Fireball of December 4, 1886

THE fireball seen at Stonyhurst College, near Blackburn, on December 4, 9h. 16m., and described in NATURE of December 9, p. 133, was observed here as follows :—

1886, December 4, 9h. 17m., meteor equal ♀. Path from 184° + 52° to 195° + 47°, rather swift. At the point 180° + 50½° it left a short brilliant streak of about ½°, which remained visible to the eye for 1½ minute. The meteor gave a distinct flash in the moonlight, and the streak was projected just where the maximum outburst took place.

I have made a preliminary comparison of the observations recorded at the two places, from which it appears that the fireball, when first seen at Bristol, was some 64 miles vertically over a point of the earth's surface near Farndale, in Yorkshire. Travelling to south-west, it evolved an enduring light-streak when 49 miles high, near Thirsk, and disappeared near Otley, at an elevation of 28 miles.

These values are derived chiefly from the Bristol observation, but they are somewhat uncertain, because the meteor was at a great distance from that city, and appeared close upon the sensible horizon. According to the Stonyhurst path, the figures are less, the streak being computed at a height of 42 miles near Thirsk, and the end point of the meteor, near Otley, is indicated at only 19 miles above the earth. The observations are extremely discordant in altitude. The exact place of the streak is given by both observers, and if we adopt a mean height of 45 miles we cannot be far wrong.

The apparent radiant-point derived from the two paths is at 137° + 59°. Before seeing the Stonyhurst observation, I attributed the fireball to a shower near β Ursæ Majoris, at 162° + 58°, from which I saw many swift streak-leaving meteors at the end of November and beginning of December, both in 1885 and 1886. I have a strong suspicion the observed paths of the fireball are slightly in error, both as to direction and length, and that the radiant should be near β Ursæ. In this case the motion would have been from near Guisborough to Harewood at heights of about 68 and 27 miles, but this does not differ materially from the course previously assigned.

In presence of the doubts as to the fireball's exact path in the air, it is most desirable to hear of further observations, and re-investigate it.

W. F. DENNING

Bristol, December 11

THE DISPERSION OF PLANTS BY BIRDS

THE part taken by birds in the dispersion of plants is one of great interest in view of the difficulty of accounting for the appearance of certain species in remote islands, no less than in localities nearer to each other, or divided by such barriers as mountain-ranges or deep seas. This subject has, more or less, engaged the attention of botanical travellers from the time when Darwin published his classical "Journal of Researches," nearly fifty years ago, down to the publication of Mr. Hemsley's "Botany of the *Challenger* Expedition," Part I., which was issued as lately as last year. In the careful summary of plants probably distributed by birds, *loc. cit.* pp. 44-49, it is mentioned that seeds may be carried by birds in either of two ways. First, by seeds, especially those provided with barbs and hooks, attaching themselves to the feathers of birds, and, in the case of aquatic or burrowing birds, being embedded in mud and thus carried accidentally outside ; or, secondly, by seeds swallowed by frugivorous birds being for a time lodged within, and dejected afterwards in such a state as to be capable of germination. My object now is not to treat generally of this subject, but to place on record two remarkable and striking instances where seeds carried and dispersed by birds have come immediately under my own observation. The examples which I shall here describe will, I believe, show clearly that birds are capable of acting as very effective agents in the dispersal of plants, and that the results are so apparent as to be placed beyond reasonable doubt.

In cases where seeds of a light character are provided with barbs or hooks, they are well adapted for attaching themselves to passing objects, and are most favourably placed for dispersal by means of birds. The particular plant with barbed seeds which I describe under this category has not, I believe, been mentioned before ; but it is deserving of notice, as it fully meets all the requirements incidental to this form of dispersal, and, moreover, I have had, for some years, very favourable opportunities of observing its behaviour. This plant is *Uncinia jamaicensis*, Pers. (Cyperaceæ), which grows in damp places in the mountains of Jamaica, at elevations of 5000 to 6000 feet. It is generally found overhanging small pools of stagnant water or on banks of mountain rivulets. Its slender tapering spikes, when ripe, literally bristle with long exserted rachilla, each shaped something like a shepherd's crook (hamate), but with the hooked part so closely fitting and elastic, that, if drawn along the back of the hand, it would grasp and draw out the finest hairs. Now, such places as are affected by this Uncinia are also the frequent resort of numerous birds that come there to drink or bathe, or to seek coolness and shade. In the case of migratory birds, and especially those that cover long distances in their flight, the high lands are generally those first touched. This is doubtless owing to the elevation at which they fly to escape surface-currents or local objects. I have often noticed birds from the north (the United States) on their way south, and again birds from the south returning to the north in early spring, frequenting the high lands of Jamaica, and resting there for a time before continuing their journey. Some such birds have been easily caught by hand, so exhausted were they with their long flight. In two instances I have found small migratory birds so completely entangled in the hooks of the Uncinia (*Gardener's Chronicle*, 1881, p. 780) that they were unable to extricate themselves ; and, unless set at liberty at the time, would probably have died in that situation. In these instances the hooks of the Uncinia overstepped their proper function ; for, obviously, no benefit would arise to the plant from the death of the birds, but only in the removal of the seed to another place. Larger birds, of course, would not be caught ; but on the other hand, if they came within reach of the Uncinia, they could hardly get away without detaching a large number of the fruits and transporting them wherever they went. In the case of the Uncinia, there is present nearly every condition necessary to secure a very complete dispersion of its fruits. The plant, in the first place, is possessed of light portable seeds easily carried about from one locality to another ; in the second place, the seeds are provided with highly specialised hooks which effectually grasp anything that comes within their reach ; and lastly, the plant affects just those places which are visited by birds, and seldom fails to secure a sure and trusty carrier. It follows, as a matter of course, that *Uncinia jamaicensis* is found plentifully distributed in the track of migratory birds, and is found in similar situations in the mountains on the mainland in Central America, Venezuela, Ecuador, &c.

So much for seeds with barbs and hooks. We now come to the second class of seeds, namely, those which are swallowed by frugivorous birds and dejected in a state suitable for germination. The most striking example I know of the dispersion of such seeds, and of the results which immediately follow, are shown in connection with the pimento industry of Jamaica, which, as shown below, depends entirely for its existence on the offices of frugivorous birds. The pimento of commerce is the dried fruit of the pimento allspice, or Jamaica pepper-tree (*Pimenta vulgaris*). No other country supplies this article (although the tree itself is widely distributed both in the West Indies and on the mainland), and the value of the exports of pimento from Jamaica have reached (in 1880) a total of 100,000*l*. This is probably the largest spice industry in the world, and, to repeat what is mentioned above, it is wholly dependent upon the action

of frugivorous birds. In Lunan's "Hortus Jamaicensis," vol. ii. p. 67, published about the end of last century, it is stated that "the usual method in forming a new pimento plantation or 'pimento walk' is nothing more than to appropriate a piece of woodland in the neighbourhood of a plantation already existing; or, in a country where the scattered trees are found in a native state, the woods of which being fallen, the trees are suffered to remain on the ground till they become rotten and perish. In the course of twelve months after the first seasons (rains), abundance of young pimento plants will be found growing vigorously in all parts of the land, being without doubt produced from ripe berries scattered there by the birds, while the fallen trees, &c., afford them both shelter and shade." In a foot-note it is added that "birds eagerly devour the ripe seeds of the pimento, and, muting them, propagate these trees in all parts of the woods. It is thought that the seeds passing through them undergo some fermentation which fits them better for vegetation than those gathered immediately from the tree." The present plan for forming pimento plantations in Jamaica is exactly as described above. In fact, the planters firmly believe that no other plan is likely to produce good pimento walks, although it has been shown by experiments in the Botanical Gardens that by careful treatment plants of pimento can be raised in nurseries in large numbers, exactly as any other economic plants. It remains, however, that all the present pimento plantations in Jamaica have been formed by the action of frugivorous birds, and to this agency alone we are indebted for the commercial supply of a most valuable and wholesome spice.

Kew, December 3 D. MORRIS

SOUNDING A CRATER

THE following is a brief account of my third ascent of Asama Yama, an active volcano about 75 miles north-west from Tokio. My first ascent was made in the spring of 1877. The time we stayed on the summit, which is about 8800 feet above sea-level, was exceedingly short. The crater looked like a bottomless pit, with perpendicular sides. It was audibly roaring, and belching forth enormous volumes of sulphurous vapour, threatening suffocation to any living thing they might envelop. The drifting of these vapours across the snow, with which the upper part of the mountain was covered, had rendered it so bitter that we were unable to use it as a means of quenching our thirst. A quantity of this snow was carried to the bottom of the mountain in a handkerchief, where it was bottled, and carried to Tokio for chemical examination. The examination, however, only yielded *pure* water, from which it was concluded that the liquefaction of the snow had been accomplished by heating over a fire, and whatever it was that had given the snow its peculiarly bitter taste had been evaporated. My next visit to Asama was in the spring of 1886. One of the chief objects of this expedition was to satisfy a curiosity which had arisen with regard to the depth of the crater. Many visitors to the summit reported that at favourable moments, when the wind had blown the steam to one side, they had been able to see downwards to an enormous depth. One set of visitors, who had remarkable opportunities for making observations, were convinced that if the crater was not as deep as the mountain is high above the plain from which it rises (5800 feet), it must at least be from 1500 to 2000 feet in depth. Although I had provided myself with sufficient wire and rope to solve this problem, owing to the inclemency of the weather and the quantity of snow then lying on the mountain the expedition proved a failure. One of our number had to give up the attempt to reach the summit at about 6000 feet above sea-level, while I and my remaining companion only reached it with great difficulty. Our stay was very short. The wind, which was at times so strong that we were often compelled to lie down, rendered it impossible to approach the crater, and after a few minutes' rest we beat a retreat, worn out with fatigue, across the snow-fields, towards our starting-point.

Two months after this, a visitor who ascended the mountain by moonlight reported that the crater was only 200 feet in depth, and that at the bottom there was a glowing surface. A second visitor, Colonel H. S. Palmer, R.E., estimated the depth as being between 500 and 600 feet. This estimate was based on the convergence of the walls of the crater, which he saw to the depth of about 300 feet, and the diameter of the crater, which he estimated by walking round a semi-circumference as about 370 yards. Previous estimates of the diameter had been 200 yards, three-fourths of a mile, and 1000 metres. The Japanese say that the periphery is $3\frac{3}{4}$ miles. These last estimates, as pointed out by Colonel Palmer, are nearly in the ratio of 10, 81, 85, and 150!

These wildly discordant results as to the dimensions of Asama, and the increasing curiosity on this question, led me, in conjunction with Messrs. Dun, Glover, and Stevens, to face the fatigue of ascending Asama for the third time. We left our resting-place, Kutoukake, at the foot of the mountain, at 4.30 a.m. on the morning of October 2, and in company with five coolies we reached the summit at 11 a.m. After a short rest, we commenced our measuring operations, the general arrangements of which were entirely the suggestion of Mr. Dun. When these are explained, they are no more remarkable than the manner in which Columbus caused the egg to stand; but before Mr. Dun made his suggestion, the various schemes which were proposed would, to my mind, have been unpractical and unsatisfactory. One suggestion was to roll a cannon-ball, with a string attached, down the crater; another was to shoot an arrow carrying a string into the hole; a third suggestion was to fly a kite across the crater; &c., &c.

Mr. Dun's method, as carried out, was as follows:—First, a light rope some 500 yards in length was attached to a block of rock lying on a high portion of the rim of the crater. Next, this rope, which I shall call the cross-line, was carried round the edge of the crater for about 150 or 200 yards. Here a heavy brass ring was tied upon it, and through the ring was passed the end of a copper wire coiled on a large reel. This was the sounding-line. Close to the ring, a string, which I shall call the guy-rope, was made fast to the cross-line. This being completed, the cross-line was then carried on round the rim of the crater until it reached an eminence, as near as we could judge, opposite to the point where the other end of it was attached to the block of rock. After this, the same line was jerked clear of pinnacles and boulders lying round the edge of the crater. The cross-line now formed two sides of a triangle, stretching across the crater from where the ring and lowering apparatus were to two points diametrically opposite to each other. By letting out the guy-rope, the cross-rope could be stretched until it formed a diameter to the crater, with the ring in the middle. The getting of these ropes into position was a matter of no little difficulty. First was the fact that clouds of vapours not only prevented us from seeing from station to station, but also from seeing far out into the crater. Secondly, on account of the hissing and bubbling noises in the crater itself, we could only communicate with each other by sound for short distances. And, thirdly, there was the difficulty of clearing the cross-rope from the ragged edges of the crater, which involved considerable risks in climbing. All being ready, word was passed along to haul on the cross-rope; and, as it tightened, the guy-line was let out, together with the sounding-line, running parallel to it, but passing through the ring. Owing to the twisting of the cross-line by tension, and the consequent revolution of the ring, the wire was broken, and the first attempt at sounding failed. This difficulty was overcome by attaching the guy-rope to the ring itself. Very luckily,