraat
te Eindhoven. Wilt u bij de portier vragen naar onder-

...ten wij een plattegrondje bijgeslo-
...n naar de Willemstraat is
...llen door ons wor-

HARVARD UNIVERSITY
DIVISION OF APPLIED SCIENCES
PIERCE HALL, CAMBRIDGE, MASSACHUSETTS 02138

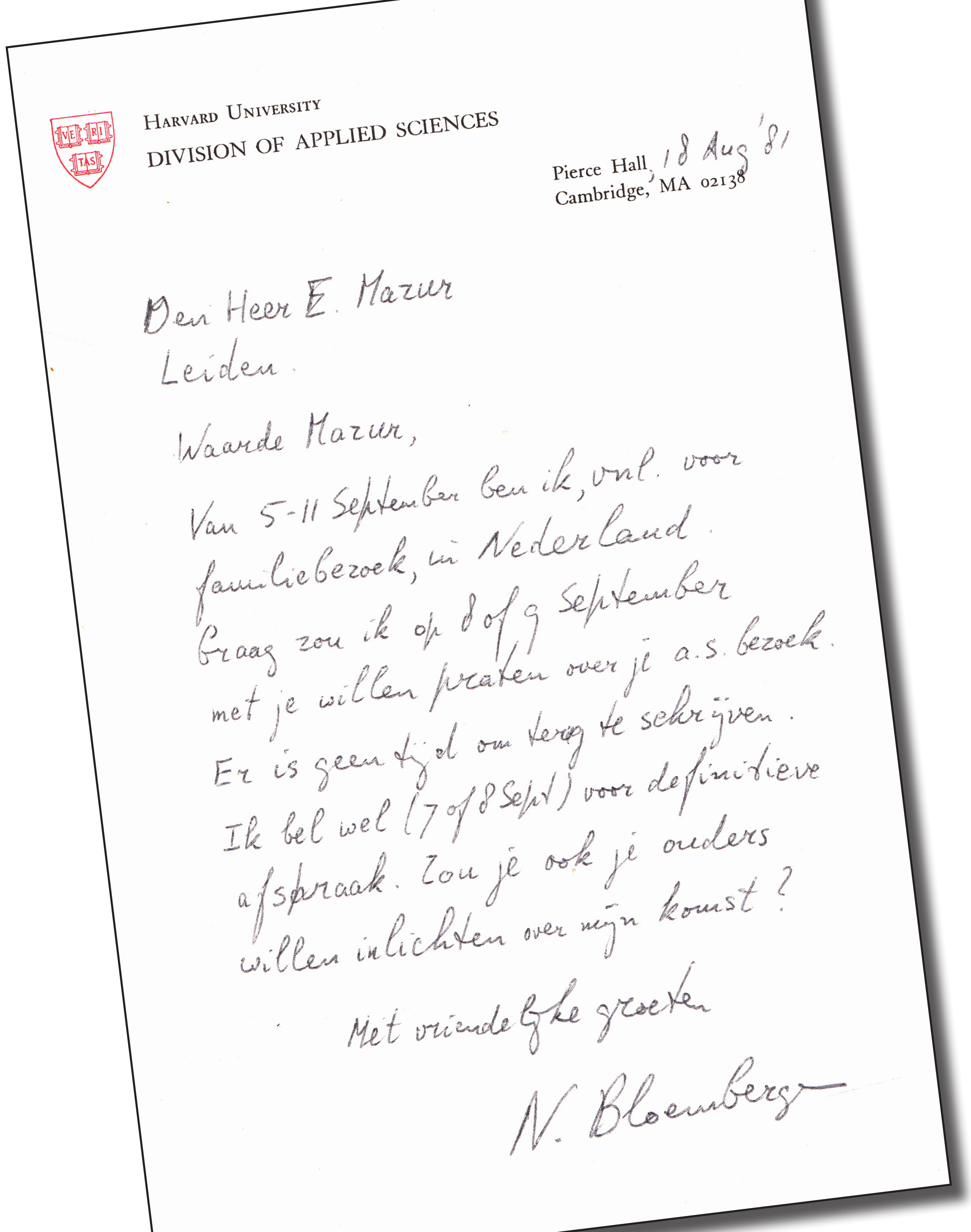
12 March 1981

Mr. Eric Mazur
Huygens Laboratorium
Wassenaarseweg 78
2300 RA LEIDEN
The Netherlands

Dear Mr. Mazur:

Referring to our correspondence in the fall of 1980, I am now pleased to inform you that we could offer you a postdoctoral position as Research Fellow, with an annual stipend of $18,600. The appointment could start any time in the fall of 1981, preferably September 15 or October 1, 1981, for the period of one year. Usually the appointment is renewable for a second year, as a two or three-year stay is preferable for the completion of an experimental project.

The expectation is that you would participate in our research on infrared excitation of molecules with short CO_2 laser pulses, and in our work on collisional effects in four-wave light mixing with dye lasers. I am sending you some preprints of our most recent work in this area, under separate cover. Please let me know whether you are interested in the position, for which your doctor's degree from Leiden University is a prerequisite. If your answer is positive, I should like to get an indication when you will defend your thesis, and when you could start here.



HARVARD UNIVERSITY
DIVISION OF APPLIED SCIENCES

Pierce Hall, 18 Aug '81
Cambridge, MA 02138

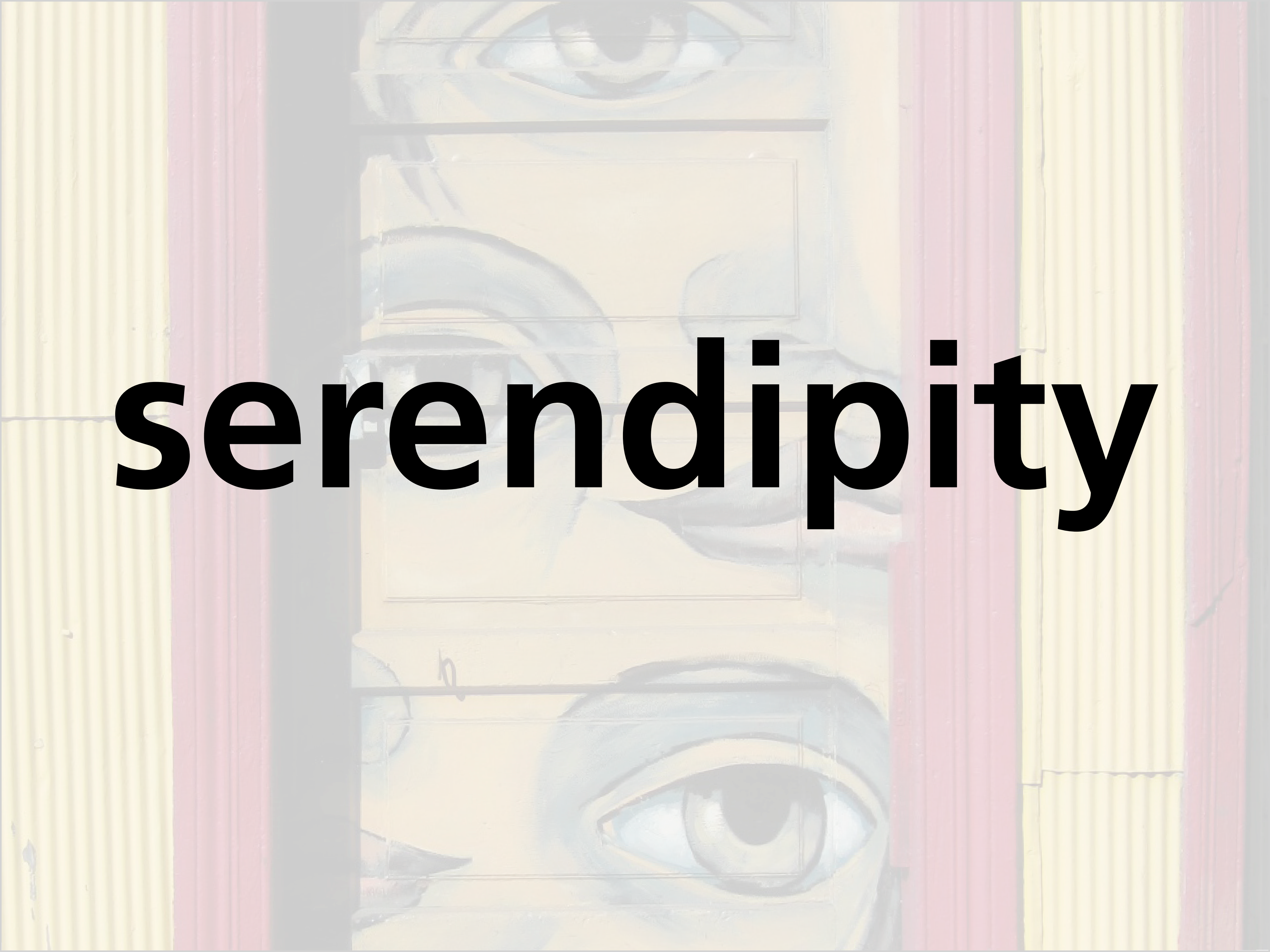
Den Heer E. Mazur
Leiden.

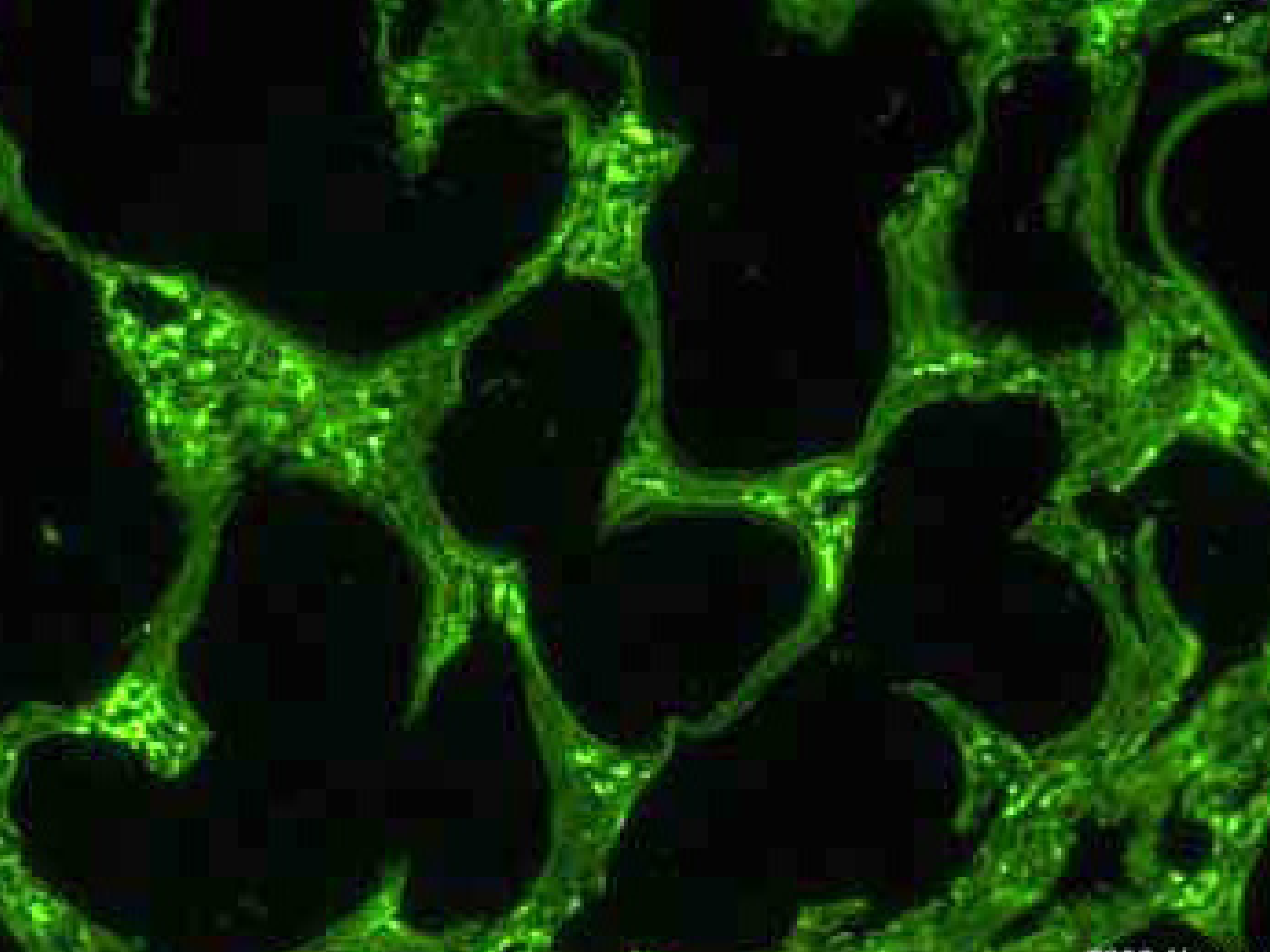
Waarde Mazur,

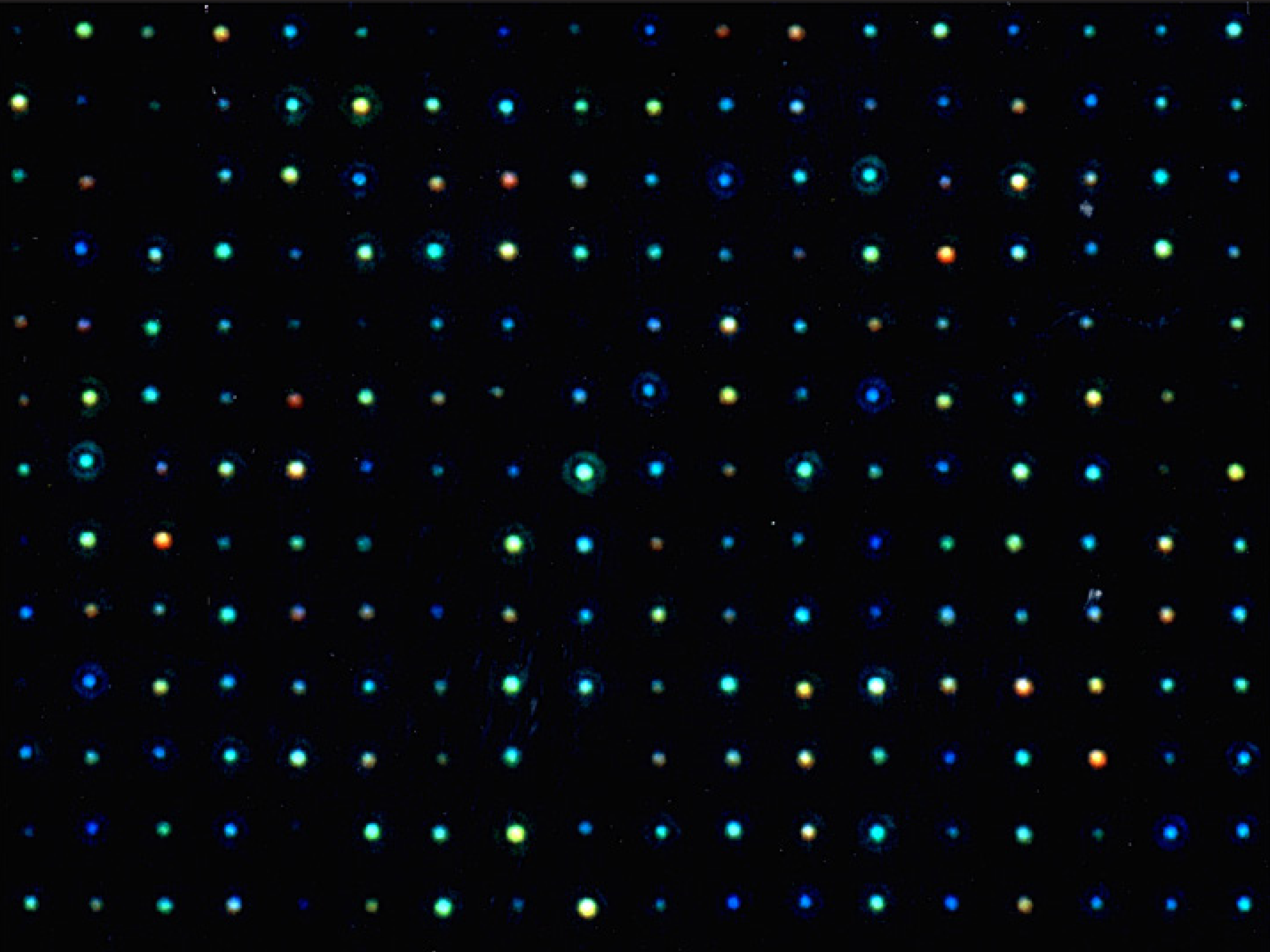
Van 5-11 September ben ik, vnl. voor
familiebezoek, in Nederland.
Graag zou ik op 8 of 9 September
met je willen praten over je a.s. bezoek.
Er is geen tijd om terug te schrijven.
Ik bel wel (7 of 8 Sept) voor definitieve
afspraak. Zou je ook je ouders
willen inlichten over mijn komst?

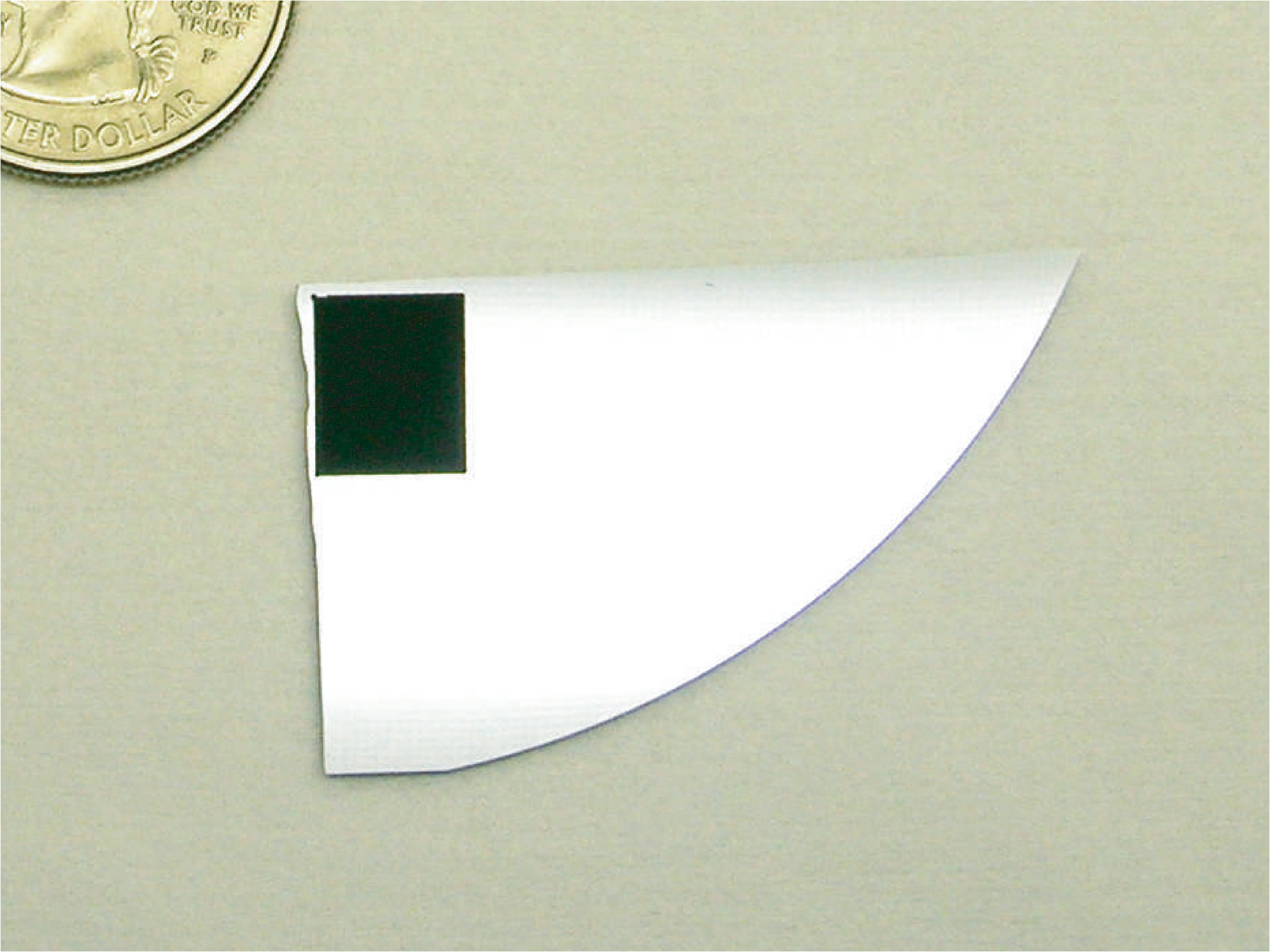
Met vriendelijke groeten

N. Bloembergen

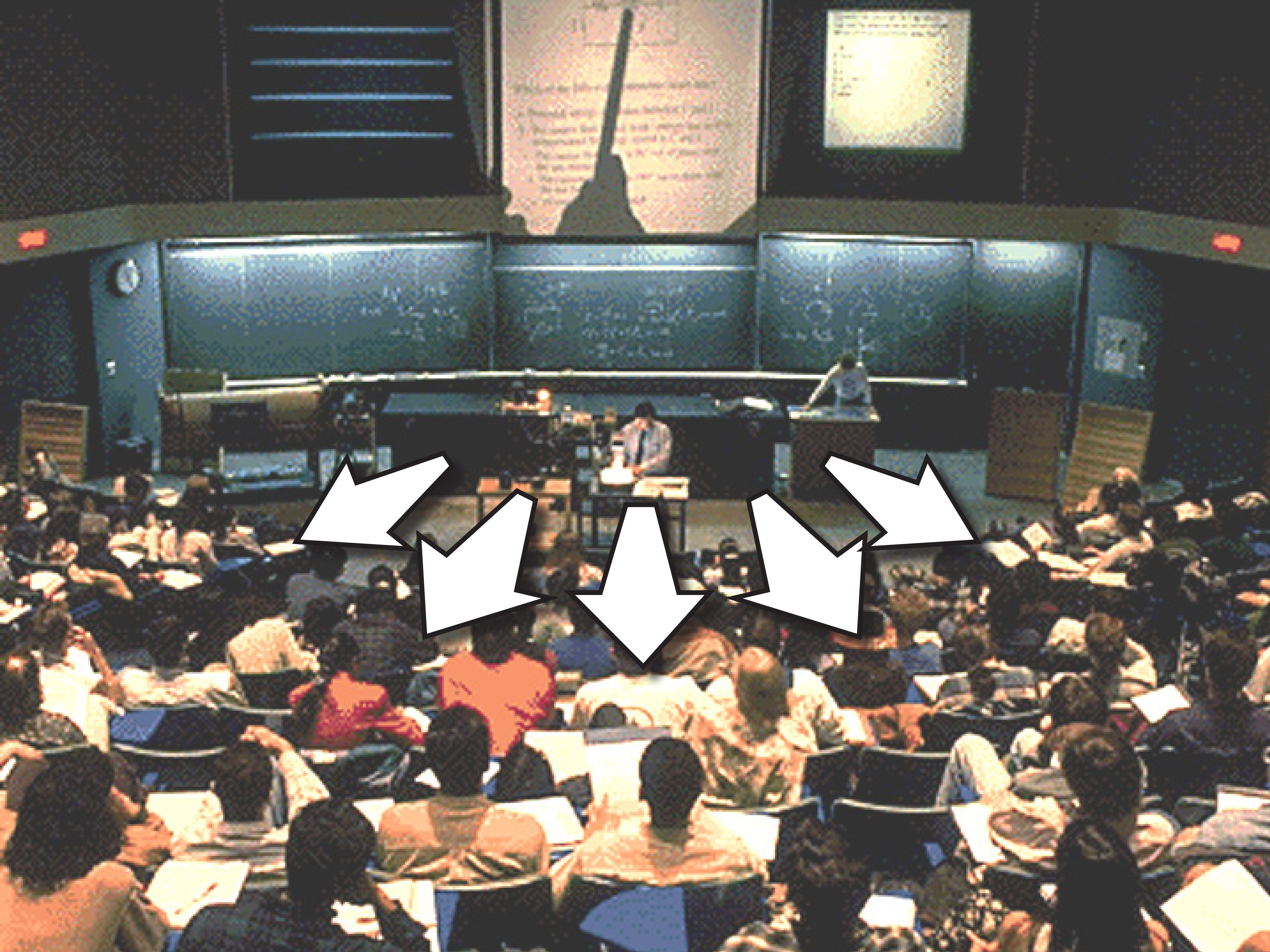

serendipity







WE TRUST
DOLLAR



Introducing Macintosh. For the rest of us.

In the olden days, before 1984, not very many people used computers.

For a very good reason.

Some particularly bright engineers.

Not very many people knew how.

And not very many people wanted to learn.

After all, in those days, it meant listening to your stomach growl through computer seminars. Falling asleep over computer manuals. And staying awake nights to memorize commands so complicated you'd have to be a computer to understand them.

Then, on a particularly bright day in Cupertino, California, some particularly bright engineers had a particularly bright idea: since computers are so smart, wouldn't it make more sense to teach computers about people, instead of teaching people about computers?

So it was that those very engineers worked long days and late nights and a few legal holidays, teaching tiny silicon chips all about people. How they make mistakes and change their minds. How they refer to file folders and save old phone numbers. How they labor for their livelihoods, and doodle in their spare time.

For the first time in recorded computer history, hardware engineers actually talked to software engineers in moderate tones of voice, and both were united by a common goal: to build the most powerful, most portable, most flexible, most versatile computer not-very-much-money could buy.

And when the engineers were finally finished, they introduced us to a personal computer so personable, it can practically shake hands.

And so easy to use, most people already know how.

They didn't call it the QZ190, or the Zipchip 5000.

They called it Macintosh.™

And now we'd like to introduce it to you.

PHYSICAL REVIEW A VOLUME 27, NUMBER 5 MAY 1983

Fluctuating hydrodynamics and capillary waves

Martin Grant* and Rashmi C. Desai
Department of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7
(Received 10 January 1983)

We derive an equation of motion for the instantaneous position of a planar liquid surface using fluctuating hydrodynamics. For the fluid constrained to be in a *nonequilibrium steady state* by a small temperature gradient, we then obtain the dynamic structure factor $S_{ss}(q,\omega)$, which represents the spectrum of thermal ripplons (capillary waves) on the liquid surface. Our analysis is done for both classical and quantum fluids. We find that there is an asymmetry in the heights of the two ripplon peaks in $S_{ss}(q,\omega)$ due to broken time-reversal symmetry. Our numerical estimates of the effect for liquid helium II, suggest that it could be measurable. We have undertaken a moment analysis of $S_{ss}(q,\omega)$; the first frequency moment is long ranged $(\sim 1/q^2)$ in the steady state, though it vanishes in equilibrium. From the zeroth frequency moment we recover the familiar result for the infrared logarithmic divergence of the mean-square displacement of the interface; the analysis explicitly involves the coupling of the surface to the bulk fluid. We modify the so-called capillary-wave model by including the surface-bulk coupling, and thereby make it consistent with the capillary-wave dispersion.

I. INTRODUCTION

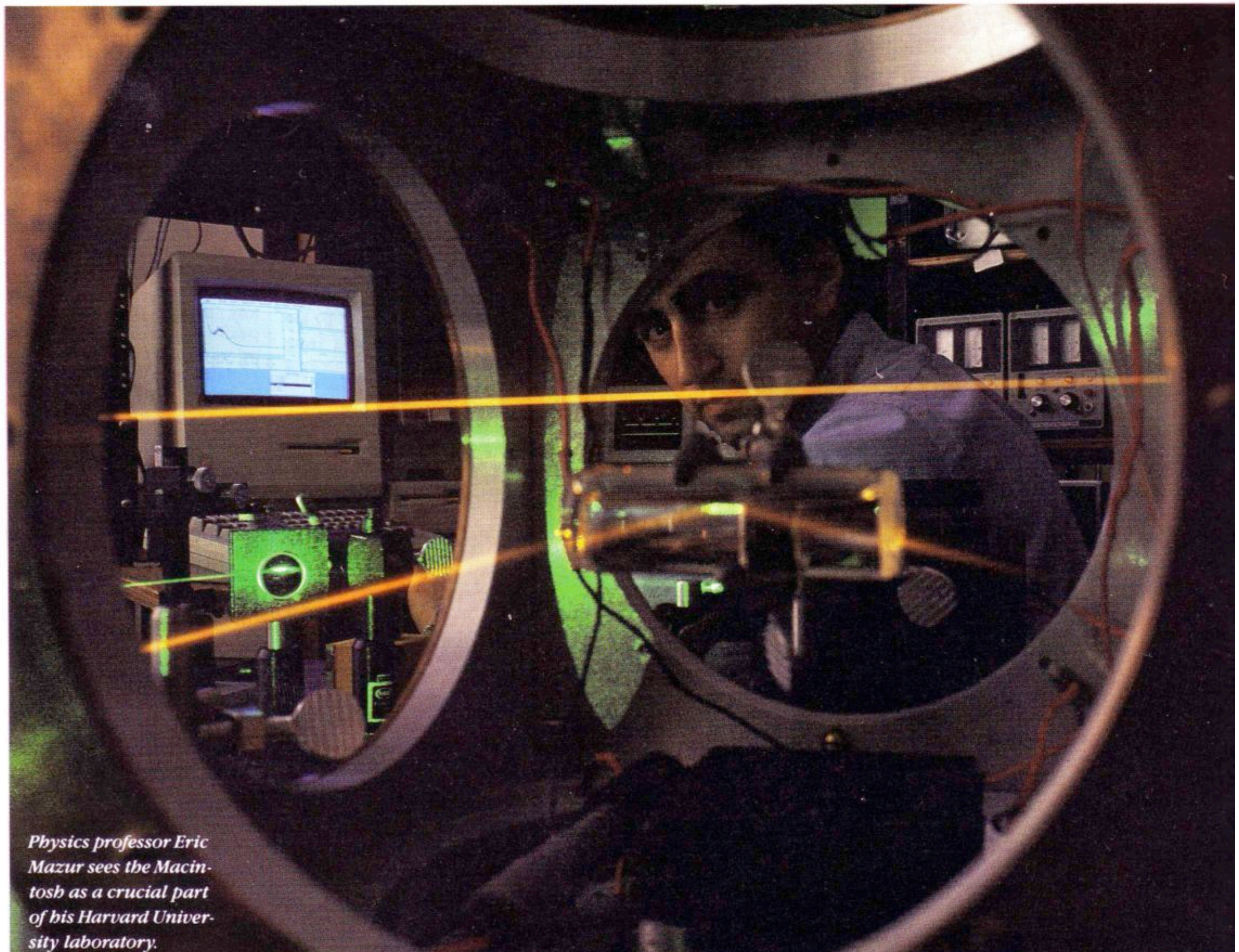
In this paper we present new results for the frequency spectrum of excitations on a liquid surface. We derive an equation of motion for the instantaneous position of the interface from linear fluctuating hydrodynamics. This equation is used to analyze fluctuations about equilibrium, and fluctuations about a nonequilibrium steady state characterized by a small temperature gradient. The analysis is made ... systems. ...

In the following we present related contributions to the problems outlined in the preceding two paragraphs. The equilibrium, and nonequilibrium steady state, spectrum of capillary waves is studied through fluctuating hydrodynamics.[9] The format of the paper is as follows.

In Sec. II we use the Landau-Lifshitz equations of linear fluctuating hydrodynamics to obtain an equation of motion for the instantaneous position of a planar liquid-vapor interface ζ, valid for both classical and quantum systems. We find that the thermal fluctuations which drive the surface ripples are due to the explicit coupling between the surface and ... equation of motion for ζ, Eq. (2.14) ... have been given in the

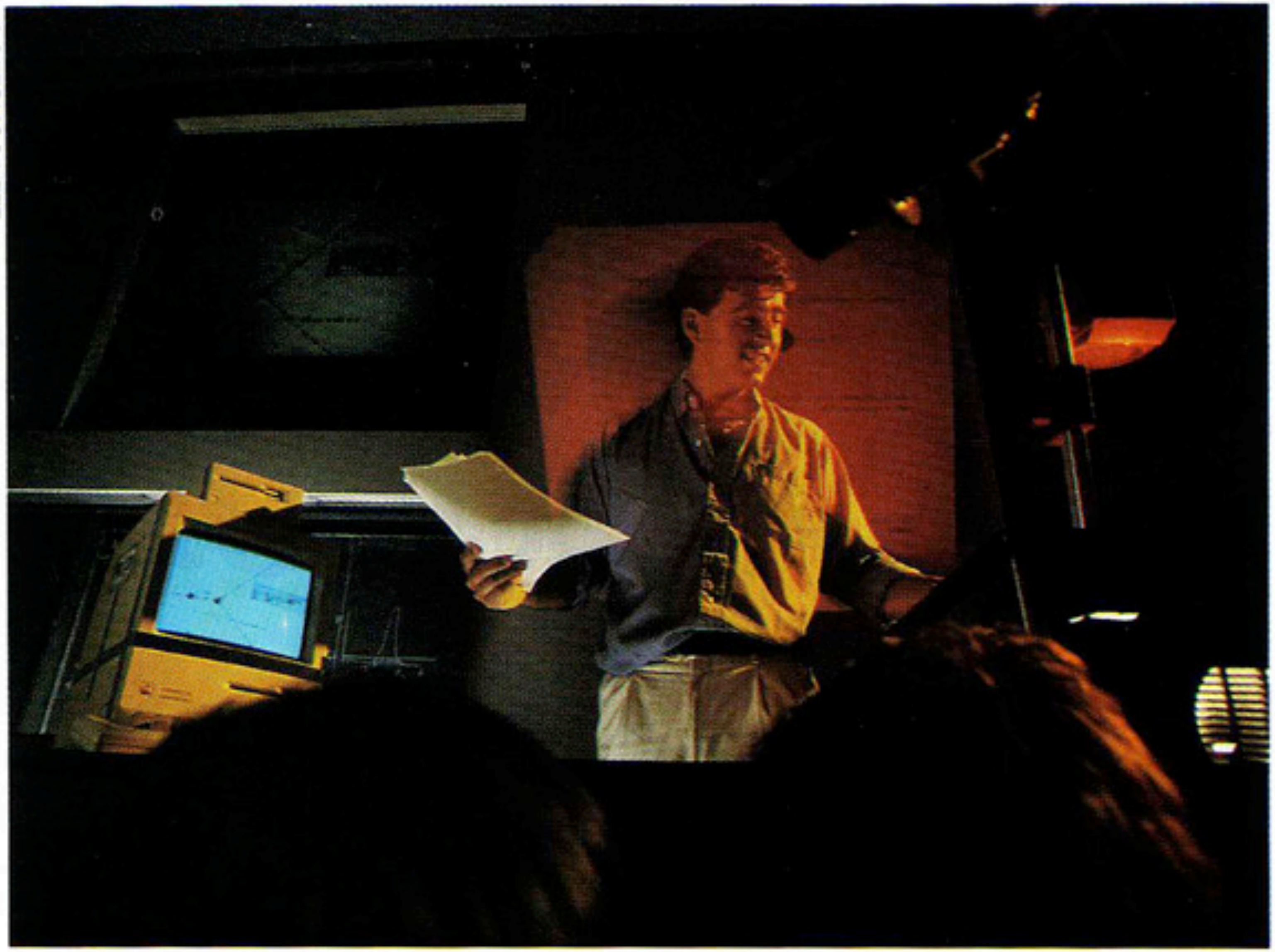
The Labtop Macintosh

Dan McNeill and Paul Freiberger



Physics professor Eric Mazur sees the Macintosh as a crucial part of his Harvard University laboratory.

LEE YOUNGBLOOD



Many instructors are using the Macintosh as a teaching assistant. Harvard physics professor Eric Mazur animates the collision of two protons with **VideoWorks.**

DOING PHYSICS WITH COMPUTERS

Eric Mazur
Harvard University

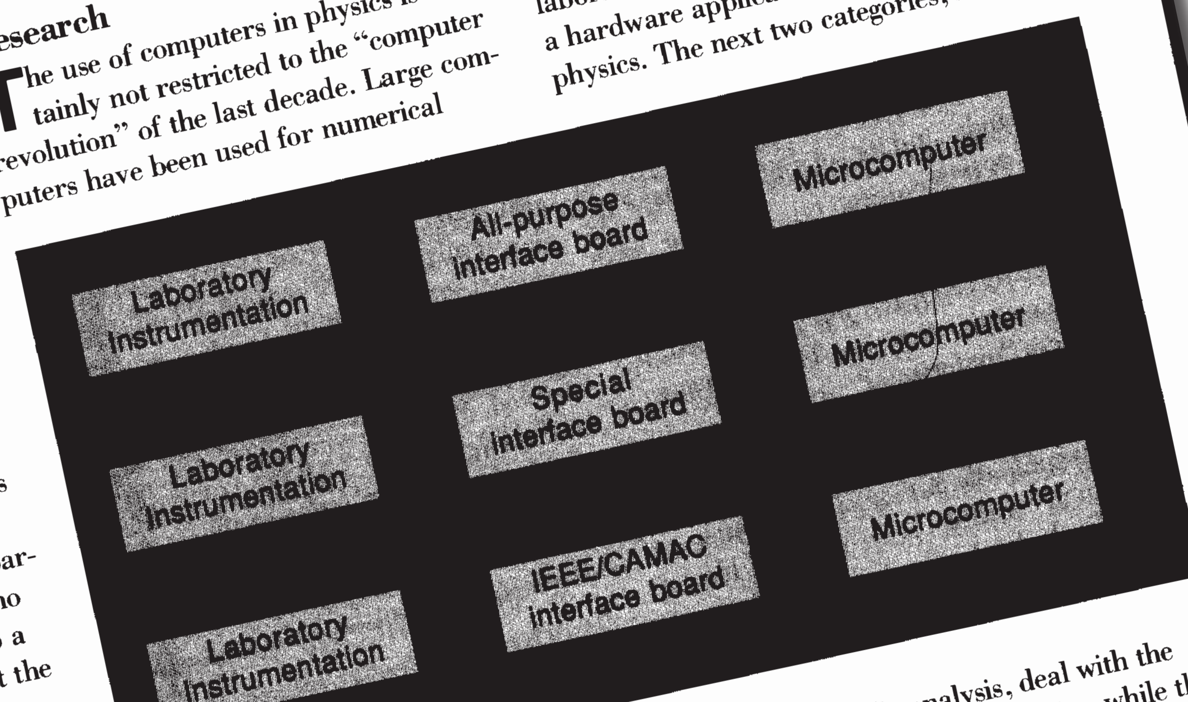
Introduction

Are the days of watching analog meters, taking notes in thick lab books, and plotting data points on graph paper gone forever? Is research in the physical sciences becoming so complex that one can no longer do research without computers? A superficial survey of the current research in physics might lead one to give an affirmative answer to these questions. It is therefore interesting to note that the award of this year's Nobel Prize in physics to Alex Müller and Georg Bednorz for their work on superconductivity was hailed as a victory for relatively simple, small-scale research. No computer was needed to show that their compound of copper, oxygen, lanthanum, and barium becomes superconducting. It shows that one can still make major breakthroughs with very simple means — without computers. Computers excel at performing tedious routine tasks. Physics research, on the other hand, seldom entails routine work. This holds true, in particular, in theoretical physics: indeed, no
... yet been able to develop a
... deny that the

mediate group, needless to say, is roughly equally distributed between those who do and those who do not use computers. This simple survey shows that, not surprisingly, the distribution of computers among physicists seems to be strongly related to age. Therefore, one might expect that in just a few more years computers will be used in one way or another by the entire physics community.

Research

The use of computers in physics is certainly not restricted to the "computer revolution" of the last decade. Large computers have been used for numerical



the research in about 95% of the experimental papers involves computers. For theoretical papers this percentage is 40%. The use of computers is more common in experimental than in theoretical groups, in part because more affordable, small personal computers are usually sufficient for the needs of an experimentalist.

A more detailed study shows that the use of computers in physics can be divided into several, fairly different categories. An overview of these categories is presented in Table 1. The first category, laboratory equipment control, is basically a hardware application of computers to physics. The next two categories, numeri-

...nalysis, deal with the
... while the

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