*Relation of Pressure and Temperature at the Ben Nevis Observatories.**

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THE object of this investigation was to ascertain the differences of atmospheric pressure, reduced to sea-level, which accompany differences of temperature, as observed at the, High and the Low-Level Ben Nevis Observatories. The period of time dealt with is the ten months from August 1890 to May 1891. The whole of the hourly observations made at each Observatory with the barometer were reduced to sea-level, those at the top of the mountain being reduced according to the table accompanying the Report on the Meteorology of Ben Nevis.†

It has been shown that the influence of high wind on the barometer is to lower the readings, the amount of the depression increasing as the velocity of the wind increases. It is, however, only when the wind exceeds force 3 on Beaufort scale, 0 to 12, or 21 miles an hour, that the barometer is lowered more than the one-hundredth of an inch. Hence in this discussion the higher velocities of the wind were wholly left out, and only such pressures and temperatures were dealt with as occurred when either calms or light winds prevailed at the time.

During the ten months examined, the differences of temperature between the two Observatories ranged from a temperature $26^{\circ}\cdot 0$ lower, to a temperature $6^{\circ}\cdot 0$ higher, than was recorded at Fort-William at the same hour. A comparison was then made by sorting the differences into two-degree amounts, thus making sixteen columns in all, the first column including those observations when the temperature at the top was from $4^{\circ}\cdot 0$ to $6^{\circ}\cdot 0$ higher than at Fort-William; the second column when from $2^{\circ}\cdot 0$ to $4^{\circ}\cdot 0$ higher; and so on to the sixteenth column, which included the observations when the temperature of the top was from $24^{\circ}\cdot 0$ to $26^{\circ}\cdot 0$ lower than at Fort-William. In these columns the differences, plus or minus, between the two barometers, after being reduced to sea-level, were entered.

The results are summarized in the following table, which shows for each two-degrees difference of temperature, the difference between the reduced barometer of the top and the barometer at Fort-William, the plus sign indicating that the top temperature, or top barometer, was the higher of the two, and the minus sign that it was the lower.

There were 5037 comparisons made. On 1645 of these cases, the reduced barometer of the top was the higher of the two, and on 3392 cases it was the lower. On fifty-five cases the temperature difference varied from the upper thermometer, being from $6^{\circ}\cdot 0$ higher to only $2^{\circ}\cdot 0$ lower than at Fort-William; and on every one of the cases the reduced barometer of the top was the higher of the two. On the other hand, there were 254 cases where the upper temperature was from $22^{\circ}\cdot 0$ to $26^{\circ}\cdot 0$ lower than

* See *Journal of Scottish Meteorological Society*, vol. ix. p. 137.† *Trans. Roy. Soc. Edin.*, vol. xxxiv. pp. lx., lxi.

Difference of Temperature.	Difference of Pressure. Inch.	Number of Comparisons made.		
		Upper Barometer was—		Total.
		Higher.	Lower.	
+ 6° to + 4°	+ 0·047	5	0	5
+ 4 „ + 2	+ 0·044	13	0	13
+ 2 „ + 0	+ 0·041	19	0	19
– 0 „ – 2	+ 0·031	18	0	18
– 2 „ – 4	+ 0·020	13	3	16
– 4 „ – 6	+ 0·009	38	15	53
– 6 „ – 8	+ 0·011	76	21	97
– 8 „ – 10	+ 0·009	160	50	210
– 10 „ – 12	+ 0·006	280	122	402
– 12 „ – 14	– 0·001	378	312	690
– 14 „ – 16	– 0·005	323	677	1000
– 16 „ – 18	– 0·010	241	802	1043
– 18 „ – 20	– 0·017	66	722	788
– 20 „ – 22	– 0·023	15	414	429
– 22 „ – 24	– 0·026	0	204	204
– 24 „ – 26	– 0·029	0	50	50
...	Total,	1645	3392	5037

at Fort-William, and on every one of these occasions the reduced barometer of the top was the lower of the two.

The greatest relative excess of the higher barometer occurs at those times when the absolute temperature at the top of the mountain most exceeds that at Fort-William. On the five occasions when the temperature at the top was from 4° to 6° higher than at Fort-William, the excess of the top barometer was 0·038, 0·042, 0·044, 0·055, and 0·057 inch. It may be added that in these cases this excess is always large, and occurs in anti-cyclonic weather, when the air is not only singularly warm, but also singularly dry. The cases of the larger excesses of the upper barometer occur at all hours of the day, but most frequently from about 10 P.M. to 8 A.M.

On the contrary, the greatest diminutions of the top barometer, as compared with that at Fort-William, occur during cyclonic weather, when the air is loaded with more than the normal amount of moisture; or when the influence of the sun's heat is great, and very much greater at Fort-William than on the top of the Ben. Of the 254 cases which have occurred when the temperature at Fort-William was from 22° to 26° higher than at the top of the mountain, all the barometric observations at the top, when reduced to sea-level, were, as stated, lower than those at the foot of the mountain.

During the anti-cyclones, when the temperature at the top of the mountain, with reference to that at Fort-William, is highest, the pressure at the top, reduced to sea-level,

is 0·047 inch higher than at Fort-William; and on the other hand, during the occurrence of cyclonic weather, when the temperature at the top is very greatly lower than the average as compared with that at Fort-William, the pressure at the top, reduced to sea-level, is 0·029 inch lower than that of Fort-William. There is, therefore, a mean difference of pressure for these distinct extreme types of weather of 0·076 inch.

A part of this difference is undoubtedly due to the time of the day when the extreme differences most frequently occur. Since the excess of the sea-level pressure at the top occurs generally when the lowering of the temperature from the effects of terrestrial radiation is greatest, it results that the mean temperature of the upper and the lower thermometers is somewhat less than that of the true mean temperature of the aerial stratum between them, and consequently a larger correction is used in reducing the upper barometer to sea-level. On the other hand, since the maximum temperature differences between the two thermometers takes place most frequently during the times of the day when solar radiation is most powerful, it follows that the mean of the upper and lower thermometers is higher than the true mean temperature of the aerial stratum intervening, and consequently a less correction for height in reducing to sea-level is used than is really due. This consideration, however, can only account for a small part of the large difference between the two sea-level pressures stated above.

The broad result is this, and it is clear and explicit: when the higher Observatory has the higher temperature, and when the differences of temperature at the two Observatories are small, then the reduced pressure at the top of the mountain is the greater of the two; but when the differences of temperature are very large, then the reduced pressure at the top is the less of the two. The regular progression of the figures in the two tables shows that what is substantially a true mean has been arrived at.

The result, which is altogether unexpected, raises questions of the greatest importance affecting the theory of storms, the effect of vertical movements of ascending or descending masses of air on the barometric pressure which accompany anti-cyclones and cyclones, and the urgent necessity there is for a more exact knowledge than we at present possess of the absolute amounts of aqueous vapour at different heights in the atmosphere under different weather conditions, and how this knowledge may be arrived at from the readings of the dry and wet bulb hygrometer.