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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 200,

For the Week ending November 1, 1879.

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PROTECTION FROM LIGHTNING.

We learn that a lightning rod company in Cincinnati has patented a system of lightning protection which consists of an iron rod running along the ridge of the building, with points at each end projecting upward. It is supported upon large glass insulators, and has no electrical connection with the building and no rod running to the ground. It is said that there are many public buildings in Iowa which have been provided with this system of lightning rods. We also perceive in the September number of the College Quarterly, a journal issued by the Iowa Agricultural College, in the interest of industrial progress, an inquiry addressed to Professor Macomber of that college in regard to the possibility of protecting a building from lightning by insulating it with a glass foundation. Professor Macomber in his reply admits that it would be possible that a house thus built could be struck by lightning; but adds, "By insulating a building the tendency to be struck by lightning would be very much lessened and the severity of the shock much decreased. Practical illustrations of this can easily be obtained by means of an electrical machine. A spark can be made to pass from the machine to an insulated body, although the force of the shock will be much less than when not insulated." After further illustration, Professor Macomber concludes thus: "Practically it would be almost impossible to insulate a building because after rain commenced to fall it would wet it so that communication with the earth would be established." The belief is quite common that by providing a chair or a bed with glass blocks upon which it rests, safety from lightning is secured, and the lightning company of Cincinnati and the inquirer in the College Quarterly both have the belief in mind. Professor Macomber is evidently not a believer; but we are nevertheless tempted to criticise the tender manner with which he treats this belief, and his use of the word "practical." In his illustration he causes a spark to pass from an electrical machine to an insulated body, and says that the shock of this spark will be much less than when the body is not insulated. We cannot regard this as a practical illustration of what would take place even if a house could be perfectly insulated by a glass foundation. In a laboratory one is dealing with feeble sparks. Moreover the relation between the size of the spark, the size of the insulated body, and the height of its insulation from the earth or neighboring conducting masses is entirely different from the relation which exists between the size of thunderbolts, the size of buildings, and the height of any glass foundation with which any building could be provided. We cannot regard his illustration in any sense a practical one. A thunderbolt which can leap to a house or other building would not be prevented from working its effect upon the building by any insulation which human means could provide its foundation with. The spark would strike the house and then pass by another leap the comparatively insensible interval which separates the house, provided with a glass foundation, from the ground. It is true that the spark would be divided into a spark to the house and another to the ground, through or around the glass foundation; but for the practical purpose of demolishing the house, its energy would be but little impaired. Suppose that a metallic ball a foot in diameter should be hung up by a rubber cord just an eighth of an inch from the ground, and we should cause a spark twenty feet or more in length to leap to the ball, what would take place? The ball would receive almost the entire force of the shock, and the discharge would find its way, so to speak, to the ground through the space of one eighth of an inch which separates the ball from the ground. It does not matter whether this space is filled with air or glass or any insulating medium now known.

This relative magnitude between the discharge and the object struck is apparently not considered by the "Chambers National Lightning Protection Company" of Cincinnati. It is needless to say that their system is impracticable and entirely untrustworthy, for the reasons that we have given above.

For the same reasons the glass insulators with which most lighting rods are provided are useless. If there is a path of least resistance from the lightning rod to the ground through the house the discharge will take this path without regard to the glass insulators. The ordinary lightning arrester in telegraph offices is an illustration of this. the discharge leaps across the short air interval provided between the telegraph wire and an earth connection, this air interval could be replaced by a plate of glass and the spark would still leap through it. All lightning rods should be connected with the system of gas pipes and steam heating apparatus, furnaces, or large masses of metal about a house, and then carefully grounded in moist earth. The best ground can be obtained by connecting the lightning rod with the water pipes if there are such about the house.

FREEZING IN FIRE.

A few days since, while observing the action of his new absorption refrigerating machine at Ruppert's brewery, 92d street and 3d avenue, Mr. T. L. Rankine casually placed a lighted candle against the expansion pipe leading from the liquid receiver. His intention was to melt the frost from the pipe; but to his surprise the effect was quite the opposite, frost forming within the flame much more rapidly than on other portions of the pipe. He afterward observed in the cellar he was refrigerating that directly over the burning gas jets the frost on the pipes along the ceiling was whiter and more abundant than elsewhere.

To those unfamiliar with the fact that the vapor of water is always a necessary product of combustion, the production of frost in an atmosphere of fire seems to be not merely wonderful but magical. And we confess that perfect familiarity with the chemistry of combustion did not greatly mitigate our surprise on witnessing the phenomenon. Of course the principle is the same as in the familiar experiment of freezing water by the rapid vaporizing of sulphuric ether or other volatile liquid in the presence of high heat; but in this case refrigeration is from within, and one sees only the flame surrounding an iron pipe, on which the nascent water vapor is immediately transformed into white frost. It is worthy of remark that the frost is whitest where the flame is hottest, for there the vapor is formed and the combustion is freest from smoke. Incidentally the phenomenon gives evidence of the intense cold generated by the machine, which is as compact and simple as it is powerful. It will be remembered that Mr. Rankine is the gentleman who constructed the large skating rink at Gilmore's Garden last winter, maintaining for some weeks the largest sheet of artificial ice ever known.

EFFECTS OF HEAT IN THE COMSTOCK MINES.

In an interesting paper read at the Pittsburg meeting of the American Institute of Mining Engineers, Mr. John A. Church reviewed at considerable length the accidents in the Comstock mines and their relation to deep mining. During the twenty-two months preceding May, 1879, there were 101 accidents, killing outright 53 persons and wounding 70 others. The accidents were classifiable under the eight following heads: 1. Falls of rock, timber, etc.; 2. Tramming; 3. Effects of heat; 4. Falls of men; 5. Explosions, 6. Hoisting apparatus; 7. Overwinding; 8. Miscellaneous. Most of these causes of danger and loss of life are common to all mining operations; the third class includes accidents peculiar to the Comstock mines.

In several instances miners have been fatally scalded by falling into the hot mine waters, which exhibit temperatures rising to 158° Fah. The most remarkable casualties, however, are due to the killing effect of labor in the hot and steaming atmosphere. The proportion of fatal casualties is larger in this class than in any other, being 73 per cent; and from the peculiar mental effects of the heat it is highly probable that it may be the real cause of many mishaps, which under other circumstances would be ascribed to culpable blundering.

On the 1,900 level of the Gould & Curry mine a drift was run along and quite near to the black dike, one of the hot spots of the mine. At a spot where the thermometer marked at times 128° Fah., Thomas Brown fainted while at work. When taken to the surface and revived he was found to have completely lost his memory. He could not tell his name or where he lived, and had to be dressed and taken home by his friends. The newspaper which recorded the occurrence said that such sudden loss of memory from overheating was quite common in the mines; aud suggested that the fact might furnish an explanation of the walking off into fatal winzes and chutes by experienced miners, seemingly with deliberate intention.

A frequent accident in these mines is fainting in the shaft while the cage is rising to the surface. The faintness is always felt immediately upon reaching the cooler air, a hundred or a hundred and fifty feet from the surface, where there is usually a side draught through some adit. This happens so often that a man who has been working in a hot drift is never allowed to go up alone. Long habitude to the heat is no safeguard against this danger, and serious accidents have occurred in this way.

Among minor casualties, Mr. Church mentions one which happened to Mr. Sutro, in the Sutro Tunnel, before it made a connection with the Savage mine. After spending some time in an air temperature of 110° Fah., Mr. Sutro went to the air pipe to cool off. He stayed so long that the miners told him to get way from the pipe and let them have air. He did not move, and when they tried to stir him up with the handles of their shovels they found him unable to move. He had lost all volition, and had to be taken out on a car.

The graver results of overheating include insanity and death. The death of a carman on the 1,400 level of the Caledonia mine, Gold Hill, March 11, 1878, is a case in. point. He had been idle for six months, and that morning he was working his first shift. At an early hour he rushed into the station of the 1,400 level and reported that the wheels of his car were smashed. The station master returned with him to his car and found it all right. There was evidently something wrong with the man, and he was taken to a cooling place. Here decided mental aberration was discovered, and the man, firmly lashed to the cage, was hoisted to the surface, where he fainted at once and died in a few minutes. In this case the heat was only about 90° Fah.

In another case a miner died from cramps, attributed to heat, but which may have been due to drinking ice water; and another death is charged to a cold taken while cooling off after being partially overcome with heat. Though contrary to the rules of outside hygiene, the miners resort to copious draughts of ice water or to exposure to strong cold air currents for recovery from overheating, and usually with impunity. The cold air cooling is considered the safer method; but to gain time Mr. Church commonly chose the ice water, and never felt any ill effects from it. With several thousand cases a day of rapid cooling off by one or the other of these methods it is surprising that fatal consequences have been so infrequent.