celestial equator, and that its intersections with that equator had R.A. 110° and 290° . The horizon was intersected by this arc about 18° N. of E. and 18° S. of W., *i.e.* in two points situated nearly 90° from the magnetic meridian (Mr. R. Capron cites 20° erroneously; a repeated calculation gives me $18^{\circ} 14'$ N. of E).

When the arc was visible over more than 90° (which lasted no longer than a few seconds), its middle part, having a breadth of about 3° , was separated by a dark rift, 10° long and $\frac{1}{2}^{\circ}$ broad, sharp at both ends.

At 6h. 25m. the whole arc had vanished.

At 6h. 27m. a bundle of red rays appeared between Ursa Major and Ursa Minor; it extended from Polaris to γ Ursæ Minoris, *i.e.* over a width of almost 20 degrees; this bundle moved steadily to the west, just as had been the case with several vertical beams of the former aurora.

At 6h. 30m. clouds began to appear in different parts of the sky: first in Auriga, in the E.N.E.; a moment afterwards another in Aries. In the beginning it was not evident if they were clouds or auroral phenomena, but they proved soon to be clouds floating off southwards by the north wind.

The aurora had now lost much of its splendour; I noted still a few beams, *viz.* :—

At 6h. 32.5m. a beam about 10° east of Polaris; at 6h. 33m. the red beam, discovered at 6h. 27m., had so far shifted to the west that it went through the head of the Dragon; at 6h. 37m. there was still a faint beam extending from α Coronæ (visible in the twilight) to Vega, which stood higher and more to the south.

At 6h. 38m. there was a white band between α Aurigæ and α Persei; I was not sure if it was auroral or a cloud.

At 6h. 40m. there appeared two new very broad beams in the north-west.

Now the east becomes more and more covered; from the north to the west there extends itself a whitish glow to a height of 40 degrees; in the north-east this glow is much feeble and lower; therefore I estimate it as not higher than from 20 to 30 degrees. It flows off very indistinctly. The polar light seemed now to have passed its greatest intensity; the observations were no longer continued.

A part of the night a white auroral light remained still visible over the northern sky; at 9h. the sky was entirely overcast.

At midnight it was clear again, and the whole northern sky was always covered by an auroral light; I am told that it was still there at 5h. in the morning.

It is said to have been then in the north-west, of a purple colour, in the north-east more pale yellow. J. A. C. O.

Utrecht, November 18, 1882

Effects of Lightning

PERHAPS your readers will be interested in the following remarkable incident of the action of lightning which has just occurred at the village of Great Lumley, near Chester-le-Street, in Durham.

A severe thunderstorm passed over the valley of the Wear on Saturday, June 9. Great Lumley is situated on the top of an elevated plateau on the east side of this valley, and its houses are conspicuously exposed to the weather. At about 11 a.m., during the progress of the storm, an old stone house with steep pantiled roof, known as the "Old Hall," was struck by a thunderbolt. The house is only of moderate height, having three low stories; but it is on some of the highest ground in the village, and is also one of the loftiest houses therein. It is on the south side of the principal street forming the village, and it has two gable ends, which are, however, partially concealed at their lower portions by lower houses joining on. There is a yard in rear of the "Old Hall," separating it by a few yards from some smaller houses mostly inhabited by pitmen. The coal lies about seventeen fathoms below the surface, and there are several pits in the neighbourhood.

The principal damage done to the house is in the internal woodwork; but a hole has also been made in the tiled roof, the upper courses of a brick chimney-stack built over the centre of a brick partition wall which divides the building into two separate dwelling-houses have been thrown down, and some broken bricks and tiles were hurled as far as sixty feet distant to the southward. The building is about 220 years old, and is externally in a rather dilapidated condition. The masonry is rough sandstone rubble, the surface of which has in places been much disintegrated by age and weather. The building is Lord

Durham's property, and is let in tenements. At the time of the accident the whole of its eastern dwelling-house was unfurnished and uninhabited. This was where the principal injuries were effected. The western compartment is occupied; and the inmates were knocked down by the concussion, various pieces of furniture being also damaged by the same cause; but nothing serious occurred. The building, being so old, has also experienced considerable damage externally from the tremendous concussion which appears to have accompanied the explosion of the thunderbolt. Loose tiles and stones have been dislodged; an old wooden frame in a window-opening in the loft at the east gable has been thrown to the ground below, and a considerable patch of surface masonry immediately above the window-opening has been shaken down. Falling bricks and stones have also made some holes in adjoining roofs; and the signs of injury shown by all these causes led the people in the adjacent houses to believe that these damages constituted the extent of the harm done by the explosion. I inspected the scene just three days after the event. The eastern and unused portion of the "Old Hall" had not then been examined internally, and the doors were still locked.

On visiting the interior I found that great injury had been done to a wooden rafter of the roof, close to the hole already mentioned; to a wooden upright post resting on the second floor and supporting this rafter; and to a wooden girder and joist sustaining the foot of the post. The plaster on the walls adjacent to the post and girder was also torn off; but below the first floor no certain trace of the explosion could be found. The damaged rafter is on the south side of the roof, and the nearest one on the east of the chimney. Its scantling is 6 inches broad by 3 inches deep; and at about one-third of its length from the eaves it is supported by a longitudinal purlin (on a level with the floor of the loft), and also (just inside the purlin) by the upright post already mentioned. From the level of the upper side of the purlin, for a length of about 6 feet upwards, the rafter is completely shivered, and two large pieces are torn out of it. One, the lower piece, is 3 feet 6 inches long, 3 inches wide, and about $1\frac{1}{2}$ inch deep. This has been cut very neatly out of the west side of the under face of the rafter, leaving the new under face almost smooth; and the lower end of the scar thus formed is scooped out in a dovetailed form flush with the horizontal top of the adjacent purlin. No broken pieces corresponding to this scar could be found anywhere about the small loft; but some very small splinters of wood were discovered on the floor to the north-east of the rent rafter and in the direction of the window-opening already mentioned. This latter was quite open to the outer air when the accident happened, and immediately after it occurred numerous small splinters of wood were found in the yard to the eastward of the opening. These had evidently been blown out of it with the old window frame. Some were found against a low wall horizontally distant 63 feet from the opening. These splinters were not visible when I arrived, as they had at once been secured for firewood by the spectators; but I brought away one of the fragments found on the loft floor. Its fibres are quite dissevered from each other, as if the wood had been completely permeated along their direction by the force of the explosion. The other scar in the rafter is cut out of the under face on the east side, partly alongside the first scar, but extending higher up and ending just under the hole in the roof tiles already mentioned. This second scar is 3 feet long by 4 inches by about 2 inches, and two pieces of wood were found lying on the loft floor about 8 feet distant to the north-east, which exactly fitted this scar. The hole through the roof is made at a point where a small iron nail fixed a lath (for the tiles) to the rafter.

The upright post underneath the rafter has a scantling of 8 inches by 3 inches; it is split and torn right up from its foot at the second floor (the next floor below the loft) to its junction with the rafter, to which it was fixed by several $2\frac{1}{2}$ -inch iron nails. The exact joint between the principal splits in the post and rafter seemed to be at the position of one of these nails, which was almost laid bare. I brought this nail away. Its upper two-thirds is quite rusty, whilst its lowest third (nearest the point) is clean and, in minute places, nearly bright. A heavy piece measuring 7 feet 6 inches by 6 inches by about 3 inches was torn clean off the north-west angle of this upright, and was found lying on the second floor about 3 feet off to the northward. The upright forms an angle post on the east side of a sort of dormer or porch projecting out of the south side of the roof, and formerly giving access from the outside to the second floor by a step-ladder. The latter, however, had disappeared shortly

before the accident occurred, having (as I understood) fallen down from age. The upright is split vertically in two places, one (where the piece was rent off) following exactly the line of the small iron nails which fixed the laths (for the wall plaster) to the upright, and the other about 2 inches to the east of this line. At this east split the outer portion of the upright is forced outwards about 4 inches from the centre portion, and all but separated from it. Along the line of the first split the lath nails are forced out of the upright, and the lath ends pushed outwards, and some broken off. A great patch of the plaster that covered them (the centre of it being about 4 feet above the floor) is torn off and thrown violently against the north wall of the building on the opposite side of the room 21 feet distant. The wall is dotted (high and low) with white powdery marks, and the floor at the foot of it is covered with broken and powdered plaster, as also is (more or less) the space of intervening floor. The splits in the upright unite upward, and pass through the loft floor at a comparatively small orifice, and the piece rent out tapers considerably from the bottom upwards. The rent surface of this piece is minutely *fretted* in a curious manner. In the bottom of the rent off piece (which comprised the greater part of the sectional area of the post at this end) were three or four $2\frac{1}{2}$ -inch iron nails, probably used for fixing the post to the floor. These appeared to be driven and bent into the wood; there was no sign of fusing on them, and the surface of the floor immediately underneath the bottom of the post was not in the slightest degree damaged, so far as could be detected. On each side of the slight brickwork forming the east wall of the dormer or porch, a small patch of plaster (about 6 inches square or so) was broken off close to the floor, and about 3 feet southward of the post, but no other marks attributable to the explosion (and these small patches might have been due only to the concussion) could be discovered at the second floor.

On entering the room below (on the first floor), which has no ceiling, it was found that the wooden girder ($9\frac{1}{2} \times 4\frac{1}{2}$), on which the post rested, had a splinter 16 inches long and about 1 inch square (on an average) torn horizontally off the east side of it, 3 or 4 feet to the southward of the position of the bottom of the post, and about 6 feet from the south wall. The girder extends across the room, and rests on the north and south walls. Below the splinter, on the same girder, there was a horizontal crack, extending through the breadth of the girder, and proceeding about 8 feet along it northward, but stopping short of the position of the post above. It seemed, however, *possible* that there might be yet another horizontal split in this girder *close* to the under side of the floor above, and extending right up to the position of the post. Along the west side of the girder is a short joist (7 inches by 3 inches) passing through the south wall, extending about 4 feet into the room, and fixed to the girder by three large iron trenails; and just below it there was some more slight woodwork bedded in the wall, and apparently rotten. This joist was forced out from the other about 1 inch, and had a horizontal split passing exactly along the line of the heads of the three trenails, and completely separating it into two layers. A small piece of the rotten wood underneath (about 6 inches by 2 inches by $\frac{1}{2}$ inch) was broken off, and thrown about 4 feet into the room on the floor to the north. An irregular patch of damp plaster about 4 feet by 18 inches, which had formerly concealed this rotten woodwork, was torn off, and most of it was (as in the room above) thrown hard against the opposite north wall, to which portions were still adhering. These portions are chiefly high up the wall, and near the floor above. Some larger pieces were also spread over the intervening space. The wall where this plaster was torn off was almost saturated with moisture, and the plaster round the rent piece was quite wet and discoloured.

There are no certain traces of the thunderbolt visible on the outside of the south wall, where, however, it most assuredly must have been present. The ground at the foot showed no signs of rending. There was a small lean-to outhouse nearly below, the roof of which was damaged; but I was led to understand that this had been done before; and as the place was locked, and my time was limited, I did not go inside it. At the angle made by one of the side walls of this outhouse with the main building, and not far from a point vertically below the position of the end of the girder, was a wet piece of ground habitually used for emptying slops at; and this seemed by no means an unlikely place for the thunderbolt to have originated. Here and there on the face of the dilapidated masonry some rather new looking abrasions were to be seen; but not even just abreast of the end of the girder could I detect for certain any

traces of the explosion; and no metal of any kind was visible. In this connection it may be mentioned that there were no eaves-gutters, rain-water pipes, or metals of any sort on the outside of the house or on the roof.

Perhaps the most noteworthy feature of this accident was the *complete absence of any sign of burning or charring* at the rents in the girder, joist, post, and rafter. The nails struck also showed no symptoms of fusing; and, for all the *traces* that were left by the stroke, it might have been quite unaccompanied by heat. The work of the explosion seems to have taken altogether the form of mechanical violence. The wood of the post, rafter, and girder is sound, dry, old fir, and this would seem peculiarly liable to be set on fire.

The almost perpendicular bend that the course of the stroke seems to have taken from the girder to the post is also very curious. That the direction and force of the stroke was *upward* appears to me a conclusion quite irresistible. I have but little doubt in my own mind, from the traces left by the thunderbolt, that it sprang from the ground outside the building, at or near the wet south wall; passed up its outer face, entered the building through the wall at the rotten wood, and passed through or close to the joist and girder; then, attracted by the nails in the bottom of the post, it took a sudden turn upward (for there were no other marks of its course in the first floor room than those described), cleft right through the heart of the post, altered its course obliquely to gouge out the lower part of the rafter as far as the small nail, broke through the tiles, knocked off the chimney-top, and thence rushed to join the complementary force that had already started from the thundercloud to meet it.

A. PARNELL

13, Windsor Terrace, Newcastle-on-Tyne, June 14

The Soaring of Birds

IN NATURE, vol. xxvii, p. 535, Lord Rayleigh gives what he suggests as a possible explanation of the soaring of "pelicans and other large birds in Assam" mentioned by Mr. S. E. Peal. My own observations correspond so exactly with the theory advanced that I venture to give them for whatever they may be worth.

I have never indeed observed the flight of pelicans, but the Indian kite, the turkey buzzard, and perhaps all vultures, have the same habit of soaring in great circles. The *sandhill crane*, as it is commonly called in the United States, a large migratory crane, possesses this characteristic in a most remarkable degree. These birds will go soaring about for hours at an immense height, never seeming to move a pinion except once in a great while to steady themselves a little. They always move in irregular circles at such times, and there is always a drifting with the wind; but at such a great distance above one it would be impossible by mere ordinary observation to detect the obliquity of the circles if it existed.

A short time since, however, I had a fine opportunity of witnessing the soaring of some kites; the advantageous circumstances being that they were not far away, and that I saw them commence when they were so low that there was little chance of being mistaken in what I saw. I was sitting before an open window one day about eleven o'clock. There was a gentle breeze blowing from the south-east at the time. Presently my attention was attracted by several kites over the village to the north-west. The motions of two in particular I followed for some time. After moving their wings to attain an elevation above the houses and trees they began soaring, and continued upward in this manner to a height of perhaps two thousand feet, apparently making no exertion with their wings except to steady themselves a little occasionally. The method of accomplishing this was evidently to circle away to leeward in a great curve which inclined downward a little, thus acquiring considerable momentum; then turning toward the wind and adjusting the surfaces of the wings to the proper angle, they would shoot upward to a point considerably higher than the one from which the circle began. By the time the momentum was exhausted the bird was circling around again for another sweep to leeward.

There was considerable drifting with the wind, so that in attaining an elevation of some two or three thousand feet the birds had moved away nearly a quarter of a mile. Their consequent upward motion was in an irregular spiral, the highest parts of the curves being on the windward side.

Ongole, India, May 21

W. R. MANLEY