

comæ, afforded a most conclusive proof that the Foraminifera were living on the sea bed at the profound depth from which they were obtained, the fact of the star-fishes being captured with the fresh remains of the Foraminifera in their digestive cavities, proves that their normal habitation is at the same great depth, inasmuch as it has been sufficiently established that the *Globigerina* are present only at the bottom. I may mention that, within the past few days, in examining a sample of the *Globigerina* deposit, brought up by a previous sounding on the same spot, I detected some Echinoderm spines, which at once struck me as being identical with those on the *Ophiocomæ*; and that, on comparison, my surmise proved to be quite correct: a further and very striking proof of the vitality of the *Ophiocomæ* at the bottom being thus afforded.

For the Journal of the Franklin Institute.

Strength of Cast Iron and Timber Pillars: A series of Tables showing the Breaking Weight of Cast Iron, Dantzic Oak, and Red Deal Pillars. By WM. BRYSON, Civ. Eng.

D = diameter or side of the square of solid pillar in inches.

D = external diameter of hollow pillar in inches.

d = internal diameter of hollow pillar in inches.

L = length or height of the pillar in feet.

w = breaking weight of long pillars in tons.

Y = breaking weight of shorter pillars in tons.

Mr. Hodgkinson gives the following formulæ for the breaking weight of Dantzic Oak and Red Deal pillars, when the length of the pillars exceeds 30 diameters, both ends being flat and firmly fixed:—

Solid square pillar of Dantzic Oak (dry), $w = 10.95 \frac{D^4}{L^2}$.

Solid square pillar of Red Deal (dry), $w = 7.81 \frac{D^4}{L^2}$.

For shorter pillars, . . . $Y = \frac{w c}{w + \frac{3}{4} c}$.

w = the weight calculated from either of the preceding formulæ.

c = the crushing force of the material.

Y = the breaking weight in tons.

The following formulæ are applicable for the breaking weight of solid cylindrical pillars of Dantzic Oak and Red Deal, both ends being flat and firmly fixed, and the length of the pillars exceeding 30 diameters and upwards:—

Dantzic Oak, $w = 6.71 \frac{D^4}{L^2}$. Red Deal, $w = 4.79 \frac{D^4}{L^2}$.

“ $w = 4.81 \frac{D^{3.55}}{L^{1.7}}$. “ $w = 3.47 \frac{D^{3.55}}{L^{1.7}}$.

Solid Square Pillars of Dantzic Oak, Both Ends being Flat and Firmly Fixed.

Length or height of Pillar in feet.	Number of diame- ters contained in the length or height.	Side of the Pillar in inches.	Calculated breaking weight in tons from formula, $w = 10.95 \frac{D^4}{L^2}$.	Calculated breaking weight in tons from formulae, $w = 10.95 \frac{D^4}{L^2}$, $y = \frac{w c}{w + \frac{3}{4} c}$.
5	30	2		5.56
6	36	"		4.40
7	42	"	3.57	
8	48	"	2.73	
9	54	"	2.16	
10	60	"	1.75	
11	66	"	1.44	
12	72	"	1.21	
5	20	3		18.74
6	24	"		15.96
7	28	"		13.58
8	32	"		11.58
9	36	"		9.93
10	40	"		8.55
11	44	"	7.33	
12	48	"	6.15	
5	15	4		40.27
6	18	"		36.03
7	21	"		32.02
8	24	"		28.37
9	27	"		25.09
10	30	"		22.28
11	33	"		19.80
12	36	"		17.64
13	39	"		15.78
14	42	"		14.17
15	45	"	12.45	
16	48	"	10.95	
5	12	5		69.76
6	14.4	"		64.35
7	16.8	"		58.94
8	19.2	"		53.74
9	21.6	"		48.85
10	24	"		44.33
11	26.4	"		40.23
12	28.8	"		36.56
13	31.2	"		33.20
14	33.6	"		30.23
15	36	"		27.58
16	38.4	"		25.22
17	40.8	"		23.11
18	43.2	"	21.12	
19	45.6	"	18.95	
20	48	"	17.10	

Solid Square Pillars of Red Deal, Both Ends being Flat and Firmly Fixed.

Length or height of Pillar in feet.	Number of diame- ters contained in the length or height.	Side of the Pillar in inches.	Calculated breaking weight in tons from formula, $w = 7.81 \frac{D^4}{L^2}$.	Calculated breaking weight in tons from formulae, $w = 7.81 \frac{D^4}{L^2}$, $\gamma = \frac{w c}{w + \frac{3}{4} c}$.
5	30	2		4.24
6	36	"		3.32
7	42	"	2.55	
8	48	"	1.93	
9	54	"	1.54	
10	60	"	1.24	
11	66	"	1.03	
12	72	"	0.86	
5	20	3		14.83
6	24	"		12.42
7	28	"		10.43
8	32	"		8.79
9	36	"		7.47
10	40	"	6.32	
11	44	"	5.22	
12	48	"	4.39	
5	15	4		32.64
6	18	"		28.76
7	21	"		25.22
8	24	"		22.09
9	27	"		19.36
10	30	"		17.01
11	33	"		15.00
12	36	"		13.28
13	39	"		11.81
14	42	"	10.20	
15	45	"	8.88	
16	48	"	7.81	
5	12	5		57.31
6	14.4	"		52.25
7	16.8	"		47.31
8	19.2	"		42.66
9	21.6	"		38.38
10	24	"		34.51
11	26.4	"		31.06
12	28.8	"		27.98
13	31.2	"		25.27
14	33.6	"		22.87
15	36	"		20.75
16	38.4	"		18.88
17	40.8	"	16.89	
18	43.2	"	15.06	
19	45.6	"	13.52	
20	48	"	12.20	

*Solid Cylindrical Pillars of Dantzic Oak, Both Ends being Flat and
Firmly Fixed.*

Length or height of Pillar in feet.	Number of diame- ters contained in the length or height.	Diameter in inches.	Calculated breaking weight in tons from formula, $w = 6.71 \frac{D^4}{L^2}$.	Calculated breaking weight in tons from formula, $w = 6.71 \frac{D^4}{L^2}$, $y = \frac{wc}{w + \frac{1}{4}c}$.
5	30	2		3.74
6	36	"		2.91
7	42	"	2.19	
8	48	"	1.67	
9	54	"	1.32	
10	60	"	1.07	
11	66	"	0.88	
12	72	"	0.74	
5	20	3		13.24
6	24	"		11.02
7	28	"		9.20
8	32	"		7.73
9	36	"		6.54
10	40	"	5.43	
11	44	"	4.49	
12	48	"	3.77	
5	15	4		29.42
6	18	"		25.78
7	21	"		22.49
8	24	"		19.60
9	27	"		17.11
10	30	"		14.98
11	33	"		13.17
12	36	"		11.63
13	39	"	10.16	
14	42	"	8.76	
15	45	"	7.63	
16	48	"	6.71	
5	12	5		51.99
6	14.4	"		47.16
7	16.8	"		42.50
8	19.2	"		38.15
9	21.6	"		34.21
10	24	"		30.63
11	26.4	"		27.46
12	28.8	"		24.68
13	31.2	"		22.22
14	33.6	"		20.07
15	36	"		18.17
16	38.4	"	16.38	
17	40.8	"	14.51	
18	43.2	"	12.94	
19	45.6	"	11.61	
20	48	"	10.48	

*Solid Cylindrical Pillars of Red Deal, Both Ends being Flat and
Firmly Fixed.*

Length or height of Pillar in feet.	Number of diame- ters contained in the length or height.	Diameter in inches.	Calculated breaking weight in tons from formula, $w = 4.79 \frac{D^4}{L^2}.$	Calculated breaking weight in tons from formulae, $w = 4.79 \frac{D^4}{L^2},$ $Y = \frac{w c}{w + \frac{1}{4} c}.$
5	30	2		2.83
6	36	"	2.12	
7	42	"	1.56	
8	48	"	1.19	
9	54	"	0.94	
10	60	"	0.76	
11	66	"	0.63	
12	72	"	0.53	
5	20	3		10.36
6	24	"		8.49
7	28	"		6.99
8	32	"		5.81
9	36	"	4.79	
10	40	"	3.87	
11	44	"	3.20	
12	48	"	2.69	
5	15	4		23.60
6	18	"		20.30
7	21	"		17.53
8	24	"		15.10
9	27	"		13.04
10	30	"		11.33
11	33	"		9.89
12	36	"	8.51	
13	39	"	7.25	
14	42	"	6.25	
15	45	"	5.44	
16	48	"	4.79	
5	12	5		42.39
6	14.4	"		37.95
7	16.8	"		33.78
8	19.2	"		29.97
9	21.6	"		26.57
10	24	"		23.59
11	26.4	"		20.99
12	28.8	"		18.72
13	31.2	"		16.75
14	33.6	"		15.05
15	36	"	13.30	
16	38.4	"	11.69	
17	40.8	"	10.35	
18	43.2	"	9.23	
19	45.6	"	8.29	
20	48	"	7.48	

In the following table, Mr. Hodgkinson gives the relative strength of pillars of different British irons as obtained from 22 solid cylindrical pillars of cast iron, 10 feet long and $2\frac{1}{2}$ inches diameter, cast out of 11 kinds of iron (9 simple irons, and 2 mixtures). The pillars were all from the same model, and were cast vertically in dry sand, and turned flat at the ends, two being cast from the same kind of iron in each case. The simple unmixed irons tried were as below, and all of No. 1 iron.

SIMPLE IRONS.		Mean breaking weight in tons.
Old Park iron,	Stourbridge, .	29.50
Derwent “	Durham, .	28.03
Portland “	Tovine, Scotland, .	27.30
Calder “	Lanarkshire, .	27.09
Level “	Staffordshire, .	24.67
Coltress “	Edinburgh, .	23.52
Carron “	Stirlingshire, .	23.52
Blaenavon “	South Wales,	22.05
Old Hill “	Staffordshire, .	20.05

The pillars formed of mixed irons were found to be weaker than the three strongest of the unmixed series.

Respecting irregularity in the strength of cast iron, of which the solid pillars experimented upon were composed, Mr. Hodgkinson says, “They were always found to be softer in the centre than in the other parts. To ascertain the difference of strength in the sections of the pillars used, small cylinders, $\frac{3}{4}$ inch diameter, and $1\frac{1}{2}$ inches high, were cut from the centre, and from the part between the centre and the circumference, and there was always found to be a difference in the crushing strength of the metal from the two parts, amounting perhaps to about one-sixth. The thin rings of hollow cylinders resisted in a much higher degree than the iron from solid cylinders. As an example, the central part of a solid cylinder of Low Moor iron, No. 2, was crushed with 29.65 tons per square inch, and the part nearer to the circumference required 34.59 tons per square inch. Cylinders out of a thin shell $\frac{1}{2}$ inch thick of the same iron required 39.06 tons per square inch, and other cylinders from still thinner shells of the same metal, required 50 tons per square inch, or upwards, to crush them.”

(To be Continued.)

On Electro-Chemical Coloring and the Deposition of Peroxide of Iron on Plates of Steel and Iron. By M. BECQUEREL.

From the London Chemical News, No. 83.

Priestly was the first to obtain colored rings by means of electricity,* by receiving strong charges from a battery, with surface of about two square metres, on metal plates, by means of metallic points directed perpendicularly to their surface.

* *Philosophical Transactions*, vol. lviii.