A. P. French at MIT: A Lifetime of Educational Innovations

Peter Dourmashkin
MIT

AAPT Winter Meeting Jan 8, 2018
San Diego, CA

Anthony Philip French
Physicist, Teacher, and MIT Citizen

November 19, 1920 – February 3, 2017

Outline

Learning From the Past

MIT Introductory Textbook Series

Tony's Educational Experiment

French-King-Morrison Connection

Educator, Athlete, Citizen

A Toast

Physics Education at MIT

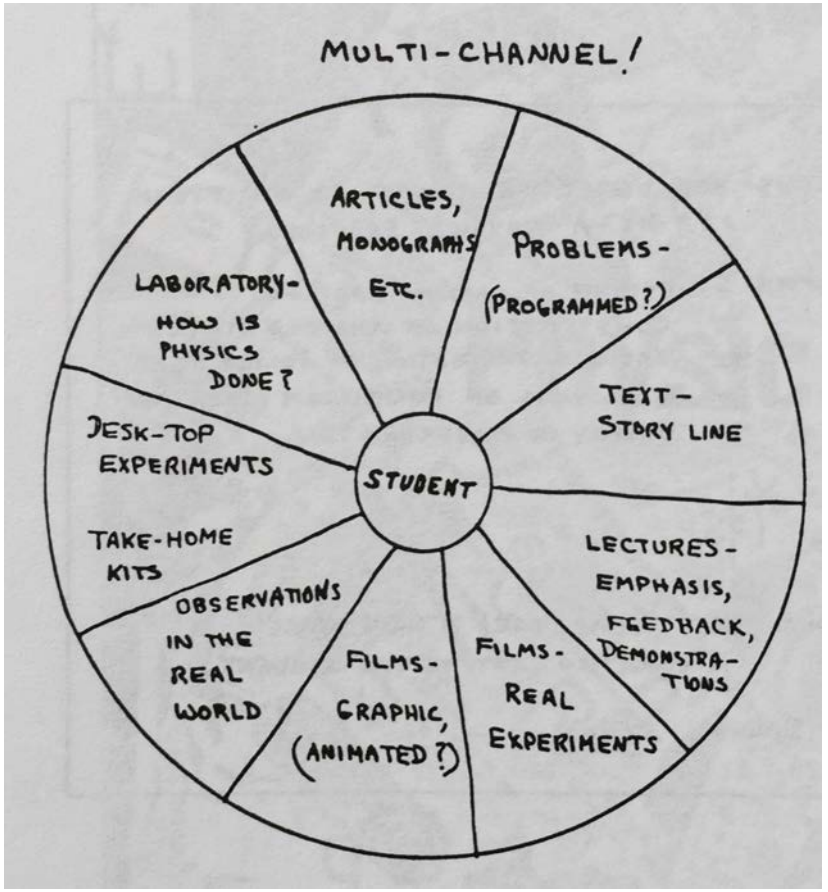
1930: John Slater Department Head; Nathaniel Frank, Francis Sears

Frank: *Introduction to Mechanics and Heat*, *Introduction to Electricity and Optics*

Post-WWII: Jerrold Zacharias and Francis Friedman Physical Science Study Committee (PSSC)

1960-1973 Francis Friedman: Science Teaching Center (became the Education Research Center)

Educational Systems



Influence of Gerald Zacharias: he was an educational systems engineer (he saw how to fit together all the pieces and make it happen, except for the role of computers).

The M.I.T. Introductory Physics Series

French, A.P. (1971). Newtonian Mechanics. MIT Introductory Physics Series. W.W. Norton & Company.

French, A.P. (1968). Special Relativity. MIT Introductory Physics Series. W.W. Norton & Company.

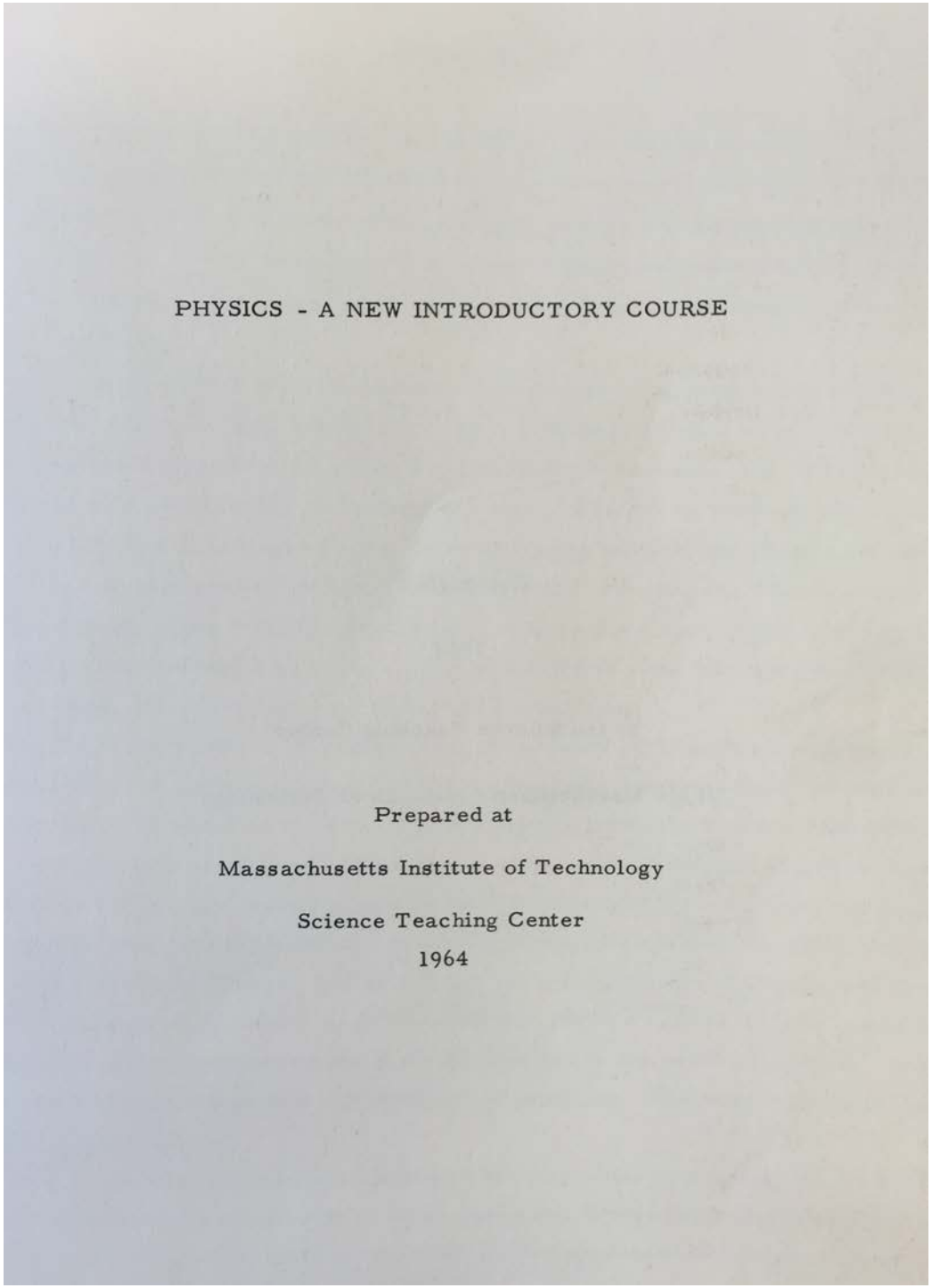
French, A.P. (1971). Vibrations and Waves. MIT Introductory Physics Series. W.W. Norton & Company.

French, A.P.; Taylor, Edwin F. (1978). Introduction to Quantum Physics. MIT Introductory Physics Series. W.W. Norton & Company.

Physics – A New Introductory Course

An electron is no more (and no less) hypothetical than a star… I am not sure whether I ought to say I have seen an electron; but I have just the same doubt if I have seen a star. If I have seen one I have seen the other.

Sir Arthur Eddington, “New Pathways in Science”, (1936)


PHYSICS - A NEW INTRODUCTORY COURSE

Prepared at

Massachusetts Institute of Technology

Science Teaching Center

1964

Page 1 of Table of Contents

Particles are introduced first.

TABLE OF CONTENTS

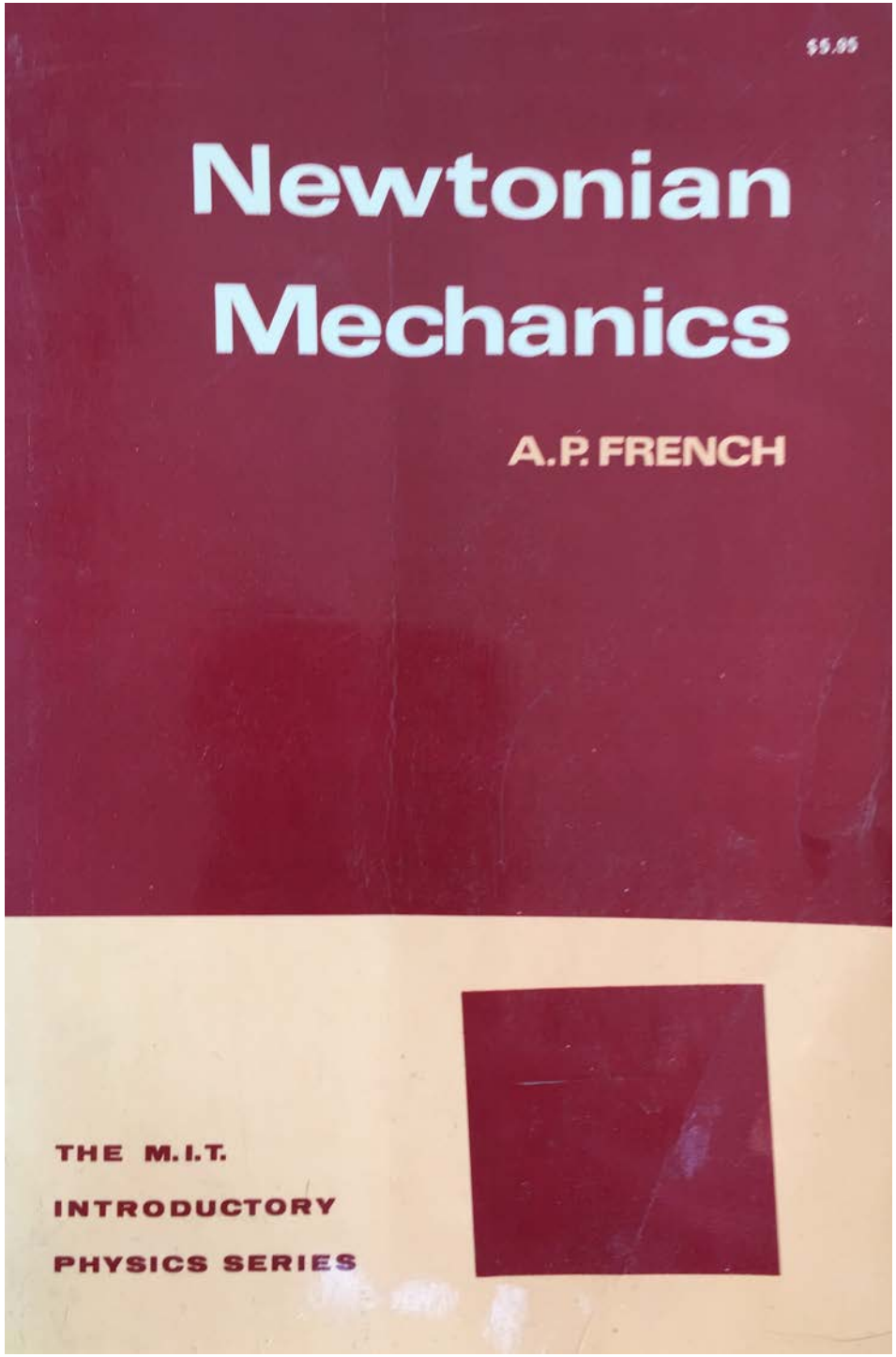
Part II of Physics – A New Introductory Course

In the Beginning was Mechanics.

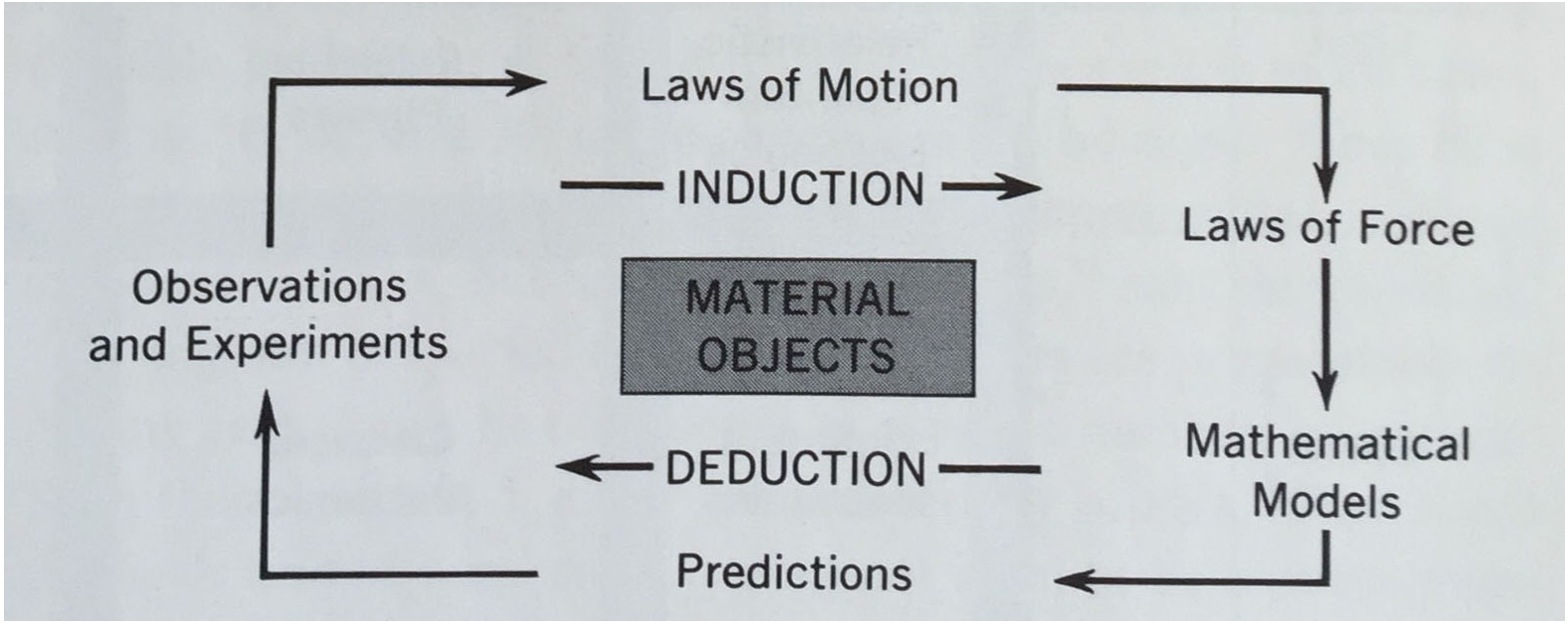
MAX VON LAUE, *History of Physics* (1950)

I offer this work as the mathematical principles of philosophy, for the whole burden of philosophy seems to consist in this—from the phenomena of motions to investigate the forces of nature, and then from these forces to demonstrate the other phenomena.

NEWTON, Preface to the *Principia* (1686)



Newtonian Flow Chart

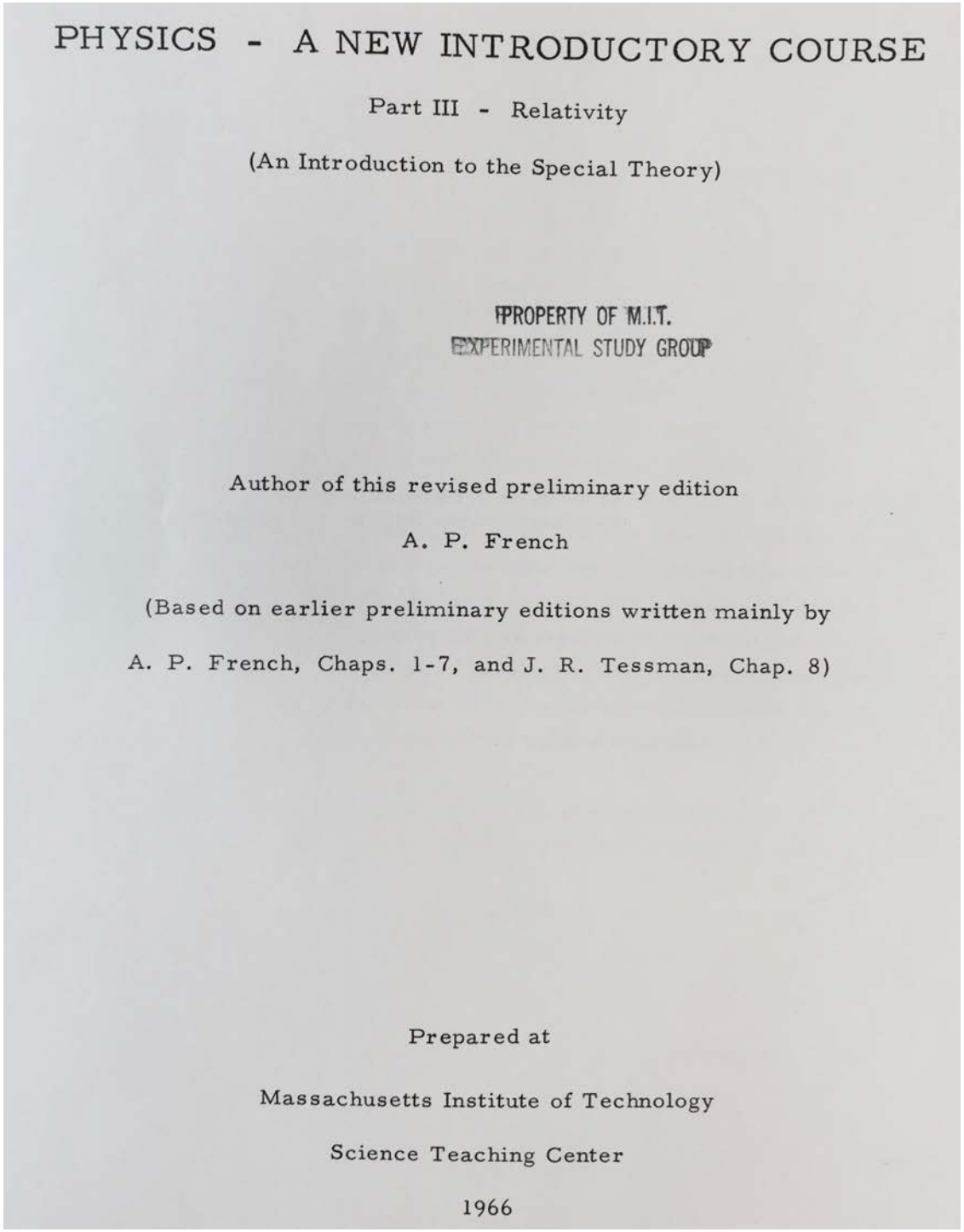


This diagram appears in Physics –A New Introductory Talk with the following extra splash--

“and sprinkle this whole pattern generously with Imagination, Insight and Intuition

Part III of Physics – A New Introductory Course

First Half of Second Semester of Introductory Course in Physics



PHYSICS - A NEW INTRODUCTORY COURSE

Part III - Relativity

(An Introduction to the Special Theory)

Author of this revised preliminary edition

A. P. French

(Based on earlier preliminary editions written mainly by

A. P. French, Chaps. 1-7, and J. R. Tessman, Chap. 8)

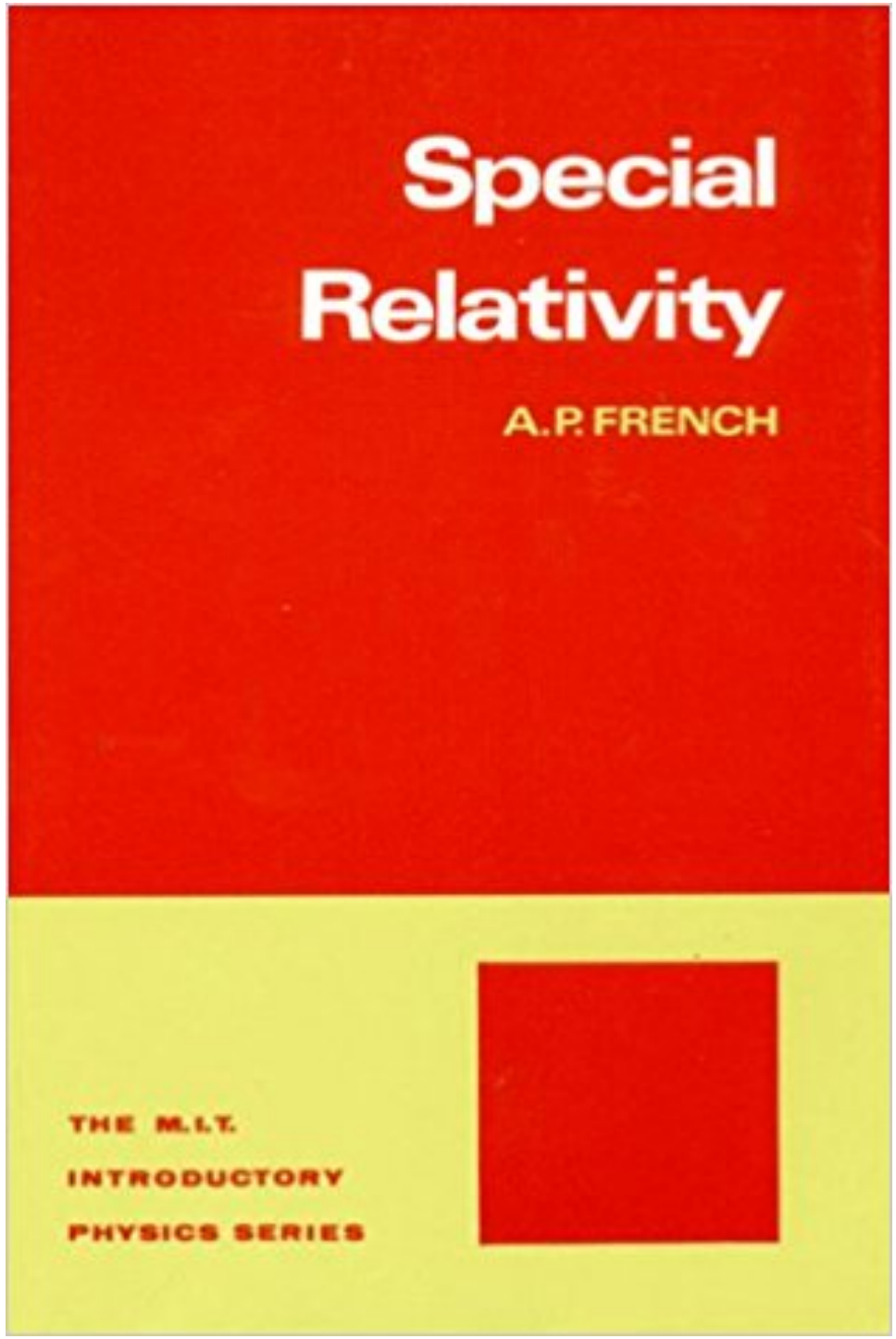
Prepared at

Massachusetts Institute of Technology

Science Teaching Center

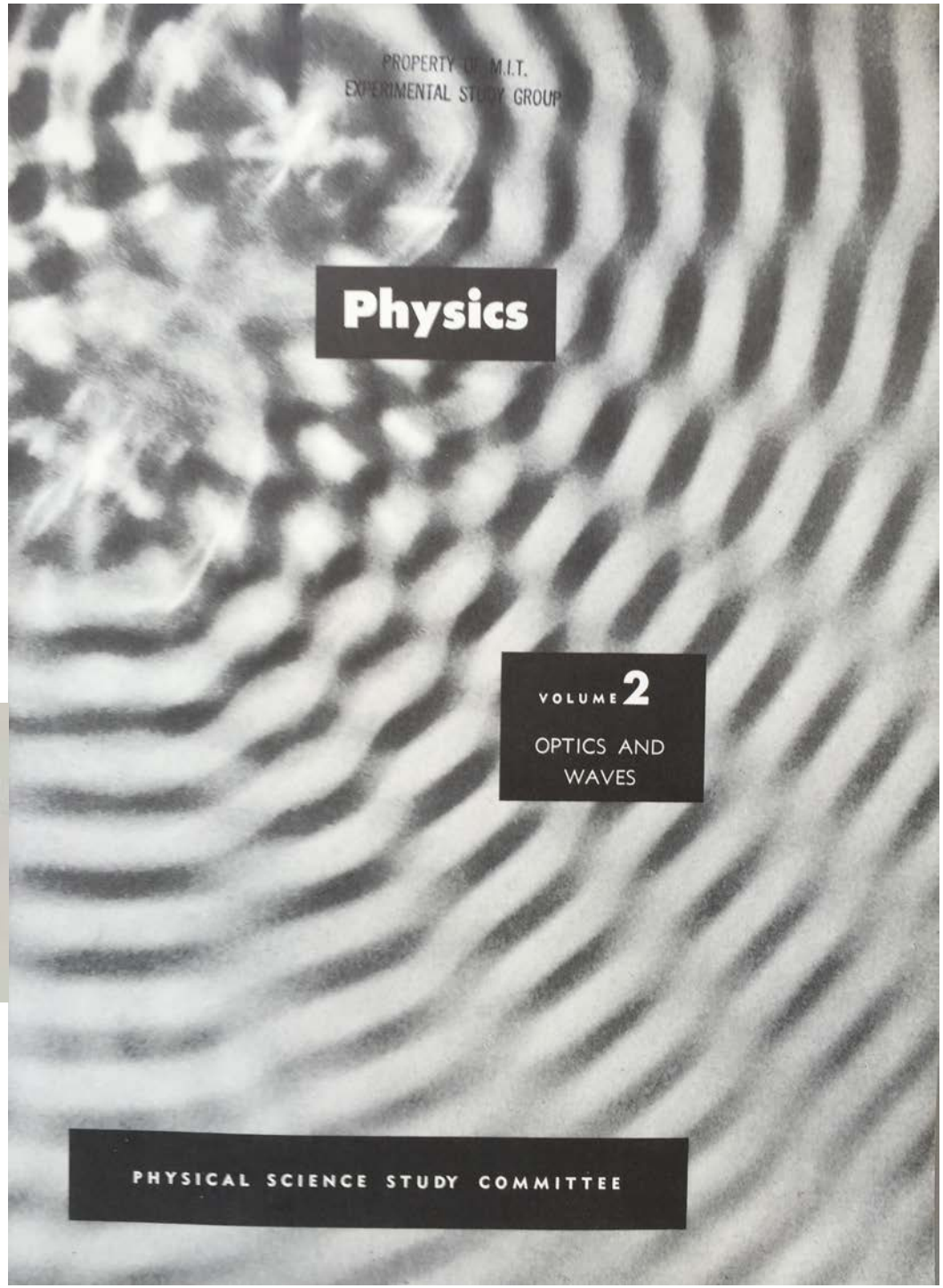
1966

In 1963-1964, Tony first co-taught course with Jack Tessman who was at the Science Teaching Center.



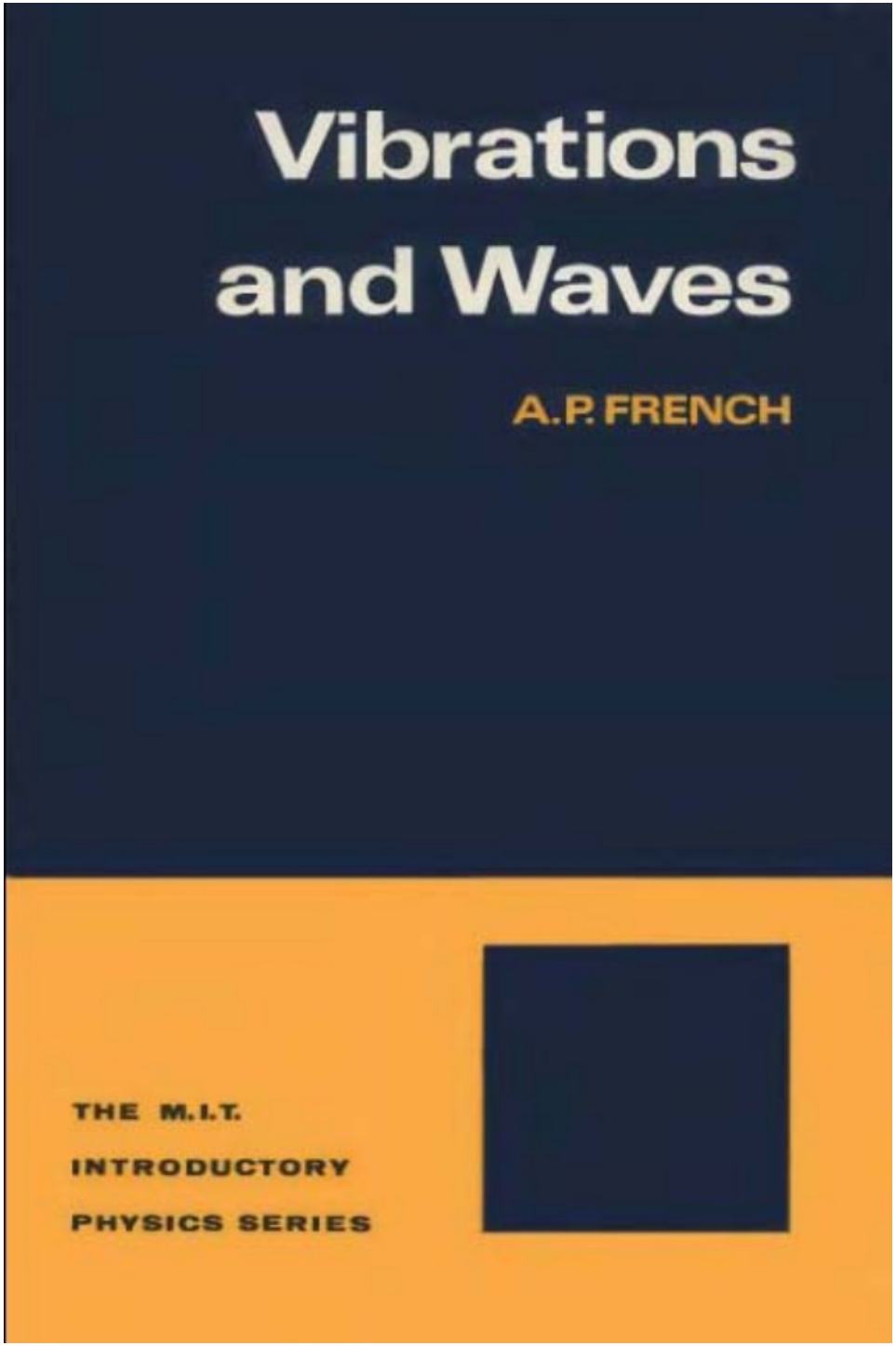
Third Semester of Introductory Physics Course

Originally Developed for PSSC

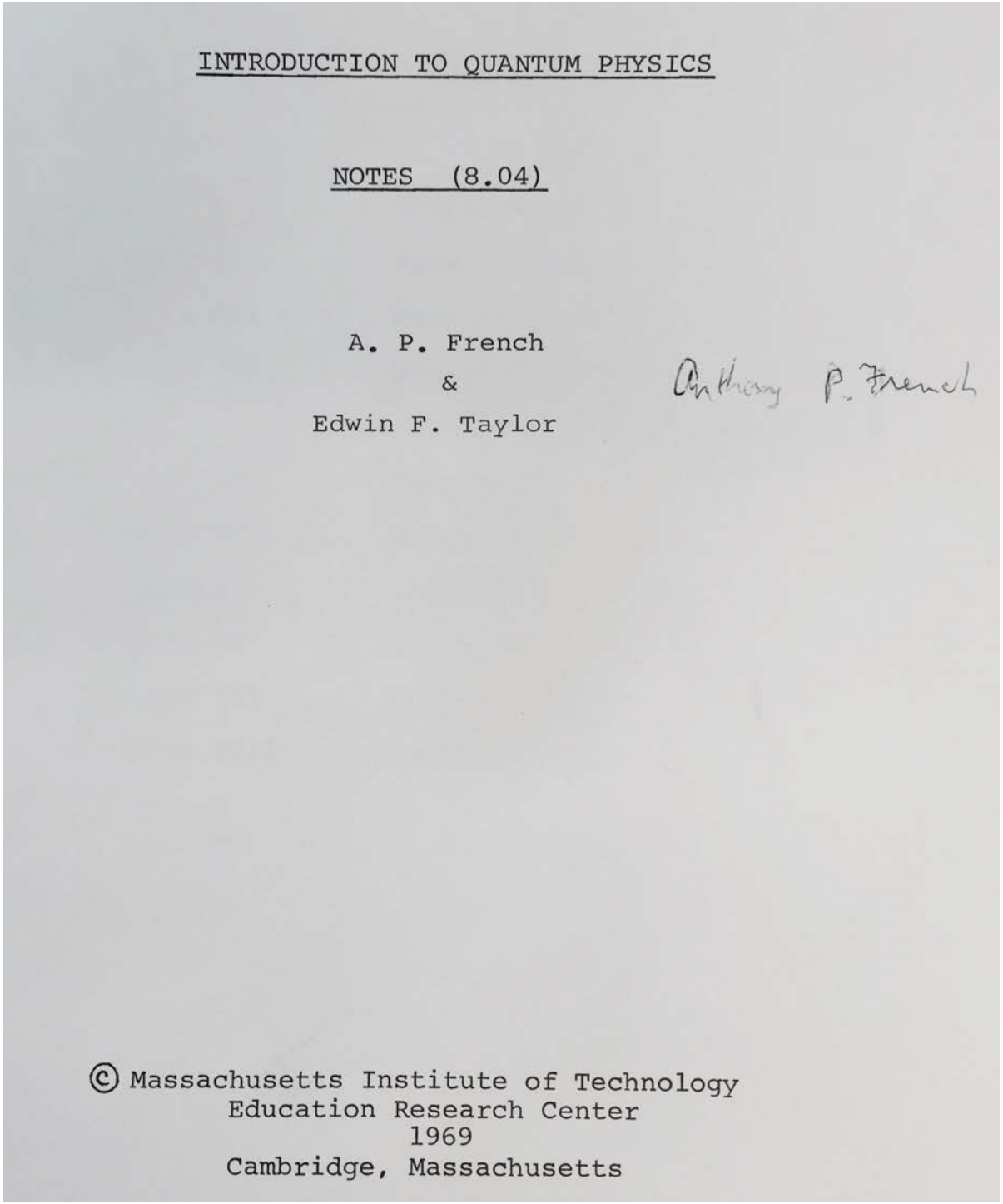


Second of Four Volumes Prepared by the
PHYSICAL SCIENCE STUDY COMMITTEE
Under an Original Grant from the
NATIONAL SCIENCE FOUNDATION
Cambridge, Mass. 1958

Third Semester of Introductory Physics Course



Fourth Semester of Introductory Physics Course



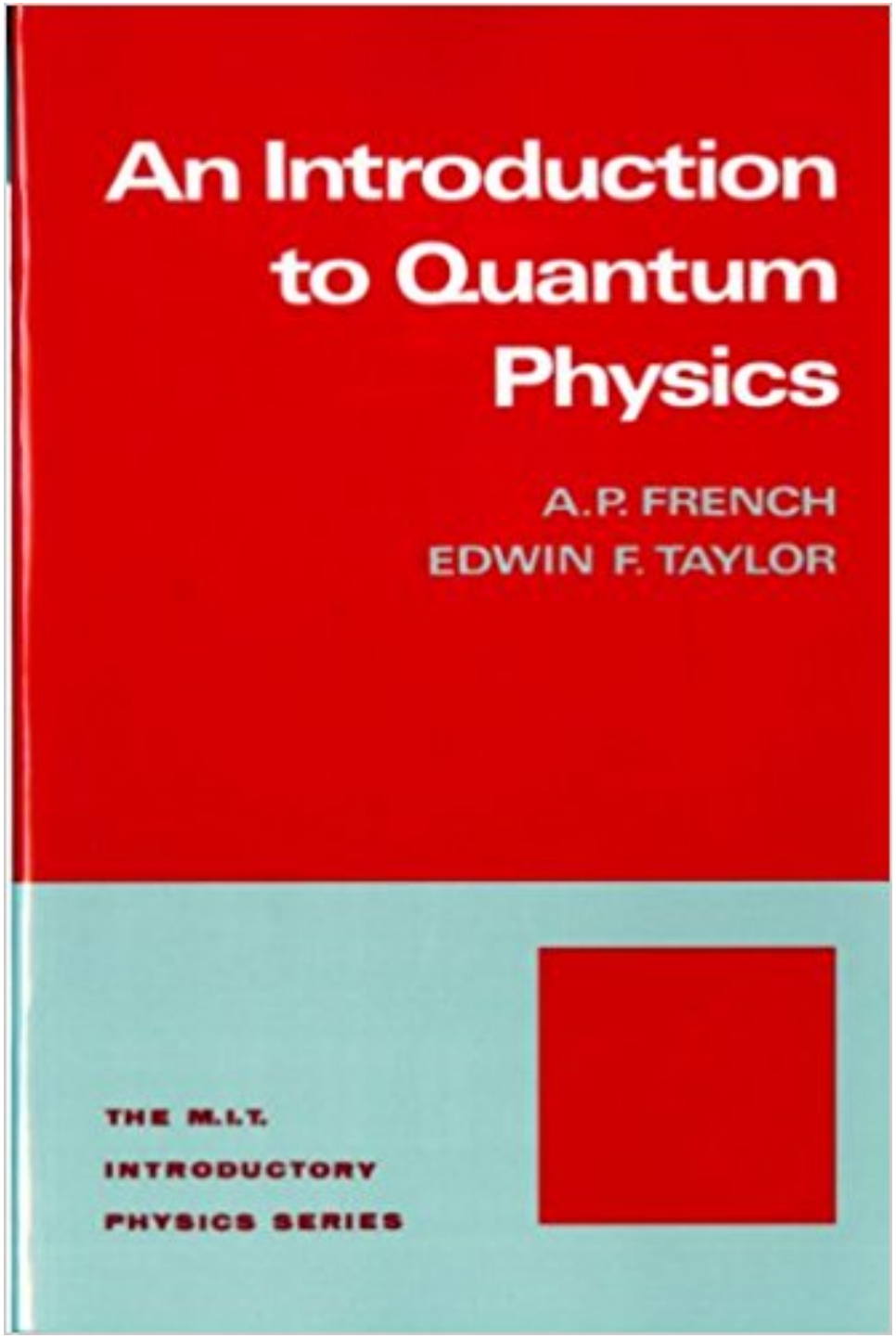
INTRODUCTION TO QUANTUM PHYSICS

NOTES (8.04)

A. P. French
&
Edwin F. Taylor

Anthony P. French

Previous Draft
“Introduction to Quantum Physics”
Arthur K. Kerman, Leo Sartori, and Edwin F. Taylor



ESG Suggestions

6/17/69
APF

I like Mark Levensky's general plan.

Some further suggestions for discussions/seminars:

- World Energy Sources
- Time
- Science & Music
- Clouds
- Morality for Scientists.
- Communication
- Relativity
- Weather
- Technology & Art.

Physics Education at MIT

1970's: Tony was Physics Academic Officer. Philip Morrison Physics for Poets; Kleppner and Kolenkow: *An Introduction to Mechanics*, Benedek and Villars: *Physics with Illustrative Examples from Medicine and Biology*

1971-1989: Non-major introductory physics courses reverted to traditional topics from mechanics and electricity and magnetism

1989-2001: John King, Philip Morrison, and A.P. French introduced 8.01x and 8.02x, experimental physics (before the x meant online). Students built desk-top experiments from Red Box Kits. A.P. French: *8.01x Course Notes* (Unpublished)

2001-Present: John Belcher Technology Enabled Active Learning (TEAL)

Rai Weiss Perspective

Rai Weiss Perspective

Tony wanted the curriculum to include a historical development in the sense of how concepts related to each other via theoretical networks of ideas and to make this as transparent and as intuitive as possible.

Tony's experiment: he wanted to show the logical procession of ideas and the impact in a scientific and cultural setting. I learned a lot from this approach.

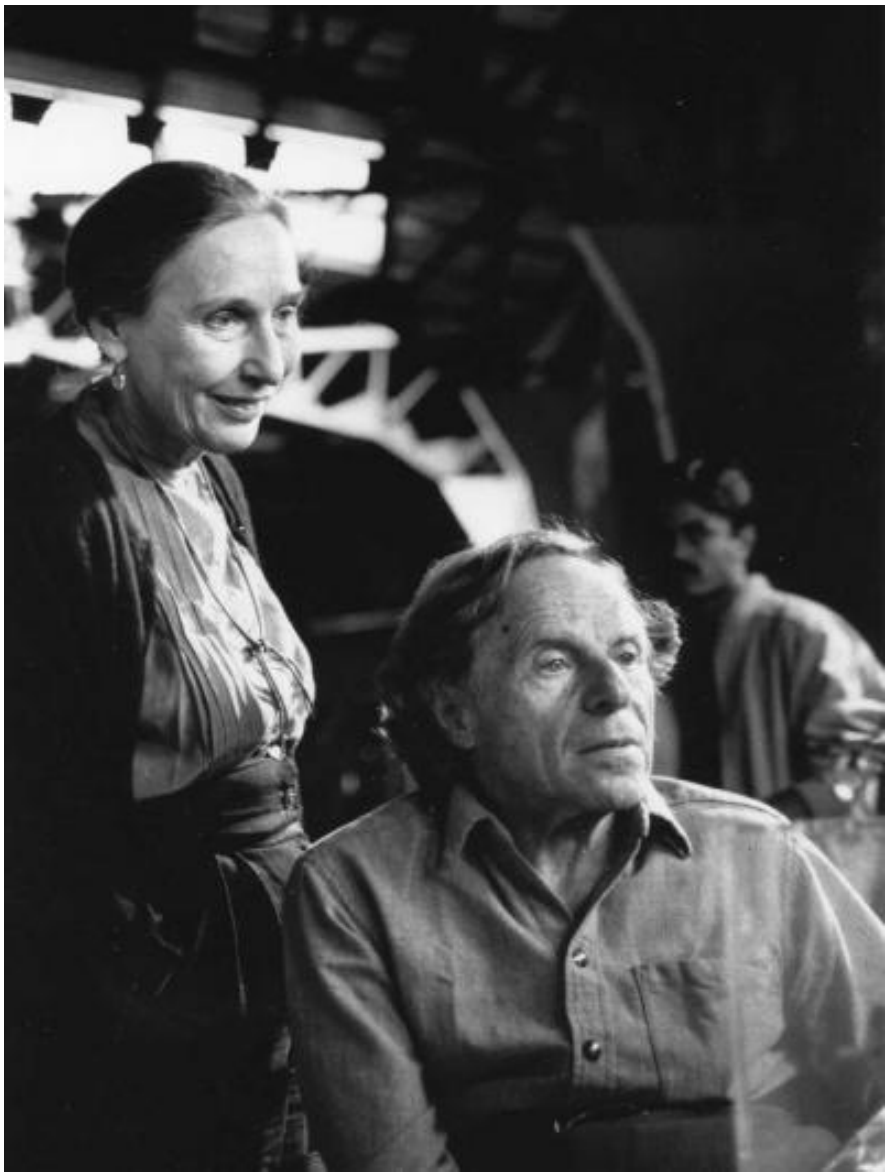
Tony's approach was very different: you just don't buy an equation, you try to understand it.

Herman Feshback truly understood the importance of what Tony was trying to accomplish,

Rai Weiss, Private Communication

Morrisons: “Less is More”

“I see no way of combatting our acceptance of inadequate performance unless we take seriously the “Less is More” that has been advocated by Phil Morrison and others for many years.”



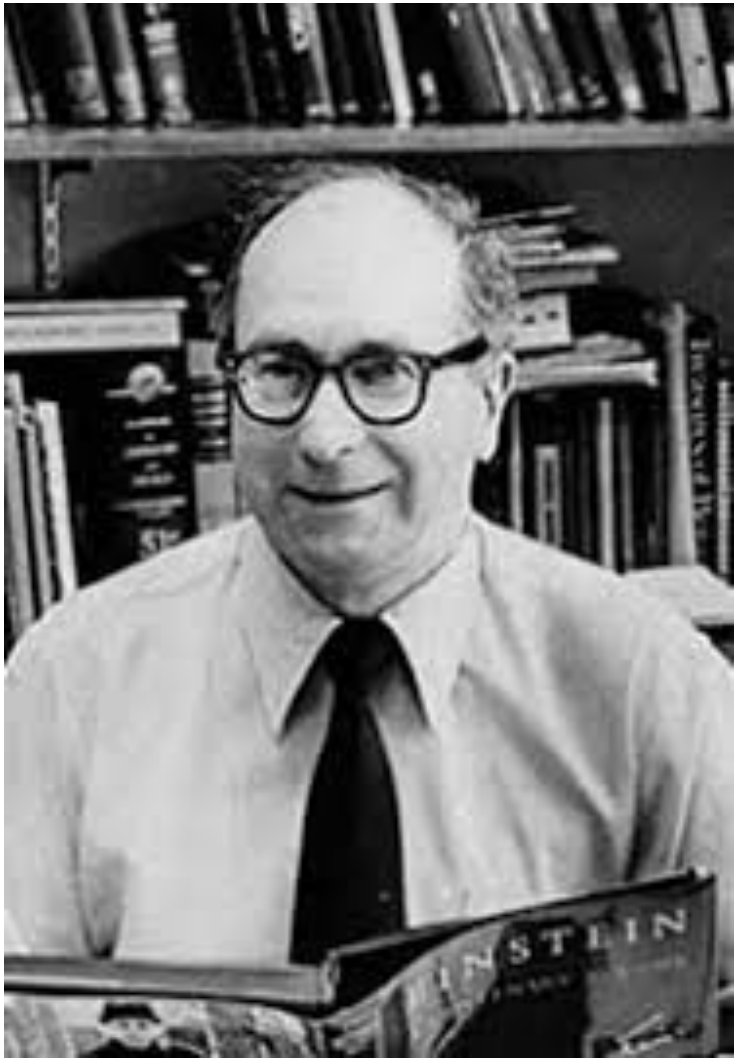
‘‘Learning from the past; Looking to the Future,’’ 17 January 1989, Am. J. Phys, **57** (7), July 1989.

Physics is Not Mathematics

" One of the worst things we can do as physics teachers, at least in the introductory courses, is to present physics as if it were a purely deductive, mathematical discipline, proceeding in an orderly sequential manner form *A* to *Z* with little room for variation of that sequence. Such an approach gives no feeling for the building of our understanding of nature through accidental discoveries, false starts, and inspired guesses."

''Some thoughts on introductory physics courses", Am. J. Phys., Vol 56, No.2, February 1988, p. 111.

The French-King Connection



Motivation for 8.01x and 8.02x

The laboratory– or any other place where measurements can be made--- is in any case the environment where the *process* of doing physics is made more real to the student. I think that in general we attach far too much importance to the development of syllabuses that appeal to us as being orderly and rationally connected. …Thus, for example in a course that I hope we shall be trying out at MIT in a year or so, the systematic development of Newtonian mechanics will not begin until late in the first semester; it will be proceeded by discussions of energy (not just mechanical) and its conservation, of current electricity, of atomicity and randomness, of wave kinematics, and of quantization as a basic phenomenon.

‘‘Learning from the past; Looking to the Future,’’ Anthony P. French’s acceptance speech for the 1989 Oersted Medal presented by the American Association of Physics Teachers, 17 January 1989, Am. J. Phys, **57** (7), July 1989.

A.P. French

Physicist

Educator

Athlete

MIT Citizen

Educator

Young people would send letters asking questions about physics to the physics department. Tony would compose thoughtful responses.

Tony would always try to provide physical explanations and suggest reading material to expand their understanding.

“Tony was truly a Teacher”, Charlie Holbrow.

Math Self-Help Modules

Tony was particularly worried about the mathematical preparation of students

In 1975 he developed self-help modules (never published) on geometry, algebra, and trigonometry.

In the 1990's Tony and Arthur Mattuck wrote a Math Diagnostic Exam that is administered every year at MIT to help guide students about which physics course to take

Community Citizen

“Tony was president of the Quarter Century Club, chaired the community service fund. He worked with staff all over the Institute. He did this very well, and he was very well liked. He was not intimidating, not arrogant, and extremely kind.”

“He was also very generous. He would give physics books to read about physics (Fred Hoyle book was one of his favorite). Tony wanted people to understand what he was doing. This had a big impact on those that knew him.”

Peggy Enders, Private Communication

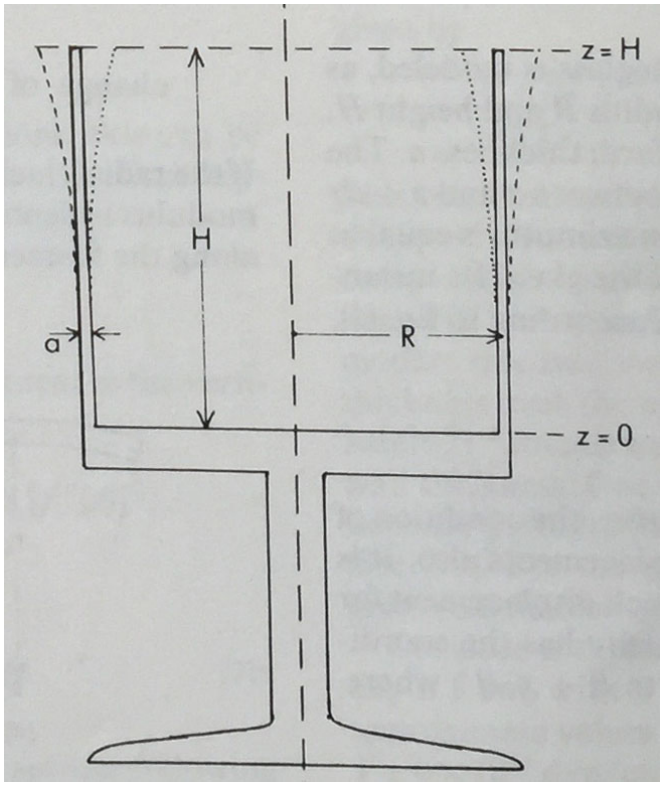
Joie de Physique

We have such a beautiful and indeed romantic subject, …--what my colleague John King calls the “joie de physique”. After all, what is a teacher but someone whose chief pleasure is to share with others what he or she has arduously learned or understood? …. Because the most wonderful thing about physics is that it offers no finality of knowledge or understanding. We shall learn from the future as well as the past. And, as a teacher, I can hardly wait to see what lies ahead!

‘‘Learning from the past; Looking to the Future,’’ Anthony P. French’s acceptance speech for the 1989 Oersted Medal presented by the American Association of Physics Teachers, 17 January 1989

A Toast to Tony

"Tony would lick his finger and rub a wine glass, and you could see how delighted he was. He always took great delight in some of the simplest things."



In Vino Veritas: **A study of wineglass acoustics**

A. P. French
Physics Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

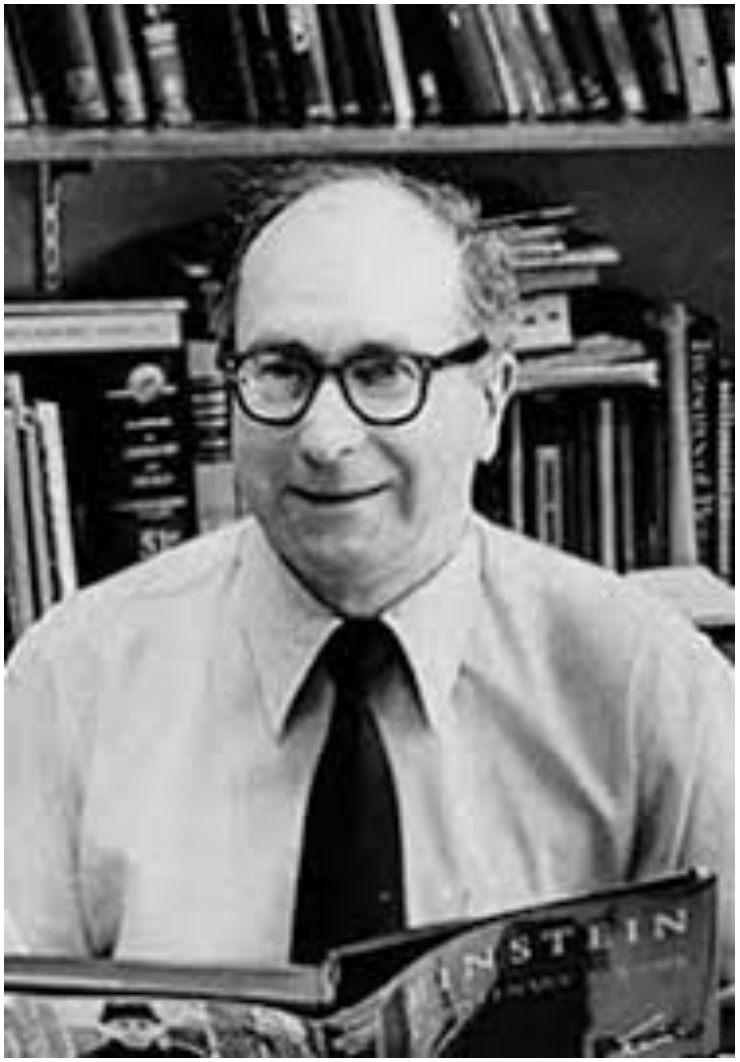
(Received 16 August 1982; accepted for publication 28 September 1982)

This paper describes an investigation of the natural resonant frequencies of vessels such as wineglasses. Measurements on a number of glasses are interpreted with the help of theoretical predictions based on the analysis of vibrating systems by means of the energy method. Results and analysis are given for empty glasses and for glasses containing different amounts of liquid. Evidence for vibrational modes above the lowest is presented.

Tony's acknowledgment in the paper

I wish to thank my son, Martin C. French, for helping to stimulate this investigation and for his partnership in all the observations.

A.P. French



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