ELEMENTARY TREATISE ON NATURAL PHILOSOPHY. PART II. HEAT

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649570799

Elementary Treatise on Natural Philosophy. Part II. Heat by A. Privat Deschanel & J. D. Everett

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

A. PRIVAT DESCHANEL & J. D. EVERETT

ELEMENTARY TREATISE ON NATURAL PHILOSOPHY. PART II. HEAT

Trieste

ELEMENTARY TREATISE

ON

NATURAL PHILOSOPHY.

ELEMENTARY TREATISE

ON

NATURAL PHILOSOPHY

BASED ON THE TRAITÉ DE PHYSIQUE OF

A. PRIVAT DESCHANEL

FORMERLY PROFESSOR OF PHYSICS IN THE LYCÉE LOUIS-LE-GRAND, INSPECTOR OF THE ACADEMY OF PARIS

BY

J. D. EVERETT, M.A., D.C.L., F.R.S.

PROFESSOR OF NATURAL PHILOSOPHY IN THE QUEEN'S COLLEGE, BELFAST.

PART II.

HEAT.

THIRTEENTH EDITION.

NEW YORK:
D. APPLETON AND COMPANY,
1898.

Authorised Edition.

PREFACE TO THE THIRTEENTH EDITION OF PART II.

This edition contains a new chapter on Thermodynamics, in which free use is made of the methods of the Differential Calculus. Entropy is explained, and several examples are given of the deduction of physical relations by changing the order of differentiation.

Among the additions in other parts of the book are:—

Bunsen's calorimeter figured and described;

Dewar's experiments on liquid oxygen;

Rowland's determination of the mechanical equivalent of heat, and of the specific heat of water at various temperatures, the minimum specific heat being attained at about 30° C.;

Thomson and Joule's experiments on forcing gases through a cotton wool plug, to determine the difference between the cooling effect of expansion and the work done in the expansion;

Van der Waals' theory with respect to the departure of gases from Boyle's law.

To prevent the book from becoming too large, the account of Melloni's experiments is curtailed; and a number of details respecting steam-engines are omitted.

The pages and sections of Part II. are now numbered from 1 onwards, instead of making the numbers consecutive to those in Part I.

BELFAST, *January*, 1894.

CONTENTS—PART II.

HEAT.

CHAPTER I.

THERMOMETRY.

1. Heat—Cold.—The words *heat* and *cold* express sensations so well known as to need no explanation; but these sensations are modified by subjective causes, and do not furnish an invariable criterion of objective reality. In fact, we may often see one person suffer from heat while another complains of cold. Even for the same person the sensations of heat and cold are comparative. A temperature of 50° Fahr. suddenly occurring amid the heat of summer produces a very decided sensation of cold, whereas the same temperature in winter has exactly the opposite effect. We may mention an old experiment upon this subject, which is at once simple and instructive. If we plunge one hand into water at 32° Fahr., and the other into water at about 100°; and if after having left them some time in this position we immerse them simultaneously in water at 70°, they will experience very different sensations. The hand which was formerly in the cold water now experiences a sensation of heat; that which was in the hot water experiences a sensation of cold, though both are in the same medium. This plainly shows that the sensations of heat and cold are modified by the condition of the observer, and consequently cannot serve as a sure guide in the study of calorific phenomena. Recourse must therefore be had to some more constant standard of reference, and such a standard is furnished by the thermometer.

2. Temperature.—If several bodies heated to different degrees are placed in presence of each other, an interchange of heat takes place between them, by which they undergo modifications of opposite kinds; those that are hottest grow cooler, and those that are coldest grow warmer; and after a longer or shorter time these inverse phenomena cease to take place, and the bodies come to a state of mutual

equilibrium. They are then said to be at the same *temperature*. If a source of heat is now brought to act upon them, their temperature is said to *rise;* if they are left to themselves in a colder medium, they all grow cold, and their temperature is said to *fall*. *Two bodies are said to have the same temperature if when they are placed in contact no heat passes from the one to the other.* If when two bodies are placed in contact heat passes from one to the other, that which gives heat to the other is said to have the higher temperature. Heat always tends to pass from bodies of higher to those of lower temperature.

3. Expansion.—At the same time that bodies undergo these changes in temperature, which may be verified by the different impressions which they make upon our organs, they are subjected to other modifications which admit of direct measurement, and which serve as a means of estimating the changes of temperature themselves. These modifications are of different kinds, and we shall have occasion to speak of them all in the course of this work; but that which is especially used as the basis of thermometric measurement is change of volume. In general, when a body is heated, it increases in volume; and, on the other hand, when it is cooled its volume diminishes. The expansion of bodies under the action of heat may be illustrated by the following experiments.

1. *Solid Bodies.*—We take a ring through which a metal sphere

Fig. 1.—Gravesande's Ring.

just passes. This latter is heated by holding it over a spirit-lamp, and it is found that after this operation it will no longer pass through the ring. Its volume has increased. If it is now cooled by immersion in water, it resumes its former volume, and will again pass