it is doubtful if birds seek fungi, except to beat them in pieces and pick out the larvæ. Whether horses, oxen, and sheep really *eat* the common mushroom, we venture to call in question, but they *do* eat the grass upon which fungus spores have fallen. We have observed horses, cattle, and sheep eating the grass all around where mushrooms have been growing, and seen them pass on, leaving the mushrooms for us to gather on our own account. This does not show much animal predilection for fungus food, and hardly bears out the paragraph that "horses, sheep, and oxen are all readily attracted by the taste and mealy smell" of the mushroom. Without venturing to throw doubt upon the old faith that the spores of the mushroom are doomed to pass through the entrails of a horse, or that a horse or cow may sometimes even eat a mushroom if one comes in its way, still we have great hesitation in accepting as an article of belief that horses are really so fond of fungi that they seek them out, and devour them bodily, for the sake of the preservation of the species. Mushroom gatherers by preference go into meadows and pastures where horses and cattle are feeding in order to fill their baskets, but this could hardly be the case if the animals themselves were so fond of the delicacy, and hence it may be inferred that it is not wholly true that mushroom spores pass through their host because that host recognizes the mealy smell and pleasant taste of the mushroom itself, but rather that they are swallowed unwittingly with the grass over which they are dispersed.

The general question still remains unanswered: "What can be the service which the presumably attractive characters of fungi induce animals to perform for them?" In the case of the *Phalloideæ* there need be little hesitation in furnishing an answer. The fœtid odour of *Phallus*, *Clathrus*, and their allies, undoubtedly attracts flies in great number, and these latter suck up the slimy mass, which contains the spores, with such avidity that scarce a speck is left. These spores are all most remarkably small,[1] so as to leave no doubt as to their being ingested whole, and probably excreted in the same condition, but how, when, and where, is a mystery still. The inference would be that, if true in this instance, why not similarly in others? and hence the inquiry. Unfortunately the data are too few for generalization, and all we can do is to demonstrate that the subject is worthy of investigation, and, as Mr. Straton has observed, "one that requires the gathering together of much individual observation in all parts of the world." Few people hitherto have considered fungi of sufficient interest or importance for any other effort than to kick them over whenever encountered, but in this respect a reform would be imminent, if, by reiteration of the questions here set down, and a wider distribution of suggestions as to the kind of observations required, a larger number of persons could be interested in looking for and recording them. If there are no sexual elements to be discovered, it is still desirable to ascertain what conditions are requisite to secure the successful germination and growth of the agamospores, and how intervening agents might aid the process. The least glimmer of light is always welcome in a dark place.

M. C. COOKE.

[1] Not more than 3 micromillimetres in diameter.

LUMINOUS CLOUDS.

LUMINOUS clouds, which were first seen in 1885, are now acknowledged to have so much importance that it may be worth while to present a brief survey of the phenomenon and the facts established by the observation of it.

On June 23, 1885, about 9.50 p.m., local time, I noticed an extraordinary brilliance produced by light-clouds in the north-western sky. I had always previously directed great attention to clouds, and on this account these bright clouds appeared to me the more surprising and puzzling. About 9.50 p.m. the north-western and northern sky was covered, to the height of about 20°, with a layer of bright cirrus-like clouds, which reached from about N.W. to N.N.E. In this layer, the lowest part of which was concealed from me by houses and trees, three horizontal zones could be distinguished. The lower zone was without lustre, and had a yellowish appearance; higher up there was a strip, several degrees in breadth, which shone with an extremely beautiful, white-gleaming, silver-like light; above this strip was another like it, but not quite so brilliant, of a bluish tint. The light of the central zone was comparable to the light of the nearly full moon, when it stands at sunset at about 10°, more over the eastern horizon. About 10.30 p.m. the height of the upper limit of the phenomenon had been somewhat lowered; the three zones were still there, but had become —especially the uppermost one—somewhat narrower.

The position of my place of observation—Steglitz, near Berlin—is 52°·5 N. lat.; about 9.50 p.m., local time, the depth of the sun below the horizon was about 9°. It is well known that, at this depth of the sun, ordinary clouds cannot any longer be affected by direct sunlight.

The same phenomenon appeared pretty often in the course of the following weeks; and I had, therefore, repeated opportunities of studying its peculiarities. I have never seen anything of the same kind at the time of sunset. As a rule, the phenomenon began to appear from 15 to 20 minutes—but sometimes 40 minutes, or more—*after* sunset. Several times I remarked that almost the whole sky—with the exception of a segment in S.E. at the height of from 10° to 20°—was covered by the gradually increasing brilliance. In all these cases a gradual, progressive extinction of the phenomenon, proceeding from S.E. to N.W., was observed. The luminous clouds, when they first shone, generally gave forth only a feeble light. As the sun sank deeper, a gradual, but in the end complete, extinction of the phenomenon took place from the south-eastern side; but at the same time the light of the remaining part became steadily stronger, until it reached its highest degree of strength, when the upper limit in the N.W. had a height of about 12°. From that point onwards the strength of the light decreased.

On some evenings the phenomenon was specially striking, less in consequence of the light than in consequence of an occasional want of light. Several times I observed—the sky having been perfectly clear when the sun set—that about an hour after sunset an absolutely impenetrable black wall, like a threatening thunder-cloud, appeared in the N.W., from the horizon to a height of from 5° to 20°. Higher up, on the contrary, the silver-bright shining showed the presence of the phenomenon. Gradually the black shadow disappeared, from above downwards, and gave place to the intense shining.

Towards the end of the month of July 1885 the luminous clouds disappeared, and it seemed as if the phenomenon had come to an end. It was therefore the more surprising when, towards the end of May 1886, the phenomenon again presented itself suddenly. As in the preceding year, it remained visible, with some interruptions, until the beginning of August. The phenomenon has since been repeated from year to year, always at the same season.

As the result of incessant efforts, I have succeeded in establishing that luminous clouds migrate in the atmosphere of the earth in such a way that during the months of December and January they are to be found in the southern hemisphere at the latitude of from about 48° to 60°. No information with regard to the phenomenon in equatorial regions has yet been received. This suggests the possibility that in passing through these regions it is not visible; but when we consider that also in the temperate zone there are extensive districts in which

the phenomenon must certainly have presented itself, but from which no record of observations has hitherto come, the fact that it has not yet been observed at the equator will not lead us to conclude that it is not visible there in intermediate times.

The above-mentioned decrease of the apparent height of the upper limit of the phenomenon, coinciding with the deeper sinking of the sun, causes us to recognize that it is due mainly to direct illumination by the sun. Starting from this assumption, we may readily find the principles for the determination of the height of the phenomenon. During the first years, therefore, I frequently made measurements of the apparent height of the loftiest point of the arc which limits the phenomenon towards the S.E.; and, having regard to the time of the measurements, I found that the distance of the phenomenon from the surface of the earth was from about 50 to 60 kilometres.

The knowledge of this extraordinary height excited in me the most intense interest, and my aim now was to determine the height by a more trustworthy method. For the ultimate success of my efforts I am especially indebted to the co-operation of Prof. Förster, Director of the Berlin Observatory. On the evening of July 6, 1887, Dr. Stolze and myself (the former having taken up his position in Berlin, while I observed the phenomenon from the Potsdam Observatory) succeeded in each getting two simultaneous photographs of the luminous clouds. The calculation made in accordance with these photographs gave a height of about 75 kilometres. But this estimate was not perfectly satisfactory, so far as precision was concerned; for, in the first place, the basis of about 26 kilometres was small; secondly, the direction of the basis was such that it formed with the direction towards the luminous clouds too small an angle; and, thirdly, the

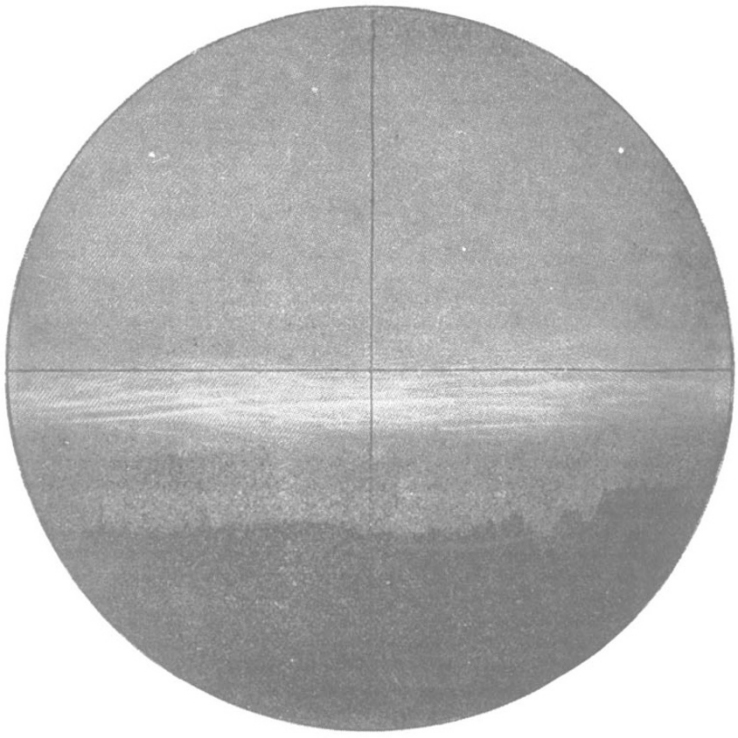

FIG. 1.

photographic apparatus employed had not been worked with sufficient exactness.

In the year 1889 the luminous clouds were at last repeatedly and simultaneously photographed, with improved apparatus, at Steglitz and Nauen, which are distant from one another about 35 kilometres, and lie with regard to one another in the direction from east to west. At Rathenow also, 70 kilometres west from Steglitz, photographs were taken. These were not exactly simultaneous with the others, but the time differed only by a few seconds; and they are useful at least as a means of checking the results obtained from the photographs taken at Steglitz and Nauen.

From these photographs it is inferred with great certainty that the distance of the luminous clouds from the surface of the earth on July 2, 1889, was 81 kilometres, and that it was 82 kilometres on July 31, 1889. For June 12 there is an estimate of 90 kilometres, but this is less certain than the other two.

These results follow from the measurement of 108 different points, corresponding to one another, which are distributed on six pairs of plates; and it is interesting, from the remaining errors of the single groups, to test more closely the question what part is taken in these errors by, say, the thickness of the cloud-layer in a vertical direction.

It is well known that there is a certain law relating to the probability of the distribution of errors in accordance with their greatness. According to this law, it is to be anticipated that errors which lie between the triple and the quadruple value of the mean error, occur *once* among 80 different points which have been measured in the photographs of July 2 (in which the conditions of accuracy were the most favourable); and, further, that of errors which lie between the double and the triple value of the mean error *six* are to be expected. In reality, the calculations agreed very well with the number of observed cases—viz. 2 and 5 respectively.

These figures show very plainly that the differences of the results with regard to the height are essentially a consequence of errors of measurement, and that the thickness of the cloud-layer itself was very small, perhaps only the fraction of a kilometre. With this agrees the almost exactly similar aspect of the phenomenon at the two places of observation.

Figs. 1 and 2 represent the phenomenon as it appeared on July 2, 1889. The photograph reproduced in Fig. 1 was taken in Steglitz at 13h. 21m. 0s., Berlin mean time, and Fig. 2 simultaneously at Nauen. It is interesting to observe the parallactic shifting of the same cloud-points, in the two illustrations, in a fixed direction. In each of the illustrations, two stars, α and β Aurigæ, appear. On account of the enormous distance, the lines of direction, in which one and the same star is seen simultaneously from different points of view, are parallel to one another. Hence the deviation of two corresponding cloud-points, in the illustrations, with regard to one and the same star, gives a measure for the parallax of those cloud-points, on the supposition that the focal distance of the photographic apparatus is known. The focal distance of the two sets of apparatus was precisely determined by the photographing of stars, and proved to be almost exactly 200 mm. In accordance with this the above-mentioned height of 81 kilometres was found.

The following peculiarities, which observation of luminous clouds has firmly established, are of great interest:—

(1) Luminous clouds had in general a very rapid movement from north-east to south-west. In some cases movements also took place in the opposite direction; but these were always much slower—and they were also much less frequent—than those first named.

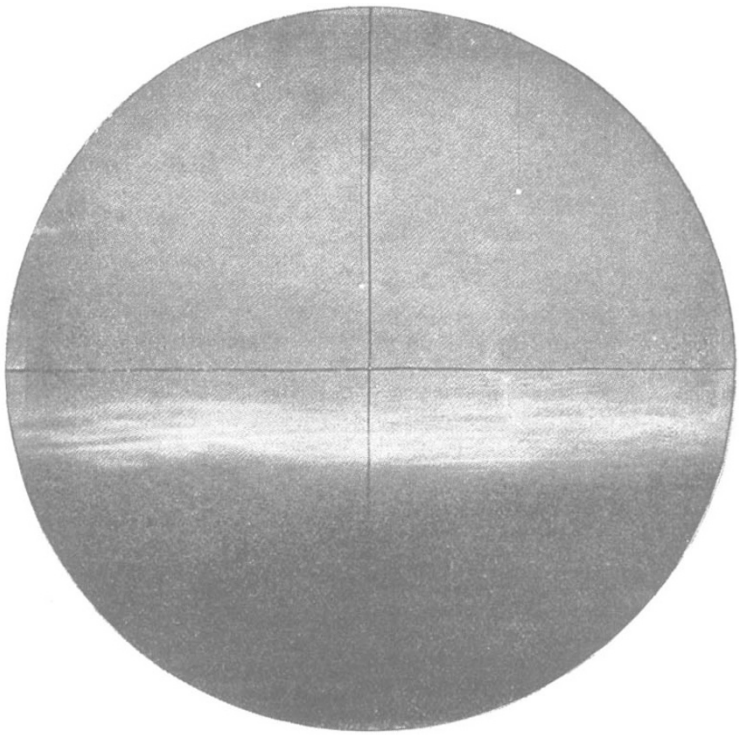

FIG. 2.

(2) Since their first appearance, luminous clouds have to a considerable extent waned. In the year 1890 they have displayed a beautiful brilliance during only about three nights; at other times the light was for the most part very feeble. Very probably we must connect with this decrease of light the fact that the apparent height at which the clouds have been seen, has been very much smaller in the last years than it was formerly.

(3) Luminous clouds present themselves generally much more brightly—therefore are more frequently visible—after than before midnight. While in the first years they appeared before midnight very frequently, they have done so in the last years very seldom. After midnight they still appear pretty often. Whether this distinction existed during the first years, was unfortunately not established, because the regular observations were then usually limited to the time before midnight. O. JESSE.

NOTES.

THE anniversary meeting of the Royal Society will this year be held on Monday, December 1, St. Andrew's Day falling on a Sunday. The medals are to be given as follows:—The Copley Medal to Prof. Simon Newcomb, for his contributions to gravitational astronomy; the Rumford Medal to Prof. Heinrich Hertz, for his work in electro-magnetic radiation; a Royal Medal to Prof. David Ferrier, for his researches on the localization of cerebral functions; and a Royal Medal to Dr. John Hopkinson, for his researches in magnetism and electricity; the Davy Medal to Prof. Emil Fischer, for his discoveries in organic chemistry; and the first Darwin Medal to Mr. A. R. Wallace, for his independent origination of the theory of the origin of species by natural selection. The anniversary dinner will take place at the Hôtel Métropole.