

THE  
**YOUNG MILL-WRIGHT'S**  
**GUIDE.**

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PART THE SECOND.

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INTRODUCTION.

WHAT has been said in the first part, was meant to establish theories, and to furnish easy rules. In this part I mean to show their practical application, in as concise a manner as possible, referring only to the articles in the first part, where the reasons and demonstrations are given.

This part is particularly intended for the help of young and practical mill-wrights, whose time will not admit of a full investigation of those principles and theories, which have been laid down; I shall, therefore, endeavour to reduce the substance of all that has been said, to a few tables, rules, and short directions, which, if found to agree with experience, will be sufficient for the practitioner.

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CHAPTER IV.

OF THE DIFFERENT KINDS OF MILLS.

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ARTICLE 70.

OF UNDERSHOT MILLS.

UNDERSHOT wheels move by the percussion or stroke of the water, and are only half as powerful as other wheels

that are moved by the gravity of the water. See Art. 9. Therefore, this construction ought not to be adopted, except where there is but little fall, or great plenty of water. The undershot wheel, and all others that move by percussion, should move with a velocity nearly equal to two-thirds of the velocity of the water. See Art. 42, Fig. 28, Plate IV., represents this construction.

For a rule for finding the velocity of the water, under any given head, see Art. 51. Upon the principles, and by the rule, given in that article, is formed the following table of the velocity of spouting water, under different heads, from one to twenty-five feet high above the centre of the issue; to which is added the velocity of the wheel suitable thereto, and the number of revolutions a wheel of fifteen feet diameter (which I esteem a good size) will revolve in a minute; also, the number of cogs and rounds in the wheels, both for double and single gears, so as to produce about ninety-seven or one hundred revolutions per minute, for a five feet stone, which I think a good motion and size for a mill-stone, grinding for merchantable flour.

That the reader may fully understand how the following table is calculated, let him observe,

1. That, by Art. 42, the velocity of the wheel must be just 577 thousandth parts of the velocity of the water; therefore, if the velocity of the water, per second, be multiplied by ,577, the product will be the maximum velocity of the wheel, or velocity that will produce the greatest effect, which is the third column in the table.

2. The velocity of the wheel per second, multiplied by 60, produces the distance the circumference moves per minute, which, divided by 47,1 feet, the circumference of a 15 feet wheel, gives the number of revolutions of the wheel per minute, which is the fourth column.

3. That, by Art. 20 and 74, the number of revolutions of the wheel per minute, multiplied by the number of cogs in all the driving wheels, successively, and that product, divided by the product of the number of cogs in all the leading wheels, multiplied successively, the quotient is the number of revolutions of the stones per

minute, which is found in the ninth and twelfth columns.

4. The cubochs of power required to drive the stone being, by Art. 61, equal to 111,78, cubochs per second, which, divided by half the head of water, added to all the fall, (if any,) being the virtual or effective head by Art. 61, gives the quantity of water, in cubic feet, required per second, which is found in the thirteenth column.

5. The quantity required, divided by the velocity with which it is to issue, gives the area of the aperture of the gate, and is shown in the fourteenth column.

6. The quantity required, divided by the velocity proper for the water to move along the canal, gives the area of the section of the canal; as in the fifteenth column.

7. Having obtained their areas, it is easy, by Art. 65, to determine the width and depth, which may be varied to suit other circumstances.

## THE MILL-WRIGHT'S TABLE

FOR

## UNDERSHOT MILLS,

CALCULATED FOR A WATER-WHEEL OF FIFTEEN FEET,  
AND STONES OF FIVE FEET DIAMETER.

Head of water above the point of impact.	Velocity of the water per second at the point of impact.	Velocity of the wheel per second, loaded at the maximum.	Number of revolutions of the wheel of 15 feet diameter, per minute.	No. of cogs in the master cog-wheel.	Rounds in the wallower.	Cogs in the counter cog-wheel.	Rounds in the trundle.	Revolutions of the stone per minute.	Cogs in the cog-wheel for single gear.	Rounds in the trundle.	Revolutions of the stone per minute.	Cubic feet of water required per second to drive a 5 feet stone 97 revolutions per minute.	Area of the gate to vent the water, or rather of a section of the column of water at place of impact.	Area of a section of the canal sufficient to bring on the water with 1.5 feet velocity.
feet.	feet.	feet.										sup. ft.	sup. ft.	sup. ft.
1	8.1	4.67	5.94	112	22	54	16	101.6				223.5	27.5	149.
2	11.4	6.57	8.36	96	23	54	19	99				111.78	9.8	74.5
3	14.	8.07	10.28	88	25	54	19	100.5				74.52	4.6	43.
4	16.2	9.34	11.19	78	23	48	20	97				55.89	3.45	37.26
5	18.	10.38	13.22	66	24	48	18	97	112	15	98.66	44.7	2.48	29.8
6	19.84	11.44	14.6	66	24	48	20	96.2	112	17	96.2	37.26	1.9	24.84
7	21.43	12.36	15.74	66	25	44	19	96.2	104	17	96.2	31.9	1.48	21.26
8	22.8	13.15	16.75	66	25	44	20	97.2	96	16	100.	27.94	1.22	18.6
9	24.3	14.02	17.86	66	26	42	19	100.2	96	17	100.8	24.84	1.02	16.56
10	25.54	14.73	18.78	60	25	44	20	99	96	18	100.	22.89	.9	15.26
11	26.73	15.42	19.7	60	26	44	20	100	96	19	99.5	20.32	.76	13.54
12	28.	16.16	20.5	60	27	44	20	100	96	20	98.4	18.63	.66	12.42
13	29.16	16.82	21.42	60	27	42	20	99.8	96	21	102.6	16.27	.56	10.8
14	30.2	17.42	22.19	60	28	42	20	99	88	20	97.63	15.94	.53	10.6
15	31.34	18.08	23.03	60	29	42	20	99	88	21	96.5	14.9	.47	9.93
16	32.4	18.69	23.8						88	21	99.7	13.97	.43	9.31
17	33.32	19.22	24.48						84	21	97.9	13.14	.39	8.76
18	34.34	19.81	25.23						80	21	96.1	12.42	.36	8.28
19	35.18	20.29	25.82						80	21	98.3	11.76	.33	7.84
20	36.2	20.88	26.6						78	21	98.3	11.17	.3	7.4
21	37.11	21.41	27.26						78	22	97.	10.64	.29	7.1
22	37.98	21.86	27.84						78	22	98.6	10.16	.26	6.77
23	38.79	22.38	28.5						72	21	97.7	9.72	.25	6.48
24	39.69	22.90	29.17						66	20	96.2	9.32	.23	6.21
25	40.5	23.36	29.75						60	18	99.	8.94	.22	5.96
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

It must be observed, that five feet fall is the least that a single gear can be built on, to keep the cog-wheel clear of the water, and give the stone sufficient motion.

Although double gear is calculated to fifteen feet fall, yet I do not recommend them above ten feet, unless for some particular convenience, such as for two pair of stones to one wheel, &c. &c. The number of cogs in the wheels is even, and is thus suited to eight, six, or four arms, so as not to pass through any of them, this being the common practice; but when the motion cannot be obtained without a trundle that will cause the same cogs and rounds to meet too often, such as 16 into 96, which will meet every revolution of the cog-wheel, or 18 to 96, which will meet every third revolution; I advise the putting in either of one more, or one less, as may best suit the motion, which will cause them to change oftener. See Art. 82.

It should be recollected, that the friction at the aperture of the gate will greatly diminish both the velocity and power of the water, where the head is great, if the gate be made of the usual form, that is, wide and shallow. Where the head is great, the friction will be great. See Art. 55: therefore, the wheel must be narrow, and the aperture of the gate of a square form, in order to avoid the friction and loss in a wide wheel, especially if it do not run very closely to the sheeting.

#### *Use of the Table.*

Having levelled your mill-seat carefully, and finding such fall and quantity of water as determines you to make choice of an undershot wheel; for instance, suppose 6 feet fall, and about 45 cubic feet of water per second, which you may find in the way directed in Art. 53; cast off about one foot for fall in the tail-race below the bottom of the wheel, if subject to back-water, which leaves you 5 feet head; then look for 5 feet head in the first column of the table, and against it are all the calculations for a 15 feet water-wheel and 5 feet stones; in the thirteenth column you have 44,7 cubic feet of water, which shows you have enough for a pair of five feet stones; and