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GRAVATT, WILLIAM

Mountain barometer tables; calculated and stereoglyphed by Messrs. : Scheutz's calculating machine No 2, and printed by machinery.

1859

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COMPANION

TO THE

BAROMETER.

Nat. Vet.
Meteor
(on)

Gravatt

His Majesty
The King of Sweden

Respectfully presented
by the Author

N

R.

COMPANION

TO THE

BAROMETER.

MOUNTAIN BAROMETER TABLES;

CALCULATED

AND

STEREOGLYPHED

BY

MESSRS. SCHEUTZ'S

CALCULATING MACHINE

No. 2,

AND

PRINTED

BY

MACHINERY.

LONDON.

1859.

KONGL. BIBLIOTHEKET STOCKHOLM

LONDON:
Printed, without the use of types, by
C. WHITING,
BEAUFORT HOUSE, STRAND,
FOR
W. GRAVATT, ESQ., F.R.S.,
FOREIGN MEMBER OF THE ROYAL ACADEMY OF SWEDEN.
&c.

(For private circulation.)

The Machine No. 1, so generously presented by Mr. Rathbone to the newly-founded Dudley Observatory, at Albany, United States, has, I believe, as yet been very little if at all worked; a circumstance not to be wondered at, considering the immense amount of labour, and difficulties of every sort, attending the formation of all new Institutions, especially when on a grand scale.

W. G.

BODLEIAN LIBRARY

My Dear Waterhouse,

This little book, which I have great pleasure in dedicating to you, will, I trust, be found useful; but, besides being useful, there is something about it particularly interesting, especially to you who have taken, and still take, so much interest in the great inventions of Babbage — namely, that it contains the first Tables which have been calculated and stereoglyphed by the *second* of the Messrs. Scheutz's Calculating Machines. This Machine, No. 2, has lately been completed by our friends, the Messrs. Donkin, for her Majesty's service, and is now being worked in Somerset House under the direction of the Registrar-General and Dr. Farr.

The results obtained by means of the first Table will be found to agree with those obtainable from Mr. Bailey's formulæ, which formulæ, however excellent, require besides their own proper Tables, the use of a Table of Logarithms.

The second Table is similar to one which (with wider intervals) I made many years ago, and have constantly

used as giving results sufficiently accurate for most engineering purposes, or whenever the difference of level does not much exceed, say about a mile; and it can be used in determining the depths of mines, as well as the height of the lower class of mountains.

You will gladly remark that this machine has given its results in the (now everywhere approved of) old-fashioned type—in fact, imitating the work of the pen.

In my opinion, however, the figures are half as large again as is necessary (in this type) for distinct reading, but I had no smaller punch-wheels ready for putting in. You who have visited every part of the globe, and know by experience the evil of "big books," will not object to the present book on account of its smallness, but will, I am sure, accept its dedication to yourself as a mark of esteem and friendship from

Yours faithfully,

WM. GRAVATT.

To JOHN WATERHOUSE, Esq., F.R.S., &c.,
Wellhead, Halifax

Tab. 1.

110	28240
111	27994
112	27750
113	27508
114	27268
115	27030
116	26794
117	26560
118	26328
119	26098
120	25870
121	25644
122	25419
123	25197
124	24976
125	24757
126	24539
127	24324
128	24110
129	23898
130	23687
131	23478
132	23271
133	23065
134	22861
135	22658
136	22457
137	22257
138	22059
139	21862
140	21666
141	21472
142	21280
143	21088
144	20898
145	20710
146	20523
147	20337
148	20152
149	19968
150	19786

Tab. 1.

150	19786
151	19605
152	19425
153	19246
154	19069
155	18893
156	18717
157	18543
158	18370
159	18198
160	18027
161	17858
162	17689
163	17521
164	17354
165	17189
166	17024
167	16860
168	16698
169	16536
170	16375
171	16215
172	16056
173	15898
174	15741
175	15585
176	15429
177	15275
178	15121
179	14968
180	14817
181	14666
182	14515
183	14366
184	14217
185	14070
186	13923
187	13777
188	13631
189	13487
190	13343

Tab. 1.

190	13343
191	13200
192	13058
193	12916
194	12775
195	12635
196	12496
197	12357
198	12219
199	12082
200	11945
201	11809
202	11674
203	11540
204	11406
205	11272
206	11140
207	11008
208	10876
209	10745
210	10615
211	10486
212	10357
213	10229
214	10101
215	9974
216	9847
217	9721
218	9596
219	9471
220	9347
221	9223
222	9100
223	8978
224	8856
225	8734
226	8614
227	8493
228	8373
229	8254
230	8135

Tab. 1.

230	8135
231	8017
232	7899
233	7782
234	7665
235	7549
236	7433
237	7318
238	7203
239	7089
240	6975
241	6862
242	6749
243	6637
244	6525
245	6414
246	6303
247	6192
248	6082
249	5972
250	5863
251	5754
252	5646
253	5538
254	5430
255	5323
256	5217
257	5110
258	5005
259	4899
260	4794
261	4690
262	4585
263	4481
264	4378
265	4275
266	4172
267	4070
268	3968
269	3867
270	3765

Tab. 1.

270	3765
271	3665
272	3564
273	3464
274	3365
275	3265
276	3166
277	3068
278	2969
279	2872
280	2774
281	2677
282	2580
283	2483
284	2387
285	2291
286	2196
287	2101
288	2006
289	1911
290	1817
291	1723
292	1630
293	1537
294	1444
295	1351
296	1259
297	1167
298	1075
299	0984
300	0893
301	0802
302	0712
303	0622
304	0532
305	0443
306	0354
307	0265
308	0176
309	0088
310	0000

Tab. 2.

540	100·94
541	100·76
542	100·57
543	100·39
544	100·20
545	100·02
546	99·83
547	99·65
548	99·47
549	99·29
550	99·11
551	98·93
552	98·75
553	98·57
554	98·39
555	98·21
556	98·04
557	97·86
558	97·69
559	97·51
560	97·34
561	97·16
562	96·99
563	96·82
564	96·65
565	96·48
566	96·31
567	96·14
568	95·97
569	95·80
570	95·63
571	95·46
572	95·30
573	95·13
574	94·97
575	94·80
576	94·64
577	94·47
578	94·31
579	94·15

Tab. 2.

579	94·15
580	93·98
581	93·82
582	93·66
583	93·50
584	93·34
585	93·18
586	93·02
587	92·86
588	92·71
589	92·55
590	92·39
591	92·24
592	92·08
593	91·92
594	91·77
595	91·62
596	91·46
597	91·31
598	91·16
599	91·00
600	90·85
601	90·70
602	90·55
603	90·40
604	90·25
605	90·10
606	89·95
607	89·80
608	89·65
609	89·51
610	89·36
611	89·21
612	89·07
613	88·92
614	88·78
615	88·63
616	88·49
617	88·34
618	88·20

Tab. 2.

619	88·06
620	87·92
621	87·78
622	87·63
623	87·49
624	87·35
625	87·21
626	87·07
627	86·94
628	86·80
629	86·66
630	86·52
631	86·38
632	86·25
633	86·11
634	85·98
635	85·84
636	85·71
637	85·57
638	85·44
639	85·31
640	85·17

CORRECTION FOR LATITUDE.

L.	*l.*
0°	+2·7
10	+2·5
20	+2·1
30	+1·4
40	+0·5
45	0·0
50	—0·5
60	—1·4
70	—2·1
80	—2·5
90	—2·7

THE Barometer (whether Mercurial or Aneroid) is to be read off in *tenths of inches* and decimal parts of *tenths of inches*, English measure. The Thermometer scale is Fahrenheit's.

B = height of Barometer as read off.
T = temperature of the mercury.
t = temperature of the air in the shade.
} At the upper station.

B = height of Barometer as *read off.*
$B_{/}$ = height of Barometer as *corrected.*
$T_{/}$ = temperature of the mercury.
$t_{/}$ = temperature of the air in the shade.
} At the lower station.

l = correction for Latitude found in the small Table. headed "Correction for Latitude."
x = difference of level between the two stations in English feet.

First correct the lower Barometer reading by putting

$$B_{/} = B + \frac{B\,(T - T_{/})}{10{,}000}$$

Enter the First Table with the integer part of B, find the corresponding tabular number (which call H), interpolate for the decimal parts of B, and put the result = h. Do the same with

$B_{,}$ and call the tabular number $H_{,}$; interpolate for the decimal parts of $B_{,}$ and put the result $= h_{,}$

Then for an ordinary state of atmosphere:—

$$h - h_{,} + \frac{h - h_{,}}{1000} \times \left\{ 1{\cdot}07\ (t + t_{,} - 100) + l \right\} = x$$

EXAMPLE 1. Latitude 30°.

B = 151·47	T = 50°·0	t = 51°·0	
B = 301·59	$T_{,}$ = 75 ·0	$t_{,}$ = 76 ·0	
— ·75	— 25 ·0	+ 27 ·0	
$B_{,}$ = 300·84		7 p. c.	1 ·9
		l =	+ 1 ·4
			+ 30 ·3

EXAMPLE I (*continued*).

H	δ H	H,	δ H,
19605	180	893	91
85	·47	76	·84
19520		817	
817			
18703			
+ 567	= + 30·3 × 18·7		
19270	= x		

EXAMPLE 2. Latitude 70°.

B = 236·60	T = 40°	t = 39°·0	
B = 306·50	T, = 30	t, = 31 ·0	
+ ·30	+ 10	— 30 ·0	
B, = 300·80		7 p. c. 2 ·1	
		— 32 ·1	
		l = — 2 ·1	
		—34 ·2	

EXAMPLE 2 *(continued).*

H	δH	H,	δH,
7433	115	893	91
69	·60	73	·80
7364		820	
820			
6544			
−222	= −34·2 × 6·5		
6322	= x		

It may be as well to remark that from B = 303 to B = 247 (a range of more than a mile in height) the differences of H (= δ H) increase only from 90 to 110—that is, one-tenth of an inch of mercury is (within these limits) equivalent to from 90 to 110 feet of height, whence we may conveniently consider the two first decimal parts of B and B, as roughly expressing whole numbers of feet, and to make them accurate feet we must for the differences, 90, 91 ... 99, deduct respectively
10 9 1 per cent. from the rough feet.

Or for the differences

101,	102,	103	...	109,	110, add respectively
1	2	3		9	10, &c., per cent. to the rough feet;

δH being the difference between the Tabular H and the Tabular number next below it, and *always subtractive.*

To use the Second Table, put

S = $B_{\prime}$ + B = the sum of the two Barometers.

b = $B_{\prime}$ − B = the difference of the two Barometers.

s = the tabular value answering to S; and note, one place of decimals is quite enough to retain in s.

$$\text{Then } b \times \left\{ s + \frac{s}{1000} \times 1{\cdot}07\ (t_{\prime} + t - 100) \right\} = x$$

Or, generally quite accurate enough,

$$b \times \left\{ s + {\cdot}1\ (t_{\prime} + t - 100) \right\} = x$$

$B_{,}$ is as before B corrected; but as in engineering operations the two stations will often happen to be upon nearly the same level, and we cannot tell beforehand which is the lower station, B ought strictly to mean the *greater Barometer-reading*: as after correcting B, we may find that $B_{,}$ turns out less than B, and so, B and not $B_{,}$ will be the lower station. And here note that the best Aneroid Barometers are corrected by the maker for what in them answers to the "temperature of the mercury." So that we at once read off $B_{,}$, and have no occasion to notice either $T_{,}$ or T; but as with the Mercurial Barometer we must always correct for temperature, we may just observe that so long as the lower-stationed Barometer reading is between 280 and 310, we may take $B_{,} = B + \cdot 03\,(T - T_{,})$ as a sufficient approximation.

We may also note that an error of 1° in $T - T_{,}$ occasions an error of about 3 feet whatever number of feet x may represent, whilst an error of 1° in $t + t_{,}$ occasions an error of about $\frac{x}{1000}$ feet in x feet.

EXAMPLE 3.

$B_{,}$ =	289·53	t =	70°
B =	269·84	$t_{,}$ =	65
S	559·37		+35
b	19·69		

We find 559 in the first column, and answering to it in the second column we have 97·5

Correction for temperature + 3·5*

101·0

and 101·0 × 19·69 = 1989 = x

The true value of x, as found from the First Table, being 1992.

* When $t + t_{,}$ is less than 100 the correction is of course negative.

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