

**PRACTICAL PHYSICS FOR  
SCHOOLS AND THE JUNIOR  
STUDENTS OF COLLEGES; VOL.  
I, ELECTRICITY AND MAGNETISM**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649276875

Practical Physics for schools and the Junior Students of Colleges; Vol. I, electricity and magnetism by Balfour Stewart & W. W. Haldane Gee

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.  
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

[www.triestepublishing.com](http://www.triestepublishing.com)

**BALFOUR STEWART & W. W. HALDANE GEE**

**PRACTICAL PHYSICS FOR  
SCHOOLS AND THE JUNIOR  
STUDENTS OF COLLEGES; VOL.  
I, ELECTRICITY AND MAGNETISM**



PRACTICAL PHYSICS



Physics  
5.

Downloaded by

# PRACTICAL PHYSICS

FOR  
SCHOOLS AND THE JUNIOR STUDENTS  
OF COLLEGES

BY  
BALFOUR STEWART, M.A., LL.D., F.R.S.

LATE PROFESSOR OF PHYSICS, VICTORIA UNIVERSITY,  
THE OWENS COLLEGE, MANCHESTER

AND  
W. W. HALDANE GEE, B.Sc. (LOND.)  
DEMONSTRATOR AND ASSISTANT LECTURER IN PHYSICS  
AT THE OWENS COLLEGE

VOL. I.  
ELECTRICITY AND MAGNETISM

London  
MACMILLAN AND CO.  
AND NEW YORK  
1888

4746  
21/2/88

## PREFACE

It has frequently been a matter of remark that while many schools are provided with fully equipped chemical laboratories, yet very few have any appliances for teaching Practical Physics. The reason is certainly not to be found in any fundamental unsuitability of Practical Physics as a training for the mind, inasmuch as the subject is universally acknowledged to be of very great importance in this respect. There are several causes which have militated against the introduction of Practical Physics, the chief, perhaps, being the want of properly trained teachers, the absence of organised methods, and the difficulty of obtaining suitable apparatus. We venture to think that, as the importance of the subject comes to be realised, there will be no lack of good teachers, each of whom will be capable of controlling a system of instruction suitable to the boys under his charge. Again, we think that instrument makers are becoming more alive to the requirements of elementary students, their strength hitherto having been mainly directed towards the manufacture of instruments suitable for commercial purposes and scientific research.

It was represented to us by several teachers that abstracts of our *Elementary Lessons in Practical Physics* might be made the basis of good school courses. We have accordingly tried the experiment with Electricity and Magnetism, so that the present volume largely consists of simple experi-



ments and measurements in Electrostatics, Magnetism, and Current Electricity, the principles of which are at the same time explained to the student. We have, however, prepared something more than an abstract. Chapter I. has been supplemented by several new lessons. Chapter II. has been largely rewritten, new instruments have been devised, and a number of new engravings have been prepared. In the Appendix will be found plans of certain typical school laboratories, a list of apparatus, tools and materials, and other information that should be of value to the teacher.

Furthermore, to make the volume complete in itself, we have given, at the commencement, a series of Introductory Measurements, with which it is essential the student of Electricity and Magnetism should be familiar.

The greater part of our course should be easily within the range of schoolboys, whilst sixth-form boys should find the more difficult portions a good introduction to advanced work.

Our thanks are due to Professor T. H. Core for looking over the proofs, and to Messrs. Henry Holden, B.Sc.; C. H. Lees, B.Sc.; and R. W. Stewart, for help in preparing the new lessons.

THE OWENS COLLEGE, MANCHESTER,  
*December 1887.*

# CONTENTS

## INTRODUCTORY MEASUREMENTS.

Lesson	Article	Page	Teacher's directions <sup>1</sup>
	Definition of Standard Yard and Mètre . . . . .	(1)	1
	Relation of Metrical to English System of Measures of Length . . . . .		2
	Area and Volume . . . . .	(2)	2
	Exercises . . . . .		2
A.	USE OF SCALES . . . . .	(3)	3
	The Vernier introduced . . . . .	(4)	4
B.	THE STRAIGHT VERNIER . . . . .	(5)	4
C.	USE OF CALLIPERS—THE SLIDE CALLIPER . . . . .	(6)	5
D.	THE MICROMETER WIRE-GAUGE . . . . .	(7)	6
	The Sheet-Metal Gauge . . . . .	(7a)	7
E.	THE STANDARD WIRE-GAUGE . . . . .	(8)	8
	The Standards of Mass defined . . . . .	(9)	9
F.	THE BALANCE . . . . .	(10)	10
	Weights . . . . .	(11)	13
G.	METHOD OF USING THE BALANCE . . . . .	(12)	13
	Estimation of Density . . . . .	(13)	15
	Estimation of Time . . . . .	(14)	15
	Units of Angular Measurement . . . . .	(15)	15
	The Dividing of Circles . . . . .	(16)	15
H.	COPYING OF CIRCULAR DIVISIONS . . . . .	(17)	16
	The Mirror and Scale . . . . .	(18)	16

<sup>1</sup> Space is left in this column for the directions of the teacher as to the order in which the lessons are to be taken, and what articles are to be read.

## CHAPTER I.

## ELECTROSTATICS.

Lesson	Article	Page	Teacher's directions
I. ELECTRIFICATION BY FRICTION AND CONDUCTION	1	17	
Gold-Leaf Electroscope . . . . .	1	18	
Manipulation of Gold Leaf . . . . .	1	18	
Electrical Amalgam . . . . .	1	19	
Ebonite and Vulcanite . . . . .	1	19	
Paraffin Wax . . . . .	1	19	
Drying Oven . . . . .	1	19	
II. ELECTRIFICATION BY INDUCTION . . . . .	2	23	
III. THE ELECTROPHORUS OF VOLTA . . . . .	3	27	
IV. FARADAY'S ICE PAIL EXPERIMENTS . . . . .	4	29	
V. ELECTRIFICATION BY FRICTION ( <i>continued</i> ) . . . . .	5	32	
VI. EFFECT OF A CONDUCTING ENCLOSURE . . . . .	6	34	
Summary of Laws . . . . .	7	36	
Fundamental Quantitative Law . . . . .	8	37	
Definition of Electrostatic Unit of Quantity	9	37	
Potential—Difference of Level . . . . .	10	38	
The Foot-Pound, Dyne, and Erg . . . . .	11	39	
Comparison of Electricity and Gravity . . . . .	12	39	
Equipotential Surfaces . . . . .	13	41	
Zero of Potential . . . . .	14	41	
Positive Current only considered . . . . .	15	42	
The Units of Density and Capacity . . . . .	16	43	
Application of Definitions . . . . .	17	43	
Condensers . . . . .	18	44	
Definition of Specific Inductive Capacity	18a	45	
Discharge of a Condenser . . . . .	19	45	
Exercises . . . . .	20	45	
VII. EXPERIMENTS ON POTENTIAL WITH ELECTRO- SCOPE . . . . .	21	46	
VIIA. THE CONDENSER . . . . .	21a	49	
VIIb. COMPARISON OF CONDENSERS—SPECIFIC IN- DUCTIVE CAPACITY . . . . .	21b	52	
VIIc. COMPARISON OF CONDUCTING POWERS OF OILS	21c	55	