# A FIRST BOOK OF NATURAL PHILOSOPHY, AN INTRODUCTION TO THE STUDY OF STATICS, DYNAMICS, HYDROSTATICS, OPTICS, AND ACOUSTICS, WITH NUMEROUS EXAMPLES

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A first book of natural philosophy, an introduction to the study of statics, dynamics, hydrostatics, optics, and acoustics, with numerous examples by Samuel Newth



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SAMUEL NEWTH

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Trieste

# A FIRST BOOK

OF

# NATURAL PHILOSOPHY:

## AN INTRODUCTION

TO THE STUDY OF

## STATICS, DYNAMICS, HYDROSTATICS, LIGHT, HEAT, AND SOUND.

With Numerous Examples.

BY

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# PREFACE.

THE following work embraces all the subjects in Natural Philosophy required at the Matriculation examination of the University of London. For the present edition it has been revised throughout. Considerable additions have been made in nearly every chapter; and, in order to meet the more recent requirements of the University, a chapter on Heat has also been added. The demonstrations are carefully adapted to the requirements of those whose Mathematical knowledge does not extend beyond the First Book of Euclid, and the easier cases of Simple Equations. In a few instances, where Mathematical demonstrations present some perplexity to the beginner, experimental proofs have been substituted. Examples in illustration are given with all the more important propositions, and numerous other examples are added for exercise. I have endeavoured hereby to supply a work which shall also be generally useful as a First Book of Natural Philosophy. Some experience in teaching has confirmed the opinion, that the junior pupil may, with a twofold benefit, be early introduced to Natural Philosophy, as a branch of his Mathematical studies. The interesting applications which this study supplies greatly assist the beginner

in mastering the processes and results of pure Mathematics; and his early familiarity with Mechanical principles, and with some at least of their practical applications, enables him afterwards to prosecute their more formal study with greater ease.

For the guidance of those who are preparing for University examinations I have introduced a considerable number of examples, on all the subjects included in the volume, taken from recent examination papers. These have been selected chiefly from those set at the Matriculation examination; some are from the Examinations for Women, and a few from the First B. Sc. papers.

The chapter on Sound, though no longer required for Matriculation, is retained for the sake of those who may use the book for other purposes.

SAMUEL NEWTH.

NEW COLLEGE, LONDON,
*October, 1877.*

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# NATURAL PHILOSOPHY.

## CHAPTER I.

### DEFINITIONS AND PRINCIPLES.

1. **Force.**—Whatever is capable of *producing* motion in a body, or any *change* in the motion of a body, is termed *force*.

In other words, force is the name we employ to express that unknown cause which, under any circumstances, can produce a change in the state, whether of rest or motion, of any material body.

Whatever causes a change in the motion of a body must be regarded as of like nature with that which produces motion, and hence the same term (force) is applied to both, even although there are some forces which, while they are able to change the motion of a body, can never produce it. Such, for example, are friction and resistances of all kinds. Forces of this nature can, it is evident, never act alone; for some other force must be present in order to produce the motion which they change, and hence if but one force act upon a body, it must be one capable of *producing* motion. Also, if one force only act upon a body, motion must necessarily follow.

2. **Equilibrium.**—When two or more forces act upon the same body, their united effect *may* be such that no motion ensues. Whenever this is the case, the forces are said to be in *equilibrium*.

3. **Statics and Dynamics.**—That branch of mechanics which investigates the relations which exist between forces in equilibrium is termed Statics; and that which investigates the