

**THE ECONOMY OF WORKSHOP  
MANIPULATION. A LOGICAL METHOD  
OF LEARNING CONSTRUCTIVE  
MECHANICS. ARRANGED WITH  
QUESTIONS FOR THE USE OF  
APPRENTICE ENGINEERS AND STUDENTS**

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The Economy of Workshop Manipulation. A Logical Method of Learning Constructive Mechanics. Arranged with Questions for the Use of Apprentice Engineers and Students by J. Richards

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**J. RICHARDS**

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*A LOGICAL METHOD OF LEARNING CONSTRUCTIVE  
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ARRANGED WITH QUESTIONS  
FOR THE USE OF  
APPRENTICE ENGINEERS AND STUDENTS.

BY

J. RICHARDS,

AUTHOR OF "A TREATISE ON THE CONSTRUCTION AND OPERATION OF WOOD-WORKING  
MACHINES," "THE OPERATOR'S HANDBOOK," "WOOD CONVERSION BY  
MACHINERY," AND OTHER WRITINGS ON MECHANICAL SUBJECTS.



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## PREFACE.

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THE contents of the present work, except the Introduction and the chapter on Gauges, consist mainly in a revision of a series of articles published in "Engineering" and the Journal of the Franklin Institute, under the head of "The Principles of Shop Manipulation," during 1873 and 1874.

The articles alluded to were suggested by observations made in actual practice, and by noting a "habit of thought" common among learners, which did not seem to accord with the purely scientific manner in which mechanical subjects are now so constantly treated.

The favourable reception which the articles on "Shop Manipulation" met with during their serial publication, and various requests for their reproduction in the form of a book, has led to the present edition.

The addition of a few questions at the end of each chapter, some of which are not answered in the text, it is thought will assist the main object of the work, which is to promote a habit of logical investigation on the part of learners.



It will be proper to mention here, what will be more fully pointed out in the Introduction, that although workshop processes may be scientifically explained and proved, they must nevertheless be learned logically. This view, it is hoped, will not lead to anything in the book being construed as a disparagement of the importance of theoretical studies.

Success in Technical Training, as in other kinds of education, must depend greatly upon how well the general mode of thought among learners is understood and followed; and if the present work directs some attention to this matter it will not fail to add something to those influences which tend to build up our industrial interests.

J. R.

10 JOHN STREET, ADLPHI,  
LONDON, 1875:

## CONTENTS.

CHAP.	PAGES
INTRODUCTION, . . . . .	1
I. PLANS OF STUDYING, . . . . .	6
II. MECHANICAL ENGINEERING, . . . . .	13
III. ENGINEERING AS A CALLING, . . . . .	17
IV. THE CONDITIONS OF APPRENTICESHIP, . . . . .	18
V. THE OBJECT OF MECHANICAL INDUSTRY, . . . . .	25
VI. ON THE NATURE AND OBJECTS OF MACHINERY, . . . . .	28
VII. MOTIVE MACHINERY, . . . . .	29
VIII. WATER POWER, . . . . .	35
IX. WIND POWER, . . . . .	41
X. MACHINERY FOR TRANSMITTING AND DISTRIBUTING POWER, . . . . .	42
XI. SHAFTS FOR TRANSMITTING POWER, . . . . .	44
XII. BELTS FOR TRANSMITTING POWER, . . . . .	48
XIII. GEARING AS A MEANS OF TRANSMITTING POWER, . . . . .	51
XIV. HYDRAULIC APPARATUS FOR TRANSMITTING POWER, . . . . .	53
XV. PNEUMATIC MACHINERY FOR TRANSMITTING POWER, . . . . .	55
XVI. MACHINERY OF APPLICATION, . . . . .	57
XVII. MACHINERY FOR MOVING AND HANDLING MATERIAL, . . . . .	60
XVIII. MACHINE COMBINATION, . . . . .	67
XIX. THE ARRANGEMENT OF ENGINEERING ESTABLISHMENTS, . . . . .	71
XX. GENERALISATION OF SHOP PROCESSES, . . . . .	74
XXI. MECHANICAL DRAWING, . . . . .	78
XXII. PATTERN MAKING AND CASTING, . . . . .	90
XXIII. FORGING, . . . . .	100
XXIV. TRIP-HAMMERS, . . . . .	106
XXV. CRANK-HAMMERS, . . . . .	108

CHAP.	PAGE
XXVI. STEAM-HAMMERS, . . . . .	109
XXVII. COMPOUND HAMMERS, . . . . .	112
XXVIII. TEMPERING STEEL, . . . . .	114
XXIX. FITTING AND FINISHING, . . . . .	118
XXX. TURNING LATHES, . . . . .	121
XXXI. PLANING OR RECIPROCATING MACHINES, . . . . .	128
XXXII. SLOTTING MACHINES, . . . . .	134
XXXIII. SHAPING MACHINES, . . . . .	135
XXXIV. BORING AND DRILLING, . . . . .	136
XXXV. MILLING, . . . . .	140
XXXVI. SCREW-CUTTING, . . . . .	143
XXXVII. STANDARD MEASURES, . . . . .	145
XXXVIII. GAUGING IMPLEMENTS, . . . . .	147
XXXIX. DESIGNING MACHINES, . . . . .	152
XL. INVENTION, . . . . .	159
XLI. WORKSHOP EXPERIENCE, . . . . .	165