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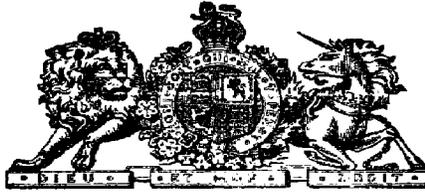
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JAMAICA.

FEBRUARY 22, 1887.

No. 75.

OBSERVATIONS

MADE ON THE

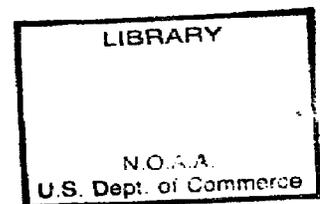
BLUE MOUNTAIN PEAK.

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OBSERVATIONS MADE ON THE BLUE MOUNTAIN PEAK.

The path or bridle-road recently constructed from the Portland Gap to the Peak renders the ascent very easy and the carriage of delicate instruments perfectly safe; and while the little wooden house on the Peak put up by the Cinchona and Coffee planters is admirably suited for hanging and reading barometers, the Stephenson's screen placed by Mr. D. Morris on the very summit, affords the best possible exposure for thermometers.

The following notes refer to an expedition from Montego Bay to the Peak in order to determine its height and to make some experiments required for the Meteorological Service in Jamaica.

The mercurial barometer used was specially constructed for the purpose, and is thoroughly reliable; on Nov. 13th, 1886, eleven comparative readings were taken with the Kingston Standard before the ascent; on Nov. 20th the same number were similarly taken after the ascent; and as the results of the two series agreed identically,* the instrument could have received no damage.

For the temperatures of the Air and the Dew-

point, Dry and Wet-bulb thermometers were placed in the screen on the Peak; and the errors of all the Thermometers used were ascertained by comparison with a standard.

In the following table the observations marked with asterisks were taken simultaneously at Kingston and the Peak: in other cases the hour of observation refers to the Peak, the corresponding readings in Kingston being easily deduced from the series made by Mr. Robert Johnstone. The readings of the Barometers have been corrected for their instrumental errors and reduced to 32°, the Kingston bar. being further reduced to the sea-level; but the cistern of the bar. at the Peak was 17 feet below the summit,† and 17 ft. must be added to the elevation deduced from these readings. It will be noticed that the temperatures of the Air and Dew-point were the same at the Peak, and that consequently the air was saturated with moisture, until noon on the 18th, when a series of experiments was made with Daniel's Hygrometer. The elevations were deduced from a formula which takes into account atmospheric vapour and other details: Laplace's value of the chief constant was adopted:

KINGSTON AND THE PEAK.

1886. Day and Hour.		Bar. cor. 32°		Temp. Air.		Dew-Point.		Peak Bar. above the sea.
		Kingston (sea-level).	Peak.	Kingston.	Peak.	Kingston.	Peak.	
		in.	in.	°	°	°	°	ft.
Nov. 16	11 a.m.	30.012	23.151	87.5	54.9	70.0	54.9	7,414
	12 n.	29.997	.140	88.4	54.4	69.5	54.4	416
	1 p.m.	29.974	.122	89.3	57.4	69.0	57.4	444
	2 p.m.	29.954	.112	86.8	57.1	68.5	57.1	418
	3 p.m.*	29.940	.104	84.3	54.4	68.0	54.4	375
Nov. 17	9 a.m.	30.017	.139	84.0	52.8	67.5	52.8	389
	10 a.m.	30.008	.142	85.1	52.8	67.4	52.8	385
	11 a.m.	29.994	.139	86.2	53.6	67.4	53.6	391
	12 n.*	29.971	.131	87.2	54.6	67.4	54.6	392
	1 p.m.	29.950	.111	88.4	54.6	67.9	54.6	408
	2 p.m.	29.932	.101	87.6	54.2	68.4	54.2	393
	3 p.m.*	29.919	.092	86.7	54.2	68.8	54.2	387
Nov. 18	10 a.m.	30.091	.267	86.1	54.6	67.4	54.6	406
	11 a.m.*	30.076	.200	87.2	55.7	67.5	55.7	417
	12 n.	30.052	.191	83.3	59.0	67.7	56.0	436
	1 p.m.	30.037	.176	83.4	56.6	67.8	54.7	429
	2 p.m.	30.023	.167	87.8	57.1	68.0	53.3	416
	3 p.m.*	30.013	23.163	86.3	56.1	68.1	52.2	7,394
Means		29.993	23.144	87.0	55.2	68.1	54.5	7,406

* Simultaneous readings.

And adding 17 feet as previously explained it appears that the Blue Mountain Peak, Northwestern summit, is 7,423 feet above the mean sea-level.

Now in Weather Report No. 51 it was shown that 7,426 feet was the mean or average of six separate determinations made at different times and under widely different circumstances; and our result is satisfactory as confirming all the previous work on this subject.

Assuming that Laplace's value of the chief constant is absolutely correct, the variations of the separate determinations from their mean lead to the conclusion that the probable error of the mean does not exceed 3 feet; or in plainer language, according to the observations made in November, 1886, the height of the Peak is most likely 7,423 feet; but it

* Making the mountain bar. read 0.009 in. higher than the standard.

† The floor of the Peak-house is 19ft. below the summit according to a rough survey made with a spirit-level

may be as much as 3 feet either higher or lower. This accuracy is more than sufficient for all ordinary purposes.

At noon on the 18th November, the clouds rolled away and the air became drier, and between that hour and 3 p.m. 25 observations of the Dew-point were made with a Daniel Hygrometer in order to compare them with the Dew-point deduced from Dry and Wet-bulb Thermometers by means of Glaisher's Factors. The Hygrometer used was a superior instrument procured for this very purpose some years ago; the Dry and Wet-bulb Thermometers used were not those placed in the screen, but another set mounted similarly to the Hygrometer; and the instruments were placed on a shelf outside the N.W. window of the Peak-house; there was not much air moving, the Anemometer recording only 12 miles between noon and 3 p.m.

The temperatures at appearances and disappearance of the dew were always noted, and the mean taken

as the temperature of the Dew-point; and from the whole series of Dry and Wet-bulb readings, the means of the readings before and after each determination of the Dew-point were adopted in the subsequent reductions.

The following are the results of observation:—

Dry-bulb	...	59°6
Wet-bulb	...	57°8
Dew-point	...	56°2

Now if we multiply the difference between the Dry and Wet bulbs by 1.88, which is Glaisher's Factor for the temperature of 59°.6 and subtract the product from 59°.6, we get 56°.2 as the Dew-point deduced from the dry and wet bulbs,—which agrees exactly with observation.

To explain the importance of this conclusion, Apjohn's formula for obtaining the Dew-point is still very generally employed,—as for instance by the U. S. Signal Service; and this formula has a factor involving the atmospheric pressure; and although under ordinary circumstances the two methods would give nearly identical results, the higher the place of observation the greater would be the divergence; and then comes the question of the 7 a.m. and 3 p.m. daily readings at the Cinchona Plantation in Jamaica. We now know that Glaisher's Factors should be universally employed.*

With regard to Temperature on the Peak, and the long series of Maximum and Minimum readings taken there, it was found that corrections had not been applied to the readings sent up for publication in the Weather Reports, and that 0°.9 and 1°.3 should be added to all the max. and min. readings published up to the end of 1886. The following are the corrected means:—

1885 Max.	70°0	} 19 readings; W.R. No. 61;
Min.	47°8	
1886 Max.	72°2	} 19 readings; W.R. No. 74;
Min.	44°8	

so we shall adopt 71°1 and 46°3 as the max. and min. respectively.

This max. is higher than that obtained at the Cinchona Plantation which is 2,516 feet below the Peak; as the air becomes rarer the rays of the Sun penetrate it more easily, and it is of course upon sunshine that the max. chiefly depends.

This result has been confirmed by Mr. B. S. Gosset at his house at the Portland Gap which is 570 feet above the Cinchona Plantation; from a series of readings taken during 1885 and 1886 the max. and min. at the Gap appear to be 69°0 and 54°6 respectively. It is true that the exposure of the instruments at the gap is not the same as elsewhere, for they are placed under the roof of a light porch attached to the wooden house; but it is a fair exposure, and the records are therefore valuable.

The following table shows the connection observed in Jamaica between elevation and temperature:—

Station.	Elevation.		Pressure.			
	ft.	in.	Max.	Mean.	Min.	Range.
Kingston	0	30.00	87.0	78.2	71.0	16.0
Kempshot	1,773	28.20	80.5	72.7	65.0	12.5
Cinchona Pl.	4,907	25.27	68.5	62.6	57.5	11.0
Portland Gap	5,477	24.71	69.0	59.7	54.5	14.4
B. M. Peak	7,423	23.14	71.1	55.7	46.3	24.8

* Apjohn's formula makes the Dew-point under consideration 56°8, which is in error one-third of the difference of the Dry and Wet bulbs.

In the *Handbook of Jamaica*, 1831, p. 84, it was suggested that the fall of temperature was 3°.2 for the fall of an inch in pressure; we shall now add another term, and take

Fall mean temp. = 2°.92 (fall press.) + 0°.08 (fall press.)²

Computing the mean temperatures by this formula we have

Kempshot	72°7
Cinchona Plantation	62.6
Portland Gap	60.5
B. M. Peak	54.4

which is fairly satisfactory.

Assuming that the formula is correct we can compute the mean temperature for any pressure; thus at an elevation of 14,000 feet where the pressure is 18 inches, the mean temperature would be 32°*, so that according to our formula 14,000 feet would be the lower limit of perpetual snow for Jamaica.

Now in *Abyssinia*, which is sufficiently near the latitude of Jamaica for our present purpose, the lower limit of perpetual snow upon the lofty mountains is 14,065 feet (Buchan, p. 204); so that our formula is correct up to this elevation at least.

We may go still higher, or further from the earth, and by making the fall of pressure equal to 30 inches we get—81° as the mean temperature of a body in space (at the distance of the earth from the Sun), such body being devoid of air, as the Moon, and Meteorites,† for instance.

But of course the side of the moon turned towards the sun must be very much hotter than the opposite side, which must have the temperature of space; and the temperature of space must therefore be very low indeed.

To find it we must employ minimum temperatures and assume that the Thermometers are always shaded from the sun by the spherical body of the earth.

The observations recorded in the table next above give us

Fall Min. Temp. = 0°.96 (fall press.) + 0°.40 (fall press.)²

Computing the Min. Temperatures by this formula we have

Kempshot	68°0
Cinchona Pl.	57.5
Portland Gap	54.7
B. M. Peak	45.6

which is very satisfactory.

Making the fall of pressure equal to 30 inches we get—311° as the temperature of space!†

Consequently this is the temperature of the side of the moon turned from the sun: and as the mean temperature is—81°, it follows that the temperature of the side turned towards the sun must be about + 149° on an average, and over 212°, the boiling point, in parts long exposed to the sun, as Lord Rosse has found by concentrating the rays of the moon in the focus of his telescope.

Enough has been said to show the importance of these observations in Jamaica; the Blue Mountain Range is admirably adapted for the complete solution of the problem sketched out above; but another station is wanted at an elevation of about 2,000 feet

* The freezing point of water.

† A meteoric mass fell in India on the 14th July, 1861: the surface was at first very hot in consequence of its rush through the air; but it soon became so cold that it could not be touched, in consequence of the low temperature of the interior of the mass (Buchan, p. 329.) This low temperature would be—81°.

‡ Sir John Herschell suggested—239°.

(to replace Kempshot which is far distant,) and Portland Gap should be supplied with good instruments and a Stevenson's screen; and then the series of stations between Kingston and the Peak would not only give us all the information required in Jamaica for various purposes, but also the data necessary for the determination of temperatures beyond the Earth.

The lowest temperature which has been observed on the Peak since the commencement of the observations in April, 1885, up to the present time is 38°.3, which was recorded on both Feb. 13th and April 9th, 1886; but a thermometer placed on the ground and fully exposed to the sky would have fallen several degrees lower than the Thermometer in the screen; so that frost may occur, and thin ice may be formed on the Peak, in accordance with the experience of different persons at different times.

Between April and the end of the year 1885, 117 inches of Rain were recorded on the Peak, which is a little more than the rainfall at the sea-level at Boston and Port Antonio that year. In 1886 the rainfall was 281 inches, which is about 70 or 80 more than at the latter places, and is the highest on record in Jamaica.

The Wind on the Peak is for the most part Easterly; but the trees are not bent by any strong prevailing winds, as at many places which at lower elevations are exposed to the combination of Sea-breeze and Easterly Trade-winds.

The Diurnal variation of the Barometer on the Peak is very much less than at the sea-level according to the following table:—

Fall of Bar. from 11 a.m. to 3 p.m.		
1886	Kingston.	Peak.
	In.	In.
Nov. 16th	0.072	0.047
17th	0.375	0.047
18th	3.063	0.037
Means	0.070	0.044

Consequently the Diurnal variation varies inversely as the square of the pressure, a most useful result for mountain readings taken not simultaneously with readings near the sea-level.

The Spectroscope merely showed that all the atmospheric lines usually seen at the sea-level were greatly reduced in strength, and as though at the sea-level the instrument was not pointed horizontally but at a considerable elevation,—with this difference, however, that at the sea-level the sky is so deeply blue at a considerable elevation the whole spectrum becomes faint and difficult; on the Peak, however, the sky is light in colour*, and as similar as possible to an English sky on a fine summer day; and all the lines in the spectrum, however feeble, were perfectly distinct.

The Ozone observations on the Peak are important as they show that ozone decreases with the elevation or pressure: thus, at Kempshot the ozone test papers after 24 hours exposure register about 5 or 6 on the scale from 0 to 10; but on the Peak, with an average wind-velocity of 270 miles per

* Due to the presence of watery particles in the air; at an elevation of 10,000 feet on the Alps I have seen the sky at mid-day nearly black and the Sun brilliant beyond description.

diem† the ozone fell to 4 on the same scale. It therefore appears that ozone diminishes from about 6 at the sea-level to 4 on the Peak, the air being supposed perfectly pure in both cases and a strong breeze blowing; consequently where at other places ozone registers less than it should in proportion to elevation, there may be either malaria or less wind; but in either case these test papers may be used for the health-giving and invigorating powers of the air, which may be destroyed by the malaria of the plains or diminished by ascending too high above the sea-level. The subject requires much attention in such a climate and country as Jamaica.

It now only remains to say a few words about the Peak itself: in Robertson's Map of 1804 we find North, Middle and South Peaks with elevations of 8,184, 7,656 and 7,576 ft. respectively. Dr. Crosbie and others referred to the North, Middle and East Peaks with elevations of 7,255, 7,232 and 6,621 ft. respectively: Mr. Sawkins, in the *Geological Report for Jamaica*, found the West Peak to be 7335 ft. and ignored any others; and some confusion has arisen in consequence.

Returning to the Portland Gap in the ridge of the Blue Mountain chain, the point from whence we started, the path follows the general course of the ridge itself, but the deviations are numerous in order to avoid abrupt ravines,—precipices there are none, the whole of the mountains being clothed with stunted trees embedded in ferns and covered with moss. These woods are silent but for the rushing wind; there are no animals, and very few birds or insects. Gaining the top we find that it is slightly cleft, so that banks of 18 or 19 ft. on the north and south sides form an admirable shelter for the Peak house; this old camping-ground is about 90 yds. long by 30 yds. wide, and is free from trees; on the top of the south bank are placed the instruments within a small enclosure. This is the north-western summit of the Peak, and it commands a view of the Island westwards, southwards, and eastwards as far as the mouth of the Yallahs River.

But the ridge stretches to the N.E., E., and S.E.; and 44 yds. north of this summit we find a path or track branching off to the N.E. by E.; 70 yds. brings us to as high ground as the north-western summit; 60 yds. more bring us to a spot whence we can look out towards the N.E. over the source of the western branch of the Back River, the steepest part of the Blue Mountain range. This is the wildest, grandest view in Jamaica.

Retracing our steps to the high ground and following the ridge towards the S.E., we descend a few feet and then gain another summit of the Peak. Here is found a Soapwood tree whose bark is covered with initials carved by travellers, of which the most conspicuous bears the date of 1849. The remains of a hut and this tree prove without doubt that this is the middle summit of the Peak referred to by travellers in former times. This middle summit is only about 370 yards from the high ground, and about the same distance E.S.E. of the north-western summit.

Continuing our course, we go down a little, and then gain the South-eastern summit, at a distance of about 220 yards from the middle. This summit is

† The wind-velocity registered by Robinson's anemometer requires correction for the diminution of the density of the air; the clouds blew over the Peak faster than the velocity recorded for sea-level pressure, but no correction has been made in this Report.

about 550 yards S.E. of the North-western ; so that the Peak really consists of a culminating ridge running S.E. and N.W., about 600 yards in length, and having three or four summits of very nearly the same height.

There is no look-out at present from either the Middle or South-eastern summits ; and if any suggestion may be made, it would be to the effect that these tracks on the Peak be cleared, and the trees cut here and there so as to open out magnificent views in different directions. Travellers arriving in

Jamaica and ascending the Peak will naturally be disappointed unless such ordinary care be taken to secure the usual object of ascent. Something has been said about the path from the Portland Gap having removed the charm or the incentive ; the declivities at the source of the western branch of the Back River are still unexplored, and there is yet scope for mountaineers to ascend from that side.

MAXWELL HALL.

Montego Bay, February 10, 1887.

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