

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 92, NUMBER 12

Modgkins Fund

REMARKABLE LIGHTNING
PHOTOGRAPHS

(WITH ONE PLATE)

BY

C. G. ABBOT

Secretary, Smithsonian Institution



(PUBLICATION 3287)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
NOVEMBER 2, 1934

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Hodgkins Fund

REMARKABLE LIGHTNING PHOTOGRAPHS

By C. G. ABBOT

Secretary, Smithsonian Institution

(WITH ONE PLATE)

About 30 years ago the Institution made grants from the Hodgkins Fund to Alexander Larsen, of Chicago, to promote his studies of lightning flashes, in which he made many photographs of lightning, using a moving camera. Mr. Larsen contributed an illustrated paper on this subject to the Appendix to the Smithsonian Report for 1905.¹ He continued these experiments for several years after 1905, and in the year 1908 sent to this Institution the two extraordinary photographs shown in plate 1, with the following notes:

The print marked no. 4 [pl. 1, fig. 1] is from a plate which was the fourth one exposed on that occasion [May 29, 1908]. The camera at the time was moved with a speed of 1 revolution in 5 seconds. The flash was a very bright one, but it was so sudden and vivid that I did not notice anything peculiar about it. The thunder accompanying it was very sharp and sudden, like the report from a cannon. The interval between lightning and thunder cannot be given accurately; it was less than a second, and probably more than half a second.

The picture of this flash is very remarkable; I have never seen any one resembling it, and would prefer to call it a tubular flash on account of its general shape and large diameter, measuring, as it does, over 3 mm at its widest part, and about 2 mm at its narrowest; this great width cannot be accounted for, to be caused by the movement of the camera; the uniformity of the width, both in the vertical and horizontal portion of it, disproves that idea. It seems to be a practically instantaneous flash, coming from a NW. direction in an almost straight line at an angle of 32°, then bending suddenly, moving upward again, bending in a SW. direction, moving downward, again turning eastward making another bend, moving south slightly upward, then turning downward again.

If we assume that the nearest portion of this flash took place at a distance of 1,000 feet, which in my opinion would be a conservative estimate, we are confronted by the remarkable fact that the diameter of this flash would be over 18 feet. (The angle of the lens is 43°.)

I am absolutely at a loss to account for this remarkable flash; it does not appear to be a ribbon flash, which can be accounted for by the movement of the lightning path, by air currents, so will have to defer my opinion until some future time, and leave it to others who may be able to give a plausible explanation.

¹ Ann. Rep. Smithsonian Inst. 1905, pp. 119-127, 6 pls., 1906.

To summarize, will say that the flash was apparently one which took place between two clouds; it has the appearance of a very flexible tube of large diameter, was almost instantaneous, and accompanied with a heavy downpour of rain. The camera when the exposure was made was moved by hand, the camera being placed on the stand described previously and was slanted upward at an angle of 15° ; the speed was 1 revolution in 5 seconds.

Temperature was 23° C. Barometer steady at 29.81 inches. Wind S.W. afterwards changing W. and N.W., with intervals of calm.

On the same evening [July 17, 1908] a friend of mine, R. J. Spickerman, residing at 2813 Lowe Ave., about 6 miles south from my place, secured a most remarkable photograph of a flash [pl. 1, fig. 2], by means of a small $2\frac{1}{2}$ by $3\frac{1}{2}$ " film camera. A copy from the original photograph is enclosed, marked no. 9, and also an enlargement of the same, marked no. 10. In describing how he obtained the flash he said that he was sitting on the porch watching the beautiful display, and having a camera, he thought that he would try his luck in photographing, having heard me speak of it several times.

He held the camera on his lap, pointing it toward the southeast, where the most flashes were observed. He thought that he held the camera still, at the time that he secured the flash, but the photograph shows that it must have moved. It shows a meandering and very complicated flash, consisting of four distinct and separate rushes,¹ following one another in the same path, opened up by the first discharge. It is almost incomprehensible how such a complicated flash can follow all those curves and bends which the photograph shows. The only reasonable explanation to my mind would be that the path of the flash was a partial vacuum with very low resistance, which the beaded or striated appearance of this flash also would tend to confirm. How this partial vacuum can be accounted for is a difficult problem to solve. It is the first lightning photograph which I have had the fortune of seeing that shows the path in broken lines, or striated. It is this peculiarity which makes it especially interesting. I have only on one occasion observed a vertical flash which showed the path broken up in alternate light and dark divisions (it is about 4 years ago). I did not succeed in getting a photograph of it.

It is possible that those beads or striae are of similar nature as those produced in vacuum tubes, although they differ from them in this respect, that the striae in a vacuum tube are narrow (as the name implies), whereas in the flash they are wide. The word striae is really a poor term to use; beads would be more appropriate, and I shall use it hereafter when speaking of them. On the original photograph some of these beads are 1 mm long but the most of them about $\frac{1}{2}$ mm. The dark spaces between them are on the average about $\frac{1}{3}$ mm wide. Now, saying that the angle of the lens is 36° , and the distance of the flash from the camera was 10,000 feet, which is a conservative estimate, that would mean that the average length of the beads would be 36.5 feet and the average distance between them would be 14.6 feet. Of course these figures are only approximate; they only give an idea for comparison between the striae in a vacuum tube and those in the flash. These divisions seem to have been of a stationary nature,

¹ I think I can see six separate rushes.—C. G. A.

occupying the same relative positions on the different rushes; in that respect they behave somewhat like the striae in a vacuum.

It is possible that these beads in reality were not as wide as they appear, the apparent width being caused by their intense light causing halation to a certain extent. The whole flash seems to be made up of these alternate light and dark spaces; in some places of the picture, where the flash was moving either away from or toward the observer, it shows the beads very close together, forming almost unbroken lines, but judging from the general appearance, it seems that the divisions are of about uniform dimensions. When this picture was taken there was a continual display of meandering flashes, lasting for over an hour. No rain was falling, and Mr. Spickerman judged the lightning to be about $\frac{1}{2}$ mile above the ground. The flash is certainly very interesting, and I think that it deserves to be reproduced in the yearly report of the Institution, if possible, together with the photograph taken by me on May 29, marked no. 4 in my last report.

The barometer reading at 7 p.m. = 758.5 mm. Temperature = 29° C. Relative humidity 80 percent. Wind, west.

B. F. J. Schonland, of the University of Cape Town, Union of South Africa, has lately been making somewhat similar experiments in lightning photography, on which he reported at the meeting of the National Academy of Sciences at Washington, in April, 1934. Mr. Schonland, calling at the Smithsonian Institution, examined Mr. Larsen's photographs and expressed a particular interest in the one here shown as plate 1, figure 1. At his suggestion this publication is made, and it seemed to the writer interesting to include also figure 2.



1. Photograph by A. Larsen of lightning flash between clouds near Chicago on May 20, 1908. Camera moving about a vertical axis. Speed one revolution in 5 seconds.



2. Photograph by R. J. Spickerman of lightning flash between clouds near Chicago on July 17, 1908. Camera held stationary in the lap of the operator.