III. Observations concerning the Height of the Barometer, at different Elevations above the Surface of the Earth, in a Letter to the Publisher from the Learned Dr. Nettleton.

SIR,

BEING curious to learn by Observation, how far the Mercury will descend in the Tube at any given Elevation, for which there is sufficient Opportunity hereabouts, I proposed to take the Altitude of some of our highest Hills; but, when we attempted it, we found our Observations so disturbed by Refractions, that we cou'd come to no Certainty. Having measur'd one Hill of a considerable Height, in a clear Day, and observed the Mercury at the Bottom and at the Top, we found, according to that Estimation, that about 90 Feet, or upwards, were required to make the Mercury fall one Tenth of an Inch ; but coming afterwards to repeat the Experiment on a cloudy Day, when the Air was somewhat grofs and hazy, we found the small Angles so much augmented by Refraction, as to make the Hill much higher than before, tho' they were taken carefully with very good Instruments, both at that Time and before. I afterwards frequently obferv'd at home, by pointing the Quadrant to the Tops of some of our neighbouring Mountains, that they wou'd appear higher in the Morning before Sun-rise, and also late in the Evening, than at Noon, in a clear Day, by several Minutes: Particularly, one Morning in *December* last, when the Vapours lay condens'd in the Vallies, and the Air above was very pure, the Top of a Mountain, at some Distance

from

from hence, appear'd more elevated, by above 30 Minutes, than it had done in the Beginning of *September* about Noon, on a very clear Day. From whence-it appears, that the Refraction is at fome times greater than at others; but probably 'tis always very confiderable, and, as there is no certain Rule to make Allowance for it, it feems likely, that all Obfervations made on very high Hills, efpecially when view'd at aDiftance, and under fmall Angles, as they commonly are, are uncertain, and fcarce to be depended on, generally erring in making the Heights greater than they really are.

I then proceeded to obferve, as near as I was able, the ⸪tion of the Mercury in fome fmaller perpendicular ⸪⸪tions, which we cou'd meafure with a Line, and alfo on the Tops of fome Hills of a moderate Height, whofe Altitude we cou'd obferve moft commodioufly, and, by taking the Angles large, avoid the Danger of any confiderable Refraction.

At the Bottom of the Tower of *Halifax* Church, the Mercury ftood at 29 *Inch.* 78 *Dec.* At the Top it fubfided to 29. 66. The Height of the Place, where the Obfervation was made, was found to be 102 Feet.

At the Bottom of a Coal-Mine, near this Place, the Mercury ftood at 29. 48. At the Top, it fell to 29. 32. The Depth of the Mine, being meafured, was found to be 140 Feet.

At the Bottom of another Mine, the Mercury was obferved to ftand at 29. 50. At the Top, it fell to 29. 23. The Depth of this Mine was 236 Feet.

At the Foot of a fmall Hill, whofe Height we cou'd meafure very exactly, the Mercury ftood at 29.81. At the Top it fell to 29. 45. The Height of the Hill was 312 Feet.

At the Bottom of *Halifax* Hill, commonly call'd the Bank, the Mercury was obferved to ftand at 30. 00.

At the Top, it fell to 29. 41. The Height of this Hill was found to be 507 Feet.

Our Mathematicians do demonstrate, that the Density of the Air decreases in a Geometrical Progression, as the Elevation encreases in an Arithmetical one, and consequently, that the Logarithms of the Densities are as the Elevations reciprocally. But the Weight of the Air being as its Density, and the Height of the Mercury in the Barometer being always proportional to the Air's Weight, it follows, that the Logarithms of the Heights of the Mercury are, reciprocally, as the Elevations : Whence having found by Observation, what Elevation is requir'd to make the Mercury stand at any Height, it will be easy to determine, how much is requisite to reduce it to any other Height propos'd. If we make 30 Inches the Standard Height of the Mercury, equal to Unity, and suppose an Elevation of 85 Feet be requir'd to make it fall one Tenth of an Inch from that Height, as by these Observations it is very nearly; then as the Logarithm of $\frac{30,0}{29,9}$ is to 85, so is the Log.

$\frac{30,0}{29,5}$ to the Number of Feet requir'd to make it fall Half an Inch, and so of the rest. When the Mercury stands above 30 Inches, the Numbers will be negative, and shew the Spaces descending; by which Method I computed the following Tables.

The latter, which contains the Differences of the Numbers in the former, was of very great Use to me, when, in these Experiments, the Mercury stood at any other Height in the Tube, besides 30 Inches, and fell any Number of Tenths, or Parts of a Tenth, by adding the Numbers answering thereto, or proportionable Parts of them, to find the Elevation requir'd in the Table, to make the Mercury fall so much, and thereby readily
to

to compare the Heights found by Observation therewith.
And though some small Errors, in the Observations, do
make them vary a little from each other, yet in the
main, they agree as near as possible with the Numbers
of the Table ; as did also several other Experiments too
long to mention, which makes me believe those Num-
bers are not far from the Truth ; but of that you will
be best able to judge, by comparing these Experiments
with others of the same Kind.

That the Air is colder, as well as more light and rare,
in Places that are situated high, than it is in the Vallies
and low Grounds, is generally known; and in order to
learn, how much it might be so, I got a Friend of mine,
who lives higher than we do here, to observe the port-
able Barometer and Thermometer, at his House, for
some Days, being plac'd as near as possible in the same
Circumstances with mine ; and we found his Barometer
stood at a Medium for 20 Days, 3 Tenths lower than
mine, and the Thermometer 3. *deg.* 2. lower ; allowing
for the Difference of the Instruments, which had been
observed before.

At another Place the Barometer, at a Medium for 14
Days, stood lower by 4. 46. and the Thermometer was
lower by 4. *deg.* 4. At another Place, which was very
high upon the Moors, the Barometer, at a Medium for
ten Days, stood lower by 0. 65. and the Thermometer
fell 7º.

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A Table shewing the Number of Feet ascending, requir'd to make the Mercury fall to any given Height in the Tube, from 30 to 26 Inches. As also the Number of Feet descending, requir'd to make the Mercury rise, from 30 to 31 Inches.

In. Dec.	Feet Dec.	In. Dec.	Feet Dec.
31 0	834 79	27 9	1847 55
30 9	752 53	27 8	1938 97
30 8	670 01	27 7	2030 72
30 7	587 21	27 6	2122 80
30 6	504 15	27 5	2215 21
30 5	420 82	27 4	2307 95
30 4	337 21	27 3	2401 02
30 3	253 32	27 2	2494 44
30 2	169 10	27 1	2588 20
30 1	84 72	27 0	2682 33
30 0	00 00	26 9	2776 80
29 9	85 00	26 8	2871 62
29 8	170 29	26 7	2966 79
29 .7	255 87	26 6	3062 32
29 6	341 73	26 5	3158 21
29 5	427 89	26 4	3254 46
29 4	514 34	26 3	3351 07
29 3	601 08	26 2	3448 05
29 2	688 11	26 1	3545 41
29 1	775 44	26 0	3643 14
29 0	863 08		
28 9	951 01		
28 8	1039 25		
28 7	1127 80		
28 6	1216 66		
28 5	1305 83		
28 4	1395 32		
28 3	1485 13		
28 2	1575 26		
28 1	1665 70		
28 0	1756 47		

A Table shewing the Number of Feet requir'd to make the Mercury fall one Tenth of an Inch from any given Height in the Tube, from 31 to 26 Inches.

In. Dec.	Feet Dec.	In. Dec.	Feet Dec.
31 0	82 26	27 9	91 42
30 9	82 53	27 8	91 75
30 8	82 79	27 7	92 08
30 7	83 06	27 6	92 41
30 6	83 33	27 5	92 74
30 5	83 61	27 4	93 07
30 4	83 89	27 3	93 41
30 3	84 16	27 2	93 76
30 2	84 44	27 1	94 12
30 1	84 72	27 0	94 47
30 0	85 00	26 9	94 82
29 9	85 29	26 8	95 17
29 8	85 58	26 7	95 53
29 7	85 86	26 6	95 89
29 6	86 16	26 5	96 25
29 5	86 45	26 4	96 61
29 4	86 74	26 3	96 98
29 3	87 03	26 2	97 36
29 2	87 33	26 1	97 73
29 1	87 63	26 0	98 10
29 0	87 93		
28 9	88 24		
28 8	88 55		
28 7	88 86		
28 6	89 17		
28 5	89 49		
28 4	89 81		
28 3	90 13		
28 2	90 45		
28 1	90 76		
28 0	91 09		

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