

The mirror is then set so that the beam of light is thrown into the room in a line forming the prolongation of the axis of the wheel, which is readily effected by means of a mark previously made on the opposite wall. The beam will preserve this direction during the day, since the mirror and the sun revolve with the same velocity, and are therefore comparatively at rest. The only motion of the beam in reference to terrestrial objects is one of rotation on its own axis. If the required direction of the beam is different from that of the first reflection, a second mirror is used.

Professor Henry's object in exhibiting this article to the Society, was to render this simple contrivance more generally known in our country. He stated that the original invention probably belongs to Dr. Young; that it was at least published by him in 1807, although an account of the same instrument is given in the *London Philosophical Magazine* for 1833, as a new invention by Mr. Potter. The details of the instrument exhibited differ from those proposed by Mr. Potter, in the addition of a hinge and clamp-screw, by which the axis may be adjusted to the angle of the latitude. The instrument was constructed by an ingenious watch-maker at Princeton; and its whole cost, including the watch-work, was but sixteen dollars.

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ON THE EFFECTS OF A THUNDER-STORM.

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Professor Henry gave an account of some observations he had made on the effects of a thunder-storm which visited Princeton on the evening of the 14th of July, 1841.

Storms of this kind (he said) are not very frequent at Princeton; but two severe ones have passed immediately over the place within the last nine years, and the lightning has struck but twice in the village during that time. It is thought by some of the inhabitants that damage by lightning was more frequent some years ago than it has been

lately; and the idea has been suggested that the water of the canal, which passes to the south of the place, may have had some effect in determining the course of the cloud. Be this as it may, the thunder-storm generally comes from the southwest, and before it reaches the village it usually divides into two parts, one of which passes along the edge of the Rocky Hill, and the other along the valley of Stonybrook, so that the principal part of the storm seldom passes immediately over the village; and when it does thus pass it is generally at a great elevation, and the thunder is not so loud as that which the observer has been in the habit of hearing at the north. In connection with this remark, Professor Henry mentioned that he has several times observed the lightning assume a beautiful violet color, similar to that of the vapor of iodine, and this was particularly the case during a storm which occurred during the 12th of April, 1840. On this occasion, although the cloud and the flashes appeared directly overhead, yet the sound of the thunder seemed to come from a distance. The peculiar color may perhaps receive a sufficient explanation by referring it to the fact of the discharge taking place at a great altitude, and consequently in comparatively rarified air, as in the case of the color exhibited by the spark through a vessel partially exhausted.

The storm of the evening of the 14th of July, was said to be more severe than any which had visited Princeton for twenty years before. It commenced between 7 and 8 o'clock, and lasted about three hours: the thunder was almost continuous, but except in two or three cases it was not very near. Several buildings and other objects were struck in the vicinity of Princeton; and also Mrs. Hamilton's house, which is situated in the village, about twenty rods west of the college, on the opposite side of the way. It seemed a little surprising that this house should be singled out, since the buildings on either side are considerably higher; although at a few rods distance, and in front of the one to the west is a number of tall trees. The house is also furnished with a lightning rod; but this, like most of the rods erected in the country, is not formed in accordance with the most scientific

principles. The front of Mrs. Hamilton's house is parallel with the main street, and is nearly in an east and west direction. The building is of brick, with a shingle roof, and is two stories high; it has on the front, three upper windows, and two windows and a door below; the latter being immediately under the western upper window. The chimney is on the eastern end, and the lightning conductor is supported against this. The rod is formed of round iron, three-eighths of an inch thick, and the several parts of it are imperfectly connected by hooks and eyes. It appears to be merely thrust into the ground to the depth of about two feet, and is terminated above by three prongs instead of one, the points of which are blunted by long exposure, but do not exhibit any appearance of fusion. The top of the rod is not more than six feet above the ridge of the roof; and since the house is about thirty feet long, the farther end of the ridge is unprotected. A point, according to the experiments of Mr. Charles, can only protect a circular space, the radius of which is not greater than twice the height of the point above the plane to be protected.

The lightning, according to the accounts of several persons, came from a cloud situated to the southwest, and the discharge did not strike the most elevated part of the building, but the western end of the horizontal wooden gutter which extends along the front of the house under the eaves. This point is at the greatest possible distance from the extremity of the lightning rod, and perhaps was as near to the cloud as any other part of the building. The discharge immediately divided itself into two parts: one of these, and probably the larger, passed along the gutter, which must have been filled with water at the time, to the eastern end of the same, and then down to the earth along an ordinary tinned iron pipe or conductor, which conveys the water from the gutter to the pavement below. Marks of its passage were observed along the gutter, and particularly near the end next the metallic conductor. The other part of the discharge passed immediately downward through the end of the gutter which first received the shock, to the casing of the window

below ; and was probably thus deflected out of its course by the attraction of the iron hinges and bolts of the shutters. Its course to the ground was further traced along the casings on each side of the front door. The wood was cracked at every place where a nail happened to be in the line of the discharge, and at some places the lightning appeared merely to pass along the surface making a groove in the wood of about one-eighth of an inch in width, and six or seven inches long ; several of these grooves were observed on the side casings of the door. Three panes of glass were broken in the window above the door, and the pieces were thrown inward. The entrance within the door was filled with dust, and a strong sulphurous odor was perceptible for an hour or more after. No marks of a discharge were found at the foot of the lightning rod.

During the storm, several women were alone in the house, and at the time it was struck three of these were in the front room in the second story, and consequently near the line of the discharge along the gutter. Two of them were on a bed placed against the partition wall, opposite to the front, and the third one was standing on the floor about eight feet from the front window, with her face to the same. Those on the bed were unaffected ; but the one on the floor stated that she felt a sensation on her right ear, as if it had been touched with a live coal ; at the same time she felt a rushing sensation down her side and perceived a flash at her foot, and a forked spark in the air between her and the nearest window. One of the persons on the bed also stated that she saw the forked spark in the air, and that the one standing on the floor appeared to her for an instant as if surrounded with light. The outside shutters of the window opposite to which she was standing, were closed, and also one leaf of the shutters of the window farther east. The western window, or that from which the glass was broken, was not in the same room, but in a small adjoining one, over the main entrance from the front door. The chamber door was shut at the time, and no marks of the entrance of the electricity into the room could be found on the walls or on the casings of the two windows.

The principal facts here detailed, although perhaps not unusual occurrences, afford interesting illustrations of the action of electrical induction. First, the horizontal gutter and the vertical tin pipe, both filled with water, formed a long continuous electrical conductor, extending from the point where the lightning first struck to the lower farther corner of the front of the house; and this conductor, on account of its length, would be intensely affected by the induction of the distant cloud, or rather by that of the approaching discharge. If the electricity of the cloud, were positive, then that of the water in the nearest end of the gutter would be negative, and consequently a powerful attraction would determine the lightning on the point where it struck. The house, under these circumstances, might have been damaged even had the rod been much higher than it was, and its connection with the earth much more perfect.

Again, the phenomena exhibited to the women in the upper chamber were also most probably due to inductive action. After a proper allowance for imperfect observation, occasioned by the fright and confusion of the moment, it is still evident that the one on the floor was in some degree affected by the discharge, although none of the electricity of the cloud actually entered the room, since no traces of it were to be found on the walls or other parts. The effects may therefore be referred to the inductive action of the lightning at a distance and through the wall as it passed along the gutter across the front of the house. When a shock of electricity from a Leyden jar is passed through a slip of tinfoil pasted on one side of a pane of glass, the hand on the other side will receive a slight sensation from the lateral induction through the glass. In the same way, it may be supposed that the effects perceived by these persons were due to the disturbance for an instant of the natural electricity of the chamber by the passage of a large charge along the outside of the house.

The discharge, as has before been stated, came from the southwest, and in its passage it crossed obliquely some houses on the opposite side of the street. In one of these, two persons

were sensibly affected by the shock ; and another, in a room with the windows closed, according to her own statement, saw sparks of electricity on the floor. The same explanation will also apply to these effects.

During the same storm another house,\* about three miles southwest of the village, was struck, and this also was furnished with an imperfect conductor. The upper part of the rod had been broken, and it hung down, so that no part was above the chimney. The lightning struck the eastern chimney, which was on the end of the house opposite to that to which the rod was attached, and passed down the inside of the flue to the kitchen fire-place, in which wood was burning at the time. It threw down a great quantity of soot, filled the lower rooms with smoke, and diffused, according to the account, a strong smell of gunpowder.

A part of the charge passed to the outside through the thick stone wall which forms the back of the chimney, and was evidently attracted by the iron hoop of a large cask which was nearly against the wall. It made a triangular hole, as if the stone and mortar had been burst outwards by an explosive force, and this was directly opposite the nearest part of the hoop. It then descended along the cask to the ground, breaking off all the wooden hoops in its course, while those of iron were undisturbed. The house is about sixty feet long; and from the state of the rod the greater part of this distance might be considered as unprotected. The stroke fell on the end most remote from the approaching storm, and probably the lightning was drawn to this chimney rather than the other on account of the heated air which was escaping from it at the time.

Effects were also produced in this case which can only be explained on the principles of induction. Three persons, the man of the house, his wife, and son, all took refuge on a bed in a room separated from that through which the chimney passes, and upwards of twenty feet from the line of the electrical discharge. They were all lying across the bed, with their feet hanging down the side, and they each received

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\* The dwelling-house of Mr. Henry Philip.

a shock in the knees and lower joints of the legs. The wife stated that the feeling was precisely like that which she had experienced from a shock from an electrical jar. No marks of the entrance of any part of the discharge from the cloud were found on the plastering or any other parts of the room; the effect can therefore only be accounted for by a sudden disturbance of the equilibrium of the natural electricity of the space within the room.

The induction of an electrical cloud is often exerted at an astonishing distance. It has long been known that a delicate gold-leaf electrometer is sometimes affected by the presence of an electrical cloud immediately overhead; but Dr. Ellet, professor of chemistry in the college of South Carolina, has informed him that if one of Dr. Hare's single-leaf electrometers be furnished with a pointed metal rod attached to the cap, and then placed on the sill of an open window in the upper story, the leaf will be seen to touch the ball at the moment of a flash, although the lightning is several miles distant.