

of the State is due not to the general frequency of thunderstorms in that region, but to the occurrence of some one specially severe storm.

6. Mr. Allen gives no data by which one can estimate the relative safety of buildings with and without lightning rods, as every one of those injured had no lightning rod. Some years ago several of our American firms manufacturing lightning rods, in their replies to the circulars of the Lightning Rod Conference, stated that no buildings protected by their rods had ever been injured. Doubtless this was an exaggeration, and yet the general conclusion to which that conference arrived still holds good, i. e., that injuries are inflicted only when the lightning rod is imperfect. If it be properly made and placed in the proper position, and in perfect electrical connection with the earth, and be terminated at the top with fine points, then the edifice protected by it with all that it contains will be safe. All accidents may be said to be due to a neglect of these simple elementary principles; "there is no authentic case on record where a properly constructed conductor failed to do its duty."—Ed.]

NOTES BY THE EDITOR.

BALL LIGHTNING.

The Editor has received the two letters following from Mr. C. N. Crotsenburg, Crow Agency, Montana, dated August 22 and September 6, 1898, respectively, and submits his own suggested explanation, but thinks it worth while to publish the whole in full, in order that the attention of others may be drawn to the subject, since, if his own explanation is correct, the phenomenon must be frequently seen by others:

As you expressed a desire to hear from those who had observed "ball lightning" at various times, I will relate an experience which befell me in the summer of 1896. I was then employed as a railway postal clerk on the line of the Chicago, Rock Island and Pacific Railway, between Davenport, Iowa, and Leavenworth, Kans.

One very dark night, about the middle of the summer, our train was going northward between Trenton, Mo., and Lineville, Iowa. Just before reaching Princeton, in Mercer County, a heavy rain began falling, which necessitated the closing of the doors on the east side of the mail car. Soon after leaving that station, at 10:35 p. m., my companion (Mr. R. C. Corbin) lay down for a short sleep. The work being very light that night, I sat in a chair, looking out of the car door to the west. The darkness was intense; not a ray of light was visible from any point, except from the train. When a few miles out from Princeton, and while traveling almost due north, I observed a peculiar light low down on the western horizon. It appeared to be perfectly round and about a foot in diameter, of a dull rose color, or, possibly, like a piece of live coal. When first observed it seemed to be floating within a hundred feet of the earth, but soon rose to a height about midway between the horizon and the zenith. For a time it floated very steadily, but soon began to oscillate up and down, at times even dropping out of sight behind hills. The wind was quite strong from the east, but the light traveled in an almost true north course. Its speed varied, sometimes seeming to outrun the train considerably, and at others it would fall behind, but never far enough to be lost to sight. Most of the time it appeared to be nearly abreast of the train and apparently from half a mile to a mile distant. Soon after it was first observed by me, my companion arose, and we both watched it closely until the town of Lineville, Iowa, was reached. There it passed out of sight behind the depot, and we saw it no more. During all the time it was in sight there was a heavy fall of rain, but very little lightning. It seemed to follow a course parallel to the Grand River, moving upstream. We had no idea at the time what caused the light, but I have since become convinced that it was "ball lightning."

Replying to your letter of August 30, and referring to my own of August 22: I have no means of ascertaining the date of the occurrence related. It made a very deep impression upon me at the time, and Mr. Corbin and myself often talked about it afterward, but I made no note of the date. We made many inquiries concerning the phenomenon which we observed, but never obtained a satisfactory explanation. We thought of distant electric light, but found that none existed within the range of our vision on that portion of the road. Since beginning this I remember that we remarked that if it had occurred a few nights before we should have felt certain that it was the light from a balloon sent up from some Fourth of July celebration, so probably it was within a week of July 4, 1896.

But even then, it would have been remarkable, as the light traveled almost directly north and kept an even course, while the wind blew quite strongly from the east. It was so very strange that I should never have mentioned it, even to my friends, had it not been corroborated by a reliable witness. I have sought for an explanation whenever and wherever I have had an opportunity, and from what I have been able to learn I had come to the conclusion that it was most probably "ball lightning."

Although my conclusions may be entirely erroneous, I have no more plausible theory to advance.

The fact that it was observed by both of us at the same time, and had the same appearance to his eyes as it had to mine before he saw it is very good evidence that it was a reality and not an hallucination. He observed it as he was passing the open door, and before I had spoken to him. In fact the thing was so unreal that I hesitated to speak of it, fearing that it was some freak of my imagination, but when he too saw it the same, I could no longer doubt its existence as a reality, and we both observed it closely while the train was running at least 15 miles. When it disappeared it was at least a mile from us, as the buildings of the town were plainly visible and it was some distance farther west than any of them.

There has always been a great deal of doubt as to whether the phenomenon known as "ball lightning" might not in some way be an optical delusion. The phenomenon rarely occurs, and it is therefore rarely seen by experienced electricians, and the latter were therefore justly skeptical. But within the past twenty years, so many instances have been recorded, some of them by observers of undoubted ability, that there can be no doubt but what this form of electrical discharge can exist, although at present we have no idea of its relation to the other forms of electricity. The following instances are recorded in the famous report of the lightning rod conference, compiled by ten or twelve members of prominent scientific organizations in England, edited by the well-known meteorologist G. J. Symons, and published in 1882:

Page 99. Near Strasburg, Germany, a discharge of globular lightning traversed a horizontal distance of 919 yards, passing below the top of a building which had three good conductors upon it, and struck a distant chestnut tree.

Page 205. D. Morgan, Master of the bark Southern Queen, on December 30, 1879, in the midst of a terrific squall, saw a ball of fire descend from the main and go over the port side of the vessel.

Page 242. Prof. P. G. Tait, of Edinburgh, says that fire ball or globe lightning undoubtedly exists, and is probably due to a species of natural leyden jar very highly charged, which no lightning rod can destroy, except perhaps a close net work of stout copper wires.

The preceding account of a phenomenon by Messrs. Crotsenburg and Corbin does not harmonize with the ordinary descriptions of ball lightning well enough to justify applying that term to it, and the editor believes that some other explanation of the phenomenon must be found. If there were a mass of falling rain, or fog, or haze at a little distance west of the train in which they were traveling, or in fact if there were groves or forests, the leaves of which were covered with rain drops, these would undoubtedly send back to the observer's eye a faint reflection or more properly an antisolar corona, which would be barely visible on a dark night. It would necessarily appear to float along with the train, as the Crotsenburg phenomenon did. There can be no doubt but what the light observed in this case was some form of reflection of the light of the train itself, as it certainly had none of the characteristics of ball lightning.

THE MEASUREMENT OF THE WIND.

The velocity of the wind is usually measured by means of some form of windmill apparatus, such as the Robinson anemometer.