A

COMPANION

TO THE

MOUNTAIN BAROMETER,

CONSISTING OF TABLES,

WHEREBY THE OPERATION OF COMPUTING HEIGHTS WITH
THAT INSTRUMENT IS RENDERED EXTREMELY SIMPLE
AND EASY, WHILST ITS ACCURACY IS INFERIOR TO NO
OTHER MODE:

TOGETHER WITH

A DESCRIPTION AND USE

OF THE

ENGLEFIELD MOUNTAIN BAROMETER.

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By THOMAS JONES,

ASTRONOMICAL AND PHILOSOPHICAL INSTRUMENT MAKER
TO HIS ROYAL HIGHNESS THE DUKE OF CLARENCE.

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A DESCRIPTION

OF

THE TABLES.

In addition to the various attempts made to simplify and render easy the operation of computing barometrical altitudes that have been laid before the public, I beg leave to present the following Tables, trusting they will not be found deficient in accuracy to any mode at present known.

Perhaps it may not be deemed intrusive to observe, that the principal inducement which led to the composition has been the great encouragement I have been honoured with in the manufacture and sale of Mountain Barometers, particularly the Englefield, having sold between three and four hundred since their first introduction, independent of those of the former construction.

In constructing these Tables, I have endeavoured that their results should correspond as nearly as possible with those obtained from the generally-approved formulæ of Dr. Maskelyne.

The first Table in use is that for the expansion of the mercury in the Barometer as given by the attached Thermometer, and which is constructed agreeably to the rule given by Sir George Shuckburgh.

The second Table consists of 32 pages computed from the logarithms to every thousandth of an inch, from 15 to 31 inches, and gives the approximate height in feet by the difference of the two numbers corresponding with the observed heights at the two stations.

The third Table consists of two pages constructed on the well-known principles of the expansion of air, and is for the correction of the air or detached Thermometers.

3

RULE.

1st. For the expansion of the mercury by the attached Thermometer, multiply the number in the Table corresponding with the coldest Barometer by the difference of the attached Thermometer, and add it to the coldest Barometer.

2d. For the approximate height.—From the second Table take the numbers corresponding with the inches and parts of the Barometers at the two stations, and the difference of those numbers will be the approximate height in feet.

3d. For the air or detached Thermometer.—Take from the third Table the number corresponding with the approximate height, multiply it by the mean of the detached Thermometers, and the product added to the approximate height will give the real height.

Method of taking an Observation, and computing the Altitude.

About five minutes before you arrive at the place of observation, take out the Thermometer (which is used as detached), holding it by the upper end at nearly arm's length, and in the shade of your person, if the sun shines; it very soon takes the temperature of the air, and is not sensibly affected by the hand. The degree being observed and written down as at D 7.4, and the Thermometer returned; place the Barometer in a vertical position, move the index until its under surface is made a tangent to the convex surface of the mercury; read off and register the inches and parts as B 29.463, together with the attached Thermometer as at A 10; then proceed to the next station and repeat the operations, as D 5.2, B 25.678, and A 7.8. Now look to the first Table, and opposite 25 inches (the coldest Barometer) is .0050, which multiplied by 2.2 (the difference of the attached Thermometers) gives .011 to be added to 25.678 = 25.689. Next look in the left hand column of the second Table for 29.463, and the number 1325 will be found to correspond with it, which set down as at H: then find the number opposite 25.689, which is 4897, and place it under the former: now, by subtracting the one from the other we have the approximate height, 3572. Take from the third Table the number corresponding with the nearest number to the approximate height, which in this case is 15.3, and multiply it by the mean of the detached Thermo-

meter 6.3, and you have 96.39 to add, which gives you 3668.39 feet, the real height.

EXAMPLE.

B	H	A	D
29.463	1325	10	7.4
25.678		7.8	5.2
.011			
		2.2	12.6
25.689	4897	.0050	
			6.3
	3572	0100	15.3
	96.39	0100	
			459
	3668.39	.01100	918
			96.39

TABLE I.

For the Expansion of the Mercury.

31	.0062
30	.0060
29	.0058
28	.0056
27	.0054
26	.0052
25	.0050
24	.0048
23	.0046
22	.0044
21	.0042
20	.0040
19	.0038
18	0036
17	.0034
16	.0032
15	.0030

A DESCRIPTION AND USE

OF

THE ENGLEFIELD MOUNTAIN BAROMETER.

THE Barometer tube is about $32\frac{1}{4}$ inches in length; its bore is from a tenth of an inch to two-tenths in diameter, and external diameter is three-tenths of an inch. This sized bore is fully sufficient to allow the free motion of the mercury. The cistern is of box-wood, turned truly cylindrical, and is one inch in its internal diameter, and an inch in depth; a short stem projects from its top (the instrument being in a position for making an observation), for the purpose of giving a firmer hold to the tube: this stem is perforated with a hole sufficiently large to admit the tube, which is glued to it in the usual mode. This tube projects into the cistern exactly to half its depth. The bottom of the cistern is closed by a brass ring and a leather bag, which screws on the cistern. The tube being filled in

the usual way, and the instrument held inverted in a per-
pendicular position, mercury is poured into the cistern till
it is filled within two-tenths of an inch of the top. The bag
is then firmly screwed on. The essential part of the instru-
ment is now finished. The end of the tube in the cistern
can never be uncovered by the mercury in any possible po-
sition, and of course no air can ever enter into it; and, as
the areas of the cistern and tube are as the squares of the
diameters, the diameter of the bore of the tube being 1,
its external diameter 3, and the diameter of the cistern
1.0, the area of the cistern is $100-9=91$; and there being
two-tenths of an inch left empty in the cistern, the mer-
cury must fall 182-tenths, or 18 inches and two-tenths, be-
fore the cistern is quite full; a space adequate to the mea-
sure of greater heights than any known mountain on the
earth, much more so to any height in this country. It will
not easily be believed, by those who have not seen it, that
the air will act on a cistern thus completely closed, and of
which the wood, in its thinnest part, is above a quarter of
an inch in thickness; but the fact is, that when the in-
strument is suspended by the side of the Mountain Ba-
rometer of the best construction, with an open cistern,
no difference whatever can be perceived in their sensibility
to the variations of the atmosphere. It is obvious that the
variations of altitude, in this instrument of dimensions,
above stated, will be one ninety-first part less than in a
Barometer furnished with an apparatus for bringing the
surface of the mercury in the cistern to a fixed level: this
defect is remedied by measuring the content of every tube
separately, and marking the correction with a diamond near
the top of the glass tube in front of the instrument. They
are marked $\frac{1}{44}$, $\frac{1}{53}$, $\frac{1}{66}$, $\frac{1}{70}$, &c. according to the bores of
the tubes, and the quantity is always to be added; that is,
one-44th, one-53d, one-66th, one-70th, &c. of the re-
sult found by the usual methods, is to be added to that re-
sult, by which method it is presumed that all errors from
the want of a gauge-point must be prevented. Indeed a
moment's consideration will convince us that the gauge-
point corrections of the best instruments of the old con-
struction are very doubtful, on account of the great incon-
venience of setting them, even in their very best mode of
construction.

The tube and cistern being thus prepared, are mounted
in a mahogany tube of the size of a common walking-stick;
the stem of the cistern enters the mahogany tube, and the
cistern is completely covered and secured by a brass tube,

containing the bottom screw, which presses against the bag for making the instrument portable.

For the observation of the height of the mercury, two opposite slits are cut in the mahogany tube, reaching from about 32 to 20 inches for the long scales ; and 32 to 25 inches for the short ones ; which are sufficiently long for any purpose in this country. The front slit has its sides bevelled, and is exteriorly about three-fourths of an inch wide ; on one side is fixed a brass plate, divided as usual into inches, tenths, and twentieths. On this plate a nonius slides, moveable by a small piece, which reads off, as in other Barometers, to 1000dth of an inch. To this nonius a small portion of brass tube is attached, which embraces the Barometer tube, and its lower edge is, in observation, made a tangent to the convex surface of the mercury, as in other well-constructed Barometers ; and the very narrow slit behind gives abundant light for observation.

On the bevelled side of the front slit, opposite the scale, a Thermometer is placed for taking the heat of the instrument ; which is so contrived as to take out of its place, and answer the purpose of the attached and detached Thermometer.

A thin brass tube, with slits in it, turns half round, in the usual manner, and covers the apertures above described in the mahogany tube when the Barometer is not in use.

The mahogany tube is made rather tapering, and with a ferrule at the end opposite the cistern. This ferrule unscrews, and shows a steel ring, by which the Barometer may be suspended when convenient: likewise a small milled head (in the best Barometers) for giving motion to the nonius by means of a screw.

The Method of taking an Observation and computing the Altitude.

Having thus described the instrument, a few practical remarks on the manner of using it may not be superfluous.

When I am about to make an observation, about five minutes before I arrive at the place I take out the Thermometer, holding it by the upper end at nearly arm's length from my body, and, if the sun shines, in the shade of my person. It very soon takes the temperature of the air, and is not sensibly affected by the heat of the hand. The heat being observed and written down as at D 7.4, and the Thermometer returned, the Barometer is turned up, the bottom screw unscrewed as far as it will come, the brass tube half turned, and the instrument held between the finger and

thumb of the left hand above the slit, so as to let it hang
freely in a perpendicular position. Few persons, if any,
have sufficient steadiness of hand to prevent little vibrations
in the mercury in this position: the hand, therefore, should
be either rested against any fixed body, or, if no such occurs,
by kneeling on one knee. The cistern should be let down
so as to touch the ground, the left hand holding the Baro-
meter in a vertical position, which a little practice will
render very easy. The index must then be moved by the
knob or head at the ferrule, till its under surface, as before
stated, is tangent to the mercury. A few light taps should
be given to the tube, to ascertain that the mercury has
fallen as low as it can. The height being then read off
and registered as at B 29.463, together with that of the
attached Thermometer as A 10, the brass tube is turned
back, so as to cover the slits; the instrument gently in-
verted, and the whole is finished. All this may be done in
two minutes.

It may be just mentioned that when the Barometer is
carried by a careful person, it is by no means necessary to
screw up the bag between every station. Now proceed to
the next station, and repeat the operation and register as
at D 5.2, B 25.727, and A 7.8. Now look to the first
Table, and opposite 25 inches (the coldest Barometer) is
.0050, which multiplied by 2.2 (the difference of the at-
tached Thermometer) gives .011 to be added to 25.727 =
25.738. Next look in the left-hand column of the second
Table for 29.463, and the number 1325 will be found
to correspond with it, which set down as at H: then
find the number opposite 25.738, which is 4847, and place
it under the former. Now, by subtracting the one
from the other, we have the approximate height 3522.
Take from the third Table the number corresponding to
the approximate height, which in this case is 15, and mul-
tiply it by the mean of the detached Thermometer 6.3, and
you have 94.5 to add, making 3616.5, which divided by 70
(the number on the glass tube for the correction of the
cistern in this case) gives 51.6 to be added, making 3668.1
the real height.

It may not be improper here to add, that I have found
by experience that it is not necessary to quit the chaise in
order to make observations with this Barometer; it is only
requisite for the horses to stand still. The Thermometer,
if held at arm's length out of the chaise window, will give
the temperature exactly, before the order is given to stop

the carriage, and the delay to the traveller will not much exceed a minute, as the observation may be read off and written down while the carriage is again going on.

When the Barometer is intended to be made portable by means of the bottom screw (at the cistern) which is covered with a brass cap to prevent its being disturbed, great care should be taken not to force the mercury to the top of the glass tube, as it would be liable to burst the bag and let the mercury run out, thereby injuring the instrument. When the bottom screw is screwed up, and the Barometer in a vertical position with the cistern downwards, the mercury should stand about one-eighth of an inch from the top of the glass tube. In carrying the Barometer, great care should be taken to keep the cistern above the horizontal position of the instrument, at about an angle of forty-five degrees; it may be carried under the arm, or in the hand at arm's length.

As it may be desirable sometimes to compare British with foreign Barometrical measurement, or *vice versâ*, an example or two may not be deemed unacceptable. Suppose it were required to convert the altitude 3668.1 feet into French measure: The metre being 3.281 English feet; say, As 3.281 : 1 : : 3668.1 : 1117.982. M. de Humboldt having given the height of Guanaxuato above the level of the sea 2084.3 metres; say, As 1 : 3.281 : : 2084.3 : 6838.588: and in like manner any other measure may be compared.

B	H	A	D
29.463	1325	10	7.4
25.727		7.8	5.2
.011			
———	4847	2.2	12.6
25.738		.0050	
	3522		6.3
	94.5	.0100	15.
		.0100	
70	3616.5		45.
		.01100	90.
	51.6		
			94.5
	3668.1		

(1)

In.dec.	0	1	2	3	4	5	6	7	8	9
	In. dec. 15.000					In. dec. 15.499				
15.00	18916	18915	18913	18912	18910	18908	18906	18904	18902	18901
.01	18899	18898	18896	18894	18892	18890	18888	18886	18884	18883
.02	18881	18880	18878	18877	18875	18873	18871	18869	18867	18866
.03	18864	18863	18861	18860	18858	18856	18854	18852	18850	18849
.04	18847	18846	18844	18842	18840	18838	18836	18834	18832	18831
.05	18829	18828	18826	18825	18823	18821	18819	18817	18815	18814
.06	18812	18811	18809	18808	18806	18804	18802	18800	18798	18797
.07	18795	18794	18792	18791	18789	18787	18785	18783	18781	18780
.08	18778	18777	18775	18773	18771	18769	18767	18765	18763	18762
.09	18760	18759	18757	18756	18754	18752	18750	18748	18746	18745
.10	18743	18742	18740	18739	18737	18735	18733	18731	18729	18728
.11	18726	18725	18723	18722	18720	18718	18716	18714	18712	18711
.12	18709	18708	18706	18704	18702	18700	18698	18696	18694	18693
.13	18691	18690	18688	18687	18685	18683	18681	18679	18677	18676
.14	18674	18673	18671	18670	18668	18666	18664	18662	18660	18659
.15	18657	18656	18654	18653	18651	18649	18647	18645	18643	18642
.16	18640	18639	18637	18636	18634	18632	18630	18628	18626	18625
.17	18623	18622	18620	18618	18616	18614	18612	18610	18608	18607
.18	18605	18604	18602	18601	18599	18597	18595	18593	18591	18590
.19	18588	18587	18585	18584	18582	18580	18578	18576	18574	18573
.20	18571	18570	18568	18567	18565	18563	18561	18559	18557	18556
.21	18554	18553	18551	18550	18548	18546	18544	18542	18540	18539
.22	18537	18536	18534	18533	18531	18529	18527	18525	18523	18522
.23	18520	18519	18517	18516	18514	18512	18510	18508	18506	18505
.24	18503	18502	18500	18498	18496	18494	18492	18490	18488	18487
15.25	18485	18484	18482	18481	18479	18477	18475	18473	18471	18470
.26	18468	18467	18465	18464	18462	18460	18458	18456	18454	18453
.27	18451	18450	18448	18447	18445	18443	18441	18439	18437	18436
.28	18434	18433	18431	18430	18428	18426	18424	18422	18420	18419
.29	18417	18416	18414	18413	18411	18409	18407	18405	18403	18402
.30	18400	18399	18397	18396	18394	18392	18390	18388	18386	18385
.31	18383	18382	18380	18379	18377	18375	18373	18371	18369	18368
.32	18366	18365	18363	18362	18360	18358	18356	18354	18352	18351
.33	18349	18348	18346	18345	18343	18341	18339	18337	18335	18334
.34	18332	18331	18329	18328	18326	18324	18322	18320	18318	18317
.35	18315	18314	18312	18311	18309	18307	18305	18303	18301	18300
.36	18298	18297	18295	18294	18292	18290	18288	18286	18284	18283
.37	18281	18280	18278	18277	18275	18273	18271	18269	18267	18266
.38	18264	18263	18261	18260	18258	18256	18254	18252	18250	18249
.39	18247	18246	18244	18243	18241	18239	18237	18235	18233	18232
.40	18230	18229	18227	18226	18224	18222	18220	18218	18216	18215
.41	18213	18212	18210	18209	18207	18205	18203	18201	18199	18198
.42	18196	18195	18193	18192	18190	18188	18186	18184	18182	18181
.43	18179	18178	18176	18175	18173	18171	18169	18167	18165	18164
.44	18162	18161	18159	18158	18156	18154	18152	18151	18149	18148
.45	18146	18145	18143	18142	18140	18138	18136	18134	18132	18131
.46	18129	18128	18126	18125	18123	18121	18119	18117	18115	18114
.47	18112	18111	18109	18108	18106	18104	18102	18100	18098	18097
.48	18095	18094	18092	18091	18089	18087	18085	18083	18081	18080
15.49	18078	18077	18075	18074	18072	18070	18068	18067	18065	18064
In.dec.	0	1	2	3	4	5	6	7	8	9

B

(2)

	In. dec. 15.500					In. dec. 15.999				
In. dec.	0	1	2	3	4	5	6	7	8	9
15.50	18062	18061	18059	18058	18056	18054	18052	18050	18048	18047
.51	18045	18044	18042	18041	18039	18037	18035	18033	18031	18030
.52	18028	18027	18025	18024	18022	18020	18018	18016	18014	18013
.53	18011	18010	18008	18007	18005	18003	18001	17999	17997	17996
.54	17994	17993	17991	17990	17988	17986	17984	17983	17981	17980
.55	17978	17977	17975	17974	17972	17970	17968	17966	17964	17963
.56	17961	17960	17958	17967	17955	17953	17951	17949	17947	17946
.57	17944	17943	17941	17940	17938	17936	17934	17932	17930	17929
.58	17927	17926	17924	17923	17921	17919	17917	17916	17914	17913
.59	17911	17910	17908	17907	17905	17903	17901	17899	17897	17896
.60	17894	17893	17891	17890	17888	17886	17884	17883	17881	17880
.61	17878	17877	17875	17874	17872	17870	17868	17866	17864	17863
.62	17861	17860	17858	17857	17855	17853	17851	17849	17847	17846
.63	17844	17843	17841	17840	17838	17836	17834	17832	17830	17829
.64	17827	17826	17824	17823	17821	17819	17817	17816	17814	17813
.65	17811	17810	17808	17807	17805	17803	17801	17799	17797	17796
.66	17794	17793	17791	17790	17788	17786	17784	17782	17780	17779
.67	17777	17776	17774	17773	17771	17769	17767	17766	17764	17763
.68	17761	17760	17758	17757	17755	17753	17751	17749	17747	17746
.69	17744	17743	17741	17740	17738	17736	17734	17733	17731	17730
.70	17728	17727	17725	17724	17722	17720	17718	17716	17714	17713
.71	17711	17710	17708	17707	17705	17703	17701	17700	17698	17697
.72	17695	17694	17692	17691	17689	17687	17685	17683	17681	17680
.73	17678	17677	17675	17674	17672	17670	17668	17667	17665	17664
.74	17662	17661	17659	17658	17656	17654	17652	17650	17648	17647
15.75	17645	17644	17642	17641	17639	17637	17635	17633	17631	17630
.76	17628	17627	17625	17624	17622	17620	17618	17617	17615	17614
.77	17612	17611	17609	17608	17606	17604	17602	17600	17598	17597
.78	17595	17594	17592	17591	17589	17587	17585	17584	17582	17581
.79	17579	17578	17576	17575	17573	17571	17569	17567	17565	17564
.80	17562	17561	17559	17558	17556	17554	17552	17551	17549	17548
.81	17546	17545	17543	17542	17540	17538	17536	17534	17532	17531
.82	17529	17528	17526	17525	17523	17521	17519	17518	17516	17515
.83	17513	17512	17510	17509	17507	17505	17503	17501	17499	17498
.84	17496	17495	17493	17492	17490	17488	17486	17485	17483	17482
.85	17480	17479	17477	17476	17474	17472	17470	17469	17467	17466
.86	17464	17463	17461	17460	17458	17456	17454	17452	17450	17449
.87	17447	17446	17444	17443	17441	17439	17437	17436	17434	17433
.88	17431	17430	17428	17427	17425	17423	17421	17419	17417	17416
.89	17414	17413	17411	17410	17408	17406	17404	17403	17401	17400
.90	17398	17397	17395	17394	17392	17390	17388	17386	17384	17383
.91	17381	17380	17378	17377	17375	17373	17371	17370	17368	17367
.92	17365	17364	17362	17361	17359	17357	17355	17353	17351	17350
.93	17348	17347	17345	17344	17342	17340	17338	17337	17335	17334
.94	17332	17331	17329	17328	17326	17324	17322	17321	17319	17318
.95	17316	17315	17313	17312	17310	17308	17306	17305	17303	17302
.96	17300	17299	17297	17296	17294	17292	17290	17289	17287	17286
.97	17284	17283	17281	17280	17278	17276	17274	17272	17270	17269
.98	17267	17266	17264	17263	17261	17259	17257	17256	17254	17253
15.99	17251	17250	17248	17247	17245	17243	17241	17239	17237	17236
In. dec.	0	1	2	3	4	5	6	7	8	9