moistened by powerful acids. P. 11, column 1, line 34, "1860" should be "1680"; p. 12, column 2, line 28, and also p. 13, column 1, line 5, *steatite* should be *pitchstone* (a vitreous variation of pyroxene andesite).

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Buitenzorg, Java, June 19

THE METEOROLOGY OF BEN NEVIS

AS regards changes of weather and many other problems of meteorology, a knowledge of the vertical variations which take place in the atmospherical conditions is of first importance; and the only way we can hope to arrive at this knowledge is by regular observations made at stations as near each other as possible in horizontal direction, but differing as much as possible in height. This point was very clearly seen many years ago by the late Mr. Allan Broun, and the idea was practically worked out by him in the elaborate series of meteorological and magnetical observations simultaneously made on the peaks and ridges and in the adjoining valleys of the Western Ghats. These observations are the best anywhere yet made to supply the observational data for the discussion of some of the more important problems of meteorology; and the science sustained no ordinary loss in the death of Mr. Broun before he had discussed the observations which had been collected by his genius, energy, and self-denial.

Next in scientific value to Mr. Broun's observations are those made on Ben Nevis since June 1881. The special advantages of Ben Nevis as a meteorological observatory are that it rises to a height of 4406 feet, and is little more than four miles distant from the sea at Fort William, and that it is situated in the track of the great storms which sweep over North-Western Europe from the Atlantic. Hence observations made on the top and at the base of Ben Nevis possess a value altogether unique in meteorology; particularly in discussing the atmospheric movements which accompany cyclones and anticyclones, and in investigating tornadoes and other destructive winds which originate when the air is abnormally warm and moist near the surface, while aloft the temperature and humidity diminish with abnormal rapidity.

For the preliminary inquiry which is necessary in order to determine the chief points in the meteorology of Ben Nevis, there are now available for a comparison of the climate of the top of the mountain with that of the sea-level at Fort William, simultaneous observations for twenty-two months, viz.: from June to October of the years 1881 and 1882, and from June 1883 to June 1884. As regards the temperature, the monthly means for Fort William were compared with the normal monthly temperatures of that place as given in the paper on the "Climate of the British Islands" (*Journ. Scott. Met. Soc.*, vol. vi. p. 33). From the differences thus obtained, the approximate normal temperatures at Ben Nevis Observatory were determined. The coldest month is February, the mean being 22°·0, and the warmest, July, 41°·3, August being nearly as warm, the mean being 41°·1; and the annual mean temperature 30°·9. Comparing the normals with those of Fort William, the greatest difference is 18°·0 in May, from which it steadily diminishes to 14°·9 in December, and then rises more rapidly to the maximum in May; the annual difference is 16°·3. The greatest difference, or the most rapid fall of temperature with height, is in the spring and early summer, when the climate of the west is driest, the temperature of the Atlantic lowest relatively to that of the air, and the top of the mountain still covered with snow. The least difference is in late autumn and early winter, when the climate of the west is wettest, Ben Nevis most frequently and densely clouded, and the temperature of the Atlantic highest relatively to that of the air. The observations of temperature at the high- and low-level stations show a variation with the hour of the day even more decidedly marked than that with season. Thus, in January the decrease of temperature, deduced from the mean maxima and minima respectively were 16°·2 and 15°·2, but in April these were 23°·1 and 12°·9, being thus in January nearly equal, whereas in April the difference of the maxima was nearly double that of the minima.

The annual means give, therefore, a decrease of temperature with height at the rate of 1° for every 270 feet of ascent—the most rapid decrease being 1° for every 245 feet in April, and the least rapid 296 feet in December.

But the individual observations show wide divergences from these rates of decrease. As disturbing conditions, the more important of these are the instances of abnormally large decrease, seeing that these imply a temperature near the surface much above the normal with respect to the higher strata, by which the equilibrium of the atmosphere is destroyed, and rapidly ascending and descending currents are generated, thus giving rise to some of the most destructive storms of wind. Of the illustrations the observations give of a rapid decrease, reference may be made to those of October 13, the day preceding the great storm which proved so destructive to the fishermen on the Berwickshire coast.

Even more striking, and, as regards their bearing on the theory of storms and weather changes, perhaps even more important, are those instances of abnormally small differences between the temperature at the top and base of the mountain, of which a good example which occurred on September 21, 1882, was given in NATURE, vol. xxvii. p. 176. All such cases have been accompanied with a high temperature and an excessive dryness of the air. It is these qualities of air which immediately connect the phenomena with the great cyclonic and anticyclonic systems in which or near to which Ben Nevis is for the time situated. The most striking case of all occurred on December 31, 1883, on which day the maximum temperature at Fort William was 30°·6, and minimum 27°·2, these being at Ben Nevis Observatory 32°·0 and 22°·8. At 11 a.m. the temperature at Fort William was 27°·5, but on Ben Nevis it was 32°·0, with a wet bulb as low as 24°·4. Hence at this hour the temperature of the air was 4°·5 higher at the Ben Nevis Observatory than at Fort William, 4406 feet lower down, and this relatively high temperature was accompanied with excessive dryness represented by the humidity of 33. From 6 a.m. to noon temperature was continuously higher on Ben Nevis than at Fort William. At 11 a.m. the abnormality in the vertical distribution of the temperature amounted to 20°·5. It is of importance to note that at this time of relatively high temperature and great drought, atmospheric pressure was very high at the Observatory, the reading of the barometer at 32° being 25·915 inches, being absolutely the highest that has occurred from November 28, 1883, to June 30, 1884. At Fort William the sea-level pressure was 30·608 inches.

Another peculiarity of the temperature is the small diurnal variation caused by the sun at all seasons, but particularly in winter; and the large variation due to the temperature changes which accompany the passage of cyclones and anticyclones over the Observatory. The means of the hourly observations show that even in May the difference between the mean warmest and mean coldest hour was only 3°·3. In January the difference was only 0°·8, and in this month the highest hourly mean occurred during the night, and the lowest during the day. On the other hand, the difference of the mean daily maxima and minima for January was 6°·7. In truth, the influence of the sun on the temperature of the air is all but eliminated during the winter months owing to the thick covering of mist, fog, and cloud, in which the mountain is almost constantly wrapped.

Since June 1881 the highest temperature on Ben Nevis was 59°·3 on August 8, 1882, and the lowest 9°·9, on February 2, 1884. During these months the extremes at Fort William were 73°·8 and 27°·0.

The barometric observations at Fort William and Ben Nevis were dealt with in a similar manner, and a table of corrections of the Ben Nevis observations to sea-level was constructed directly from the observations of the two stations, the table giving the approximate corrections for each tenth of an inch of the sea-level pressure, and for each degree of mean temperature of the stratum of air from the Observatory to sea-level, which was assumed to be the arithmetic mean of the temperatures at the two stations. The normals of atmospheric pressure for Ben Nevis were then calculated. The lowest normal monthly pressure is 25·141 inches for January, and the highest 25·410 inches for June, and for the year 25·281 inches. Comparing the normal pressures at the high- and low-level stations, pressure on Ben Nevis is on the mean of the year 4·557 inches lower than at the sea-level at Fort William, the least monthly difference being 4·484 inches in July, and the greatest 4·620 inches in February.

The morning maximum of pressure was at 10 a.m. in January, at noon in February and March, 1.30 p.m. in April and May, while in June it was delayed to 3 p.m. From Mr. Wragge's observations in 1882, the same diurnal phase of the pressure occurred about 9 a.m. in the summer months at Fort William, being thus six hours earlier than on the top of Ben Nevis. From February to June the morning minimum of pressure was very large. On the other hand, the afternoon minimum was comparatively small; and as the season advanced it became less and less pronounced, till in June the diurnal oscillation approached closely to one single minimum and maximum. Owing to the low readings of the morning minimum and the high readings of the afternoon maximum, which have their explanation in the diurnal change of the temperature of the aërial stratum below the level of the Observatory, the diurnal range of pressure on Ben Nevis exceeds that of any other meteorological station in Scotland.

The rainfall on the top of Ben Nevis is very large. At Fort William the mean annual amount is about 83 inches. During the three years beginning 1881, while the rainfall at Fort William was 24·59 inches from June to October, it was 47·10 inches on Ben Nevis. During the two years 1882 and 1883, for the same months, the rainfall at Fort William was 21·96 inches; at the lake (1840 feet high), 28·42 inches; but on Ben Nevis, 44·35 inches: hence during the summer months the rainfall on Ben Nevis is nearly double that of Fort William, and the greater part of the increase in the rainfall from Fort William to the top of Ben Nevis takes place above the level of the lake. No inconsiderable proportion of the large rainfall collected on the top is due to driving mists and drifting wet fogs, during which, though often no raindrops are visible, or only a few small drops at wide intervals apart, yet everything is dripping wet, and the funnel of the rain-gauge is crowded with numerous runnels of clear water, steadily trickling down into the receiver of the gauge.

On plains and extensive plateaux the wind attains a diurnal maximum velocity shortly after noon which is generally nearly double the minimum velocity, which occurs shortly before sunrise. But on Ben Nevis, in common with other observatories which are situated on peaks rising to a considerable height above the whole of the surrounding region, the reverse of this takes place, the maximum velocity occurring during the night, and the minimum during the day. The difference between the mean minimum and maximum hourly velocities on Ben Nevis in each of the seven months ending June last was about five miles. A tendency to a secondary maximum was shown in May, but in March, April, and June no such tendency was apparent. A full gale from south-east blew almost continuously at the Observatory from February 15 to 21, and during these seven days there was a mean maximum of 58 miles from 5 to 6 a.m. and a mean minimum of 42 miles from 4 to 5 p.m. With an hourly difference of 16 miles, the daily variation in the velocity of the wind was maintained during the continuance of this great storm.

Another main object in constructing the table of corrections to sea-level for Ben Nevis Observatory was to afford a ready comparison between the atmospheric pressure at sea-level and that on Ben Nevis from the important bearings of the observed differences on the changes of weather which precede, accompany, and follow storms, and on such inquiries as the singular and opposite relations which obtain during storms of wind and during the remarkable weather which often occurs within, or on the confines of, anticyclones.

ALEXANDER BUCHAN

THE FORESTRY EXHIBITION

SINCE our last notice of the International Forestry Exhibition great progress has been made in the concentration and arrangement of the various products which testify to the importance of the subject. We believe that the juries have now met, and such names as Sir Joseph Hooker, Colonel Moncreiff, R.A., Profs. T. R. Fraser of Edinburgh, Bayley Balfour of Oxford, Dr. Lyons, M.P., with several Indian and Scotch Forest Officials, and others will inspire confidence in their work. We to-day give a description of one of the most interesting sections, which well repays a visit.

The Japanese Court occupies the eastern transept, and forms one of the largest and most important sections. The whole arrangements have been carried out in the most thorough and business-like manner. Immediately on the arrival of their goods, knowing beforehand the amount of space required, and working with a rapidity and skill which might put to shame some more civilised nations, the Japanese Commissioners have shown that they are far in advance of many countries in business capacity as well as in the science of forestry. In Great Britain the importance of forestry to the welfare of the country and its colonies has but lately been recognised. In Japan, on the contrary, it has long formed an important feature in national education. This is evident from the ingenious devices represented on the walls of the department, and which can only have been the outcome of long experience.

With excellent taste the Japanese have placed the timber in the most prominent position, and the products in the background, giving at once the impression that it is purely a forestry exhibit. The central tables are occupied with longitudinal sections of trees, with the surface planed so as to render the grain visible. Above these are similar sections, but showing the bark, and above these are coloured drawings of the trees yielding them. At the foot of these sections a paper explains in English the Japanese name, the botanical name and habitat, and the relative rarity or abundance of the tree, its girth and height at fifty years old and at maturity, the best mode of propagation, the quality and uses of its wood and of other parts. Each section, drawing, and description is marked with a corresponding number. On the wall of the Southern Court are some artistic drawings in monochrome of the various devices for felling and floating the trees along mountain streams, for slipping them over precipitous cliffs, and for stopping and collecting the timber at certain localities in its course for storage. The expedients adopted for floating the timber down narrow gullies, and the sledges used for sliding it down over the snow in winter, and other details of forest work and a forester's life, are depicted in a manner that is easy to remember from the quaint dress, the life-like attitude, and excessive energy thrown into the actions represented. These drawings are mounted in wooden frames, and the background