IRON AND HEAT; BEAMS, PILLARS, AND IRON SMELTING

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649616466

Iron and Heat; Beams, Pillars, and Iron Smelting by James Armour

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

JAMES ARMOUR

IRON AND HEAT; BEAMS, PILLARS, AND IRON SMELTING

Trieste

IRON AND HEAT

Beams, Pillars, and Iron Smelting

EXHIBITING IN SIMPLE FORM THE PRINCIPLES CONCERNED IN
THE CONSTRUCTION OF IRON BEAMS, PILLARS, AND BRIDGE
GIRDERS, AND THE ACTION OF HEAT IN THE
SMELTING FURNACE

By JAMES ARMOUR, C.E.

With numerous Illustrations

BIBLIOTHECA BODLEIANA

Capio Lumen

LONDON:
LOCKWOOD & CO., 7, STATIONERS' HALL COURT,
LUDGATE HILL.
1871.

186. g. 49.

PREFACE.

THIS little work is intended to present in simple form the fundamental principles concerned in the construction of Iron Beams, Pillars, and Bridge Girders; and as it is designed to benefit those who are more intimately acquainted with practical operations as workmen than with the principles on which practice is based, common arithmetic only is used in the treatment of the questions; and the endeavour is, rather to explain circumstantially the rules of common use than to develop new theories.

The sections on Iron Smelting may be regarded as rudimentary, though the action of the heat, in its various operations inside the furnace, is followed up so closely, from its generation opposite the blast-nozzles, to its final escape in the molten matter and the chimney gases, that the essential conditions of the smelting process may be clearly apprehended.

The design, however, is not so much to explain the art of Iron Smelting, as simply to exhibit the action of heat upon the different materials concerned; the compass of the work being too limited to admit of more.

J. A.

GATESHEAD, *September*, 1870.

IRON AND HEAT.

SECTION I.

1. There is no definite beginning to the science of mechanics at all resembling in simplicity the alphabet of language; but, as we intend to limit our inquiry to simple questions relating to iron beams and pillars, the lever gives us an easy entrance to the subject, and we shall find that, right on to the end, the cases will resolve themselves into mere questions of leverage, all more or less simple; so that, to make our course clear for the end in view, we will begin by a few rudimentary illustrations of the principle of the lever.

2. Here is a Salter's balance: when we place a 14-lb. weight in the scale, the pointer simply indicates 14 lbs. We now place a thin-edged block in the scale for a fulcrum, which we letter *a*, Fig. 1, and upon this fulcrum rests a straight rod, 2 feet long, so that it rocks balanced. The 14-lb. weight suspended from one end of the rod at *b*, 1 foot from *a*, will require a force of 14 lbs. at *c*, likewise 1 foot from *a*, to balance it; but the pointer at *d* will show that the fulcrum *a* has to bear twice 14 lbs., or 28 lbs.

3. Again, using two weighing balances, Fig. 2, with a fulcrum in each, and a 28-lb. weight hung from the middle where the fulcrum is in Fig. 1, the pointers *d* and *e* indicate only 14 lbs. weight on each scale.

the respective weights of the two arms; but we will speak of this more particularly further on.

9. In Figs. 1 and 3 the levers as drawn are what is termed of the *first* order, the fulcrum *a* being between the weight *b* and the power *c*.

10. In Fig. 2, if we make *b* the fixed fulcrum and *c* the power, with the weight between, we have a lever of the *second* order.

11. And, again, using Fig. 1, if we make *c* the fixed fulcrum, and use the weighing balance *d a* for the power, we have a lever of the *third* order.

12. Laying the scales of the spring balances aside, and using the spring cases in the manner shown in Fig. 4, one at each end of the 2-foot lever, which we place on the fulcrum *a*, so that the distance *b a* is equal to *a c*, and then wedging up the fulcrum *a* until the pointers *d* and *e* indicate a strain of 5 lbs. at the ends of the lever *b* and *c*, then, as these two strains of 5 lbs. each draw the lever downwards with a united force equal to 10 lbs., it is clear, and has been proved in the case of Fig. 1, that the fulcrum *a* has that 10 lbs. to bear.

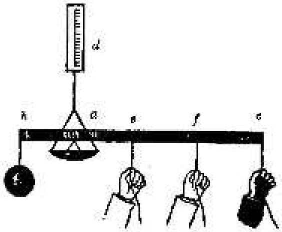

Fig. 3.

13. In explaining Figs. 2 and 3 we showed that as the length of leverage increased, so did the necessary force decrease. We will here, in few words, show that, as might

be expected, the necessary force increases as the length of leverage diminishes.

14. Let us divide *b c*, in Fig. 4, into eight equal distances, and let us keep the spring *d* where it is in Fig. 4, with 5 lbs. strain upon it as before, but shift the spring *e* to *h*.

Then, as *h* is only three divisions from *a*, while *b* is four, we find that a power of 6·66 lbs. is required at *h* to balance 5 lbs. at *b*, because 5 lbs. multiplied by four parts, *b* to *a*, equals 20, and this divided by three parts, *a* to *h*, equals 6·66 lbs.

15. Again, multiplying 5 lbs. by four parts, *b* to *a*, and dividing by two parts, *a* to *g*, we find that 10 lbs. are required at *g* to balance 5 lbs. at *b*; and, dividing the 20 for *a b* by the one part *a f*, that 20 lbs. is required at *f* to balance 5 lbs. at *b*.

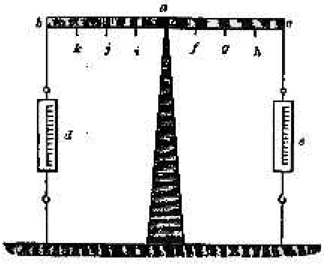

Fig. 4.

16. Let us place a 2-lb. weight, as in Fig. 5, on the outer end of the arm *a c*. You see that the pointer *e* now shows only 4 lbs. strain, while the pointer *d* has risen to 6 lbs.; that is, the arm *a c* being now 2 lbs. heavier at *c* than the arm *a b* at *b*, the spring *e* has 2 lbs. less work to do in balancing the force of the spring *d*, and as the two forces at *b* and *c* have to be balanced simply, and the lever *b c* is stiff