

**THE ELEMENTS OF
THE THEORY OF
MECHANICS**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649572465

The Elements of the Theory of Mechanics by Robert Walker

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

ROBERT WALKER

**THE ELEMENTS OF
THE THEORY OF
MECHANICS**

30258

THE
ELEMENTS
OF THE
THEORY OF MECHANICS.

BY THE
REV. ROBERT WALKER, M. A.
OF WADHAM COLLEGE.

OXFORD
D A TALBOYS

1830

9.
W. Jones.

PREFACE.

It is the object of the present treatise to exhibit, in a rigorous and connected form, the principles of Mechanical Science. The works in this department already published in this country are, it is conceived, either limited by the method of demonstration, or deficient in pointing out the connexion of the various parts of the subject. In the present treatise, therefore, the powerful aids of analysis have been introduced; and with the view of marking the distinction between that which is important as theory, and that which is the application of the theory, each of the great divisions of the subject is subdivided into two parts; the first part containing that which rests upon the assumed methods of estimating force, and which will consequently stand upon that, as an hypothesis, were matter differently constituted; the second containing the application of these principles to matter as it is. The application has been carried only so far as seemed necessary to exhibit the importance and object of the results of the theory. Examples have been purposely avoided as tending to draw off the attention from the dependence of one principle upon another, and therefore excluded by the design of the treatise: but, should this attempt be favourably received, the author proposes to prepare another

volume, which shall be, as it were, a companion to the present. This second volume shall contain deductions from the principles here established, a selection of examples with their solutions, either complete, or partly so, or merely with their results, as may appear necessary, and any historical illustration or remark which may throw light or interest upon the subject.

In a work like the present there can be little room for originality, and originality has not been aimed at. Every work, which was thought likely to assist, has been consulted; and whatever appeared to fall in with the design, has been borrowed. The names of Pontécoulant, Poisson, Boucharlat, Venturoli, Lloyd, and Whewell must be mentioned as authors, whose works were constantly at hand; and to the first of these the present treatise is most largely indebted.

For the convenience of students, asterisks are prefixed in the Table of Contents to those articles and chapters which may be omitted on a first reading.

WADHAM COLLEGE,
July 1830.

CONTENTS.

INTRODUCTION.

Art.

1. MECHANICS. Subject divided into STATICS and DYNAMICS.
2. *Motion and Rest.*
3. Meaning attached to *force*.
4. Force measured by its *effect*, which depends on the *intensity*, the *point of application*, and the *direction*.
5. *Body*, an assemblage of points.

STATICS.

SECTION I.

CHAP. I.

FORCES APPLIED TO A POINT.

6. Two equal and opposite forces are in equilibrium.
7. Any two forces inclined at an angle are not in equilibrium.
8. Meaning of the words *resultant* and *component*.
9. Parallelogram of forces.
10. Two forces and their resultant represented by the sides of a triangle.
11. Any number of forces represented by a series of parallelograms or a polygon.

Art:

12. Parallelepiped of forces.
 13. Analytical formulæ for the resultant of any number of forces acting on a point;

$$X = \Sigma. p \cos. \alpha, \quad Y = \Sigma. p \cos. \beta, \quad Z = \Sigma. p \cos. \gamma;$$

$$R = \sqrt{(X^2 + Y^2 + Z^2)};$$

$$\cos. A = \frac{X}{R}, \quad \cos. B = \frac{Y}{R}, \quad \cos. C = \frac{Z}{R}.$$

14. Modification of formulæ, when the forces are in the same plane.
 15. *Moment* of a force with reference to a *point*. Moment of resultant is equal to the sum of the moments of the components.
 16. Modification of formulæ, when the forces are in the same line.
 17. Convenient formula for two forces,

$$R^2 = p'^2 + p''^2 + 2pp' \cos. \theta.$$

18. Conditions of equilibrium,

$$X = 0, \quad Y = 0, \quad Z = 0.$$

19. Formulæ for the equilibrium of a point on a curve,

$$N = \sqrt{(X^2 + Y^2 + Z^2)},$$

$$X dx + Y dy + Z dz = 0.$$

20. Modification of formulæ when the curve is in the vertical plane.

CHAPTER II.

PARALLEL FORCES.

Art:

21. The resultant of two parallel forces is equal to their sum or difference, is in the same direction, and its point of application is determined by the proportion

$$p' : p'' :: q'' : q'$$

Case of two equal and contrary, but not opposite forces.

22. Resultant of any number of parallel forces.
 23. *Centre* of parallel forces.
 24. Formulæ for finding the position of the centre of parallel forces,

$$x, = \frac{\Sigma px}{\Sigma p}, \quad y, = \frac{\Sigma py}{\Sigma p}, \quad z, = \frac{\Sigma pz}{\Sigma p}.$$

25. Modification of formulæ, when the forces are in the same plane.
 26. Modification of formulæ, when the forces are in the same line.
 27. *Moment* of a force with reference to a *plane*.
 28. Moment of resultant equal to the sum of the moments of the components.
 29. Conditions of equilibrium,
 1st. Sum of the forces equal to zero,
 2ndly. Sum of their moments with reference to two parallel planes, each equal to zero.
 30. One force equal and opposite to the others, in case of equilibrium.
 31. If equilibrium subsist in one, it does in all directions.

* CHAPTER III.

FORCES ACTING IN SPACE.

Art.

32. Formulæ for the effects of forces any how situated,

$$X = \Sigma p \cos. \alpha, \quad Y = \Sigma p \cos. \beta, \quad Z = \Sigma p \cos. \gamma,$$

$$L = \Sigma p (\cos. \alpha. y - \cos. \beta. x),$$

$$M = \Sigma p (\cos. \gamma. x - \cos. \alpha. z),$$

$$N = \Sigma p (\cos. \beta. z - \cos. \gamma. y).$$

33. Conditions of equilibrium,

$$X = 0, \quad Y = 0, \quad Z = 0; \quad L = 0, \quad M = 0, \quad N = 0.$$

34. Modification of formulæ, when the forces meet in a point.

35. Modification, when the forces are parallel.

36. Modification, when the forces are in the same plane.

37. Formula of condition for a single resultant,

$$LZ + MY + NX = 0.$$

38. Magnitude of resultant, as in 13.

39. Case where $X = 0$, $Y = 0$, and $Z = 0$.40. Case where $X = 0$, $Y = 0$, and Z does not = 0.41. Case where only $X = 0$.42. Case where $L = 0$, $M = 0$, $N = 0$, but either X , Y , or Z not = 0.43. Case where one or more of the moments L , M , N , and one or more of the forces X , Y , Z do not = 0.

44. If the equation is not satisfied, no single resultant.