

**ABSOLUTE
MEASUREMENTS IN
ELECTRICITY
AND MAGNETISM**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649034468

Absolute Measurements in Electricity and Magnetism by Andrew Gray

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

ANDREW GRAY

**ABSOLUTE
MEASUREMENTS IN
ELECTRICITY
AND MAGNETISM**

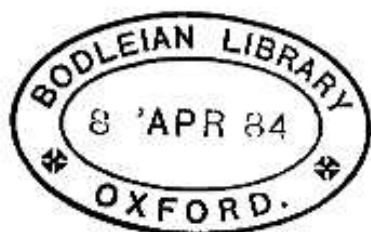
ABSOLUTE MEASUREMENTS
IN
ELECTRICITY AND MAGNETISM.

BY
ANDREW GRAY, M.A., F.R.S.E.,
CHIEF ASSISTANT TO THE PROFESSOR OF NATURAL PHILOSOPHY IN THE
UNIVERSITY OF GLASGOW.

London:
MACMILLAN AND CO.

1884.

S. Macmillan
1064. f. 6



LONDON:
R. CLAY, SONS, AND TAYLOR,
BREAD STREET HILL

PREFACE.

THIS little book was originally intended to be mainly a reprint of some papers on the Measurement of Electric Currents and Potentials in Absolute Measure contributed to *Nature* during the winter of 1882-3; but as these were being reprinted, many alterations and additions suggested themselves, which it was thought would render the book more generally useful. Most of the additional matter is mentioned in the introductory chapter, but I may here refer to a sketch of the theory of alternating machines, and of methods of measurement available in such cases, contained in Chapter X., and to Chapter XII. on the Dimensions of Units, which I have thought it desirable to introduce.

The work has of course no pretensions to being a complete treatise on Electrical and Magnetic

Measurements, but is rather designed to give as far as is possible within moderate limits a clear account of the system of absolute units of measurement now adopted, and of some methods and instruments by which the system can be applied in both theoretical and practical work.

I am under great obligations to Sir William Thomson and to Mr. J. T. Bottomley, who have kindly examined some of the proofs, and favoured me with valuable suggestions.

A. GRAY.

THE UNIVERSITY, GLASGOW.

October, 1883.

CONTENTS.

CHAPTER I.

INTRODUCTORY.

CHAPTER II.

DETERMINATION OF THE HORIZONTAL COMPONENT OF THE EARTH'S MAGNETIC FIELD.

	PAGE
Gauss's Method of determining H	6
Bottomley's Magnetometer	6
Tempering and Magnetization of Magnets	8
Setting-up of Instruments	9
Observation of Deflections of Needle	9
Convention as to Blue and Red Magnetism	10
Observation of Periods of Magnets	13
Calculation of Moments of Magnets and of H from Results	15
Corrections	16
Correction for Magnetic Induction	17

CHAPTER III.

ABSOLUTE UNITS OF MAGNETIC POLE, MAGNETIC FIELD, AND ELECTRIC CURRENT.

Electromagnetic System of Units	20
Unit Magnetic Pole	21
Uniform Magnetization	21
Dynamical Basis of Definition of Unit Pole	21

	PAGE
Kinetic Measure of Force	22
C.g.s. System of Units	22
<i>Dyne</i> or c.g.s. Unit of Force	22
Unit Magnetic Pole in c.g.s. System	22
Magnetic Moment	22
Magnetic Field	22
Magnetic Field of Unit Intensity defined by Unit Pole	23
Magnetic Field due to a Single Pole	23
Definitions of Unit Current derived from Unit Pole	24
C.g.s. Unit of Current	26

CHAPTER IV.

MEASUREMENT OF A CURRENT IN ABSOLUTE UNITS, AND
PRACTICAL CONSTRUCTION OF A STANDARD GALVANO-
METER.

Theory of Tangent Galvanometer with Short Needle	27
Correction for Dimensions of Coil	29
Correction for Torsion	31
Method of Kohlrausch for determining <i>H</i>	32
Sir William Thomson's Method	33
Construction of Standard Tangent Galvanometer	33
Winding of Coil	35
Adjustment of Needle, Scale, &c.	36

CHAPTER V.

DEFINITION OF ABSOLUTE UNITS OF POTENTIAL AND RESIST-
ANCE, AND DERIVATION OF PRACTICAL UNITS—VOLT,
OHM, AMPERE, COULOMB.

Difference of Potentials	38
Absolute Electrometer	39
Ohm's Law	39
Electric Resistance	39
Unit of Potential based on Unit Magnetic Field, and de- fined by means of Rails and Slider	40

CONTENTS.

	ix PAGE
Electromotive Force	41
Derivation of <i>Volt</i> , or Practical Unit of Potential	41
Absolute Unit of Resistance based on Unit of Potential and Unit of Current	42
Derivation of <i>Ohm</i> , or Practical Unit of Resistance	42
A Resistance in Electromagnetic Units is a Velocity	43
Dimensions of Units	43
Realisation of the Ohm	44
Derivation of Practical Units of Current and of Quantity of Electricity— <i>Ampere</i> and <i>Coulomb</i>	45
Definition of Work	45
Foot-Pound	45
Horse Power	46
Erg. or c.g.s. Unit of Work	46
Definition of Activity	46
Proof by means of Rails and Slider of the Expression for the Total Electrical Activity in any Circuit	46
Joule's Law of the Generation of Heat by a Current	47
<i>Joule</i> , or Unit of Electrical Work	48
<i>Watt</i> , or Unit of Electrical Activity	48

CHAPTER VI.

DESCRIPTION OF SIR WILLIAM THOMSON'S GRADED GALVANOMETERS.

I. The Potential Galvanometer	50
II. The Current Galvanometer	59

CHAPTER VII.

GRADUATION OF SIR WILLIAM THOMSON'S GRADED GALVANOMETERS.

Convenience of a Galvanometer of Great Resistance for Measurements of Potential	63
Graduation of a Potential Galvanometer	64