Meteorological observations on the Maloja plateau, Upper Engadine, Switzerland, 6,000 feet above the sea / by A. Tucker Wise.

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THE increasing attention given to Alpine climate, as an adjunct in the treatment of some important diseases, renders a study of these cold climates, and the peculiar meteorological conditions experienced in the mountains, of much interest.

We are indebted to Dr. Hermann Weber for the first paper in England, just twenty years ago, on the value of a winter residence in the Alps for several forms of ill-health, especially scrofulous and pulmonary complaints. His statements and views met with but little consideration or attention at this time. Some "authorities" even treated him rather roughly for this "quasi-sensational and unreasonable practice."

Twenty-four years before this, however, Dr. Bodington, of Warwickshire, recommended "dry frosty air" for pulmonary consumption. He was also roughly handled by the reviewers, and on that account never pursued the subject. Within the last seven years Alpine winter residence has been brought more prominently before the public and the medical profession, chiefly by Drs. Theodore Williams, Symes Thompson, and Clifford Allbutt; but nearly all interest has been concentrated on one village of the Grisons,—Davos Platz—

5,000 feet above sea-level. Wiesen and St. Moritz also, both in the Grisons, have recently attracted winter visitors, and doubtless these places, which differ somewhat in meteorological conditions, will be appreciated for their slight variations from the climate of Davos, which latter has usually been held up as a suitable standard for comparison. The Maloja plateau is now developing into a health-resort ; a large amount of capital has been expended in constructing an Hôtel-Kursaal with 400 apartments; in which all sanitary arrangements are carried out according to the teachings of hygiene. With the meteorology of this plateau, situated at the upper extremity of the Engadine, I shall now deal.

The Maloja or Maloggia (bad lodging-place) was so named on account of the danger to travellers from robbers and brigands in former days. At present, from personal experience, I can say that the *morale* of the Maloja in this respect has undergone a great change, for I have left thermometers and other instruments quite unprotected during the past winter in all parts of the plateau, some even lying on the snow ; and I have never had any of my arrangements interfered with, although there have been hundreds of Italian and Swiss workmen passing my instruments every day.

The Maloja plateau is situated at the higher extremity of the Upper Engadine, and is well protected from Northerly, Easterly and Southerly winds. Facing the plateau is the lake of Sils, the largest in the chain of lakes between Maloja and St. Moritz. In contrast with the glassiness of its tranquil waters, and the clear blue of the sky, are the rugged crags of the higher Alps, clothed below with red firs and larches.

On the eastern wing of the lake and plateau lie the Bernina chain, comprising the loftiest mountains of the Grisons, studded with glaciers and snow-fields to an extent of more than 350 square miles ; the slopes of the Surlej, Corvatsch and Della Margna (their peaks rising to 10,000 and 11,000 feet) abut on the lake of Sils and the eastern side of the plateau, protecting the lower ground. Opposite and rounding towards the north-east, the rough broadside of Lunghino, Gravasalvas and La Grêve are in close proximity. To the south are the Muretto, Dei Rossi, Del Forno and Salecina ; whilst a mile or so to the south-west are seen the prominent Piz Duan and the serrated crests on the eastern ridge of the Val Bregaglia.

By these mountains the plateau is screened from keen upper currents of air. The "Thalwind" or valley wind, which blows in every Swiss valley, seldom exceeding a force of 1 Beaufort scale, is by no means insupportable, and dies away in force and frequency when snow covers the adjacent regions. At this season and when the lake of Sils freezes, greater calm prevails, and the locality partakes of that Alpine stillness and sunshine which allows the most delicate individuals to be exposed to a low temperature without being conscious of any sensation of cold.

The instruments in use during the winter 1883-4 were by Casella, and had been all verified at the Kew Observatory. A Stevenson's screen of the old pattern was placed in the shade of a large châlet, and fitted with an arrangement admitting of its adjustment after a snow-fall to the ordinary distance of four feet from the surface of snow. The nearest building was the châlet, sixty feet distant.[1]

In the Alpine climate a thermometer screen of any pattern should be placed in shade, otherwise the intense solar heat warms the wood-work and thereby raises the temperature of the interior, many degrees above that of the external air.

The treatment of the ice-covered bulb also requires great attention, or a wider difference will be noted between the two thermometers than ought actually to occur. This takes place during a rise in temperature, and if not met by moistening the muslin around the bulb half or three-quarters of an hour previous to observation, a false estimate of the amount of humidity will be made.

The dew-point and weight of vapour in the atmosphere were calculated from Glaisher's *Hygrometrical Tables* in conjunction with Apjohn's formula:—

$$F=f\ \frac{d}{88}\times\frac{h}{30}$$

when the temperature of the wet bulb was above 32°,

$$\text{and } F=f\ \frac{d}{96}\times\frac{h}{30}\ \text{when below } 32°\ \text{Fahr.}$$

The force of the wind was noted according to the Beaufort scale, deduced from the readings, in miles, of an anemometer placed on high ground in an exposed part of the plateau, fourteen feet above the snow. Another anemometer was erected six feet above the snow in the garden, south-west of the Hôtel-Kursaal; this instrument registered from $\frac{1}{3}$ to $\frac{1}{2}$ the number of miles of the former.

The past winter in the Engadine was not so calm as the previous four winters, owing to the exceptionally small quantity of snow which fell in November and December. The depth of snow even in mid-winter being unusually slight, many slopes and rocks were left bare, favouring absorption of solar heat by the earth, to be again radiated off into space during the night; and in this way giving rise to local movements of air.

At the end of January and during February the snow covering of the earth was from one to three feet deep, and the calmness, blue sky and sunshine at this time were typical of an Alpine winter. Although the mean temperature for February was 26°·5 at noon, no necessity to put on extra garments was felt. No great coats were needed, and a cold bath at a temperature of 41° could be taken with advantage and with less feeling of positive cold than in London during winter.

Mist or fog was observed five times during the winter :—in the month of November, not at all; December, twice; January, once; February, twice.

The hygrometric state of the atmosphere reached saturation fourteen

[1] The Paper was accompanied by Tables of daily observations for the four months. As these have been printed *in extenso* in Dr. Wise's recent work *The Alpine Winter Cure*, only a summary of the results are given with this Paper. *Ed.*

Summary of Meteorological Observations taken at the Maloja during the Winter 1883-84.

Months. 1883-84.	At 9 a.m. Temperature. 9 a.m.	Mean Max.	Mean Min.	Amnt. Cloud.	At Noon. Temperature. Noon.	Mean Max.	Mean Min.	Amnt. Cloud.	Weight of Moisture in 10 cub. ft. of air.	Drying Power of air per 10 cub. ft.
	°	°	°		°	°	°		Grains.	Grains.
Nov.....	26·4	31·8	20·4	4·4	30·5	31·4	24·3	4·8	14·0	6·1
Dec.....	19·3	27·6	14·4	4·1	25·0	26·0	17·1	4·2	11·1	5·4
Jan.....	19·3	27·7	11·9	3·9	25·7	26·9	16·3	3·3	11·0	5·4
Feb.....	17·4	28·5	9·1	4·0	26·5	27·9	15·5	4·3	12·3	4·7
Winter	20·6	28·9	13·9	4·1	26·9	28·1	18·3	4·2	12·1	5·4

Months. 1883-84.	At 3 p.m. Temperature. 3 p.m.	Mean Max.	Mean Min.	Amount of Cloud.	Temperature. In Shade. Absolute Max.	Absolute Min.	Mean Solar Radtn.	1 foot below Surface.	Force of Wind.	Rain.
	°	°	°		°	°	°	°		Ins.
Nov.....	30·5	32·3	28·6	4·1	44·0	11·0	113·6	32·7	0·8	2·21
Dec.....	24·8	27·5	22·0	4·8	45·0	—2·0	89·0	31·1	1·0	1·03
Jan.....	27·3	29·8	23·2	2·8	41·0	—4·0	105·5	30·9	1·3	0·52
Feb.....	27·6	29·5	24·1	4·3	38·0	—7·5	108·7	30·8	0·7	0·84
Winter	27·5	29·8	24·5	4·0	45·0	—7·5	104·2	31·4	1·0	4·60

times only :—November, three ; December, five ; January, one ; and February, five.

The extreme temperatures noted in the day time were :—1° at 9 a.m. on February 19th ; 45° on December 26th ; and 143° for the black bulb thermometer *in vacuo* on February 13th.

The "drying power of the air" in the tables is the weight of vapour which ten cubic feet of air were still capable of absorbing at the time of observation. The mean "drying power" for the winter was 5·4 grains against a yearly average of 12 grains of vapour. Owing to this dry air being a bad conductor of heat, it is possible to quit a heated room and remain in the open air for several minutes without being able to recognise the wide difference in temperature, which, if the room has been over-heated, sometimes amounts to as much as 50°. To this absence of moisture in the air may be ascribed the immunity of the population from catarrhs, and the capability of animals to support the low temperature in the Alps.

One of the objects of the present Paper is to elucidate the opinions of Fellows on what, doubtless, is an important section of meteorology, viz. observations in reference to the Medical aspect of Climatology.

I am of opinion that from a medical point of view the usual rules laid down for meteorological observations are not altogether sufficient for testing what may be termed the physiological effects of climate. Many perhaps will agree with me in thinking that a special system of observation is needed for this kind of investigation.

To me it seems so, as the present methods and formulæ of meteorology give too little prominence to the details on which the features of climate in relation to health so much depend, and embrace considerations too general and vast to enable a clear conception to be formed of a health-resort from any meteorological report. The cause of this lies much in the manner of arrangement, and the comparative neglect of such important climatological elements as—absolute moisture ; the character of certain winds and their immediate effects on the sensations, or on vegetation ; solid particles in the air, as dust, pollen, &c. ; variations in temperature during the day time ; nature of soil and vegetation ; ozone and the electrical conditions of the atmosphere. To the first of these items, "absolute" humidity, the greatest importance should be attached, as it gives a much clearer impression of the quality of air than "relative" humidity. For example, if we calculate the quantity of watery vapour in a London atmosphere at 90 per cent. of relative humidity, with a temperature of 40°, we shall find it to contain 25 grains of water in 10 cubic feet; the air will feel cold, the skin will be clammy, the air passages chilled, and catarrhs will be prevalent. On the other hand, 90 per cent. of relative humidity in the Alps at a temperature of 25° will indicate but 14 grains, the skin will be dry, no danger of catarrh will be experienced, with an entire absence of disagreeable chilliness, attributable solely to the quantity and not to the percentage of vapour present.