SCIENCE AND MECHANICS.

PROTECTION OF BUILDINGS FROM LIGHTNING.

"If there be one time more than another," says a late writer on electricity, "in which man feels that he is entirely in the hands of One mightier than himself, in which all his personal pride sinks in the conviction of his utter helplessness, it is when the forked bolts of heaven glare about him with frightful brightness, and the dread artillery of the skies stuns him with its deafening peals, and shakes the very earth on which he treads. Then I say, it is that his conscience tells him how entirely dependent he is; and how, in a moment, the next flash might be to him the instrument of death, without his having the slightest power to avert his fate. In respect to the other great and irresistible powers of nature, man, in some sort, seeks them out—the lightning's flash seeks out him. It is true he may go to shores where thunder-storms are less violent, or to others where they are much more violent than in his own land; but regarding it generally, lightning is no respecter of time nor place; it was as much known to the ancients as to ourselves; it comes to us, so to speak, 'in season and out of season'—its geographical distribution is less restricted than that of any other of nature's great phenomena—tempests, perhaps, excepted."

With this startling admonition before him, let any one of the readers of these observations pause for a moment and count the number of lightning-rods in his own neighborhood. Does he hesitate? He thinks there may be one on the village spire, and perhaps another on yon tall chimney; but where else, he knows not. Now he is led to ask What is the cause of this apparent neglect? Why this consummate audacity in trifling with the eternal laws of nature by erecting monuments and inviting down the fire of heaven, and providing no means of conducting it safely away? The leading reasons for this, are, first, the comparatively few accidents by lightning; second, the very recent adoption of lightning protectors; third, the want of confidence in the efficacy of the latter; and fourth, their cost.

Although the extreme magnitude of accidents by lightning cannot be otherwise than recognized by all, and the almost certainty of some one or more buildings being the marked victims at every season; yet each man builds with the chance of his edifice not being the fatal one. Amongst so many, the chances are so much in his favor, that he will run the risk; or else he comes to the still more unphilosophical conclusion, that, as storm after storm has left him unscathed, so will he for ever be safe.

With regard to the very recent discovery of means of averting the effects of lightning, it will be remembered that it was not until the month of June, 1752, that mankind knew what lightning really was. Then it was that Dr. Franklin first drew down lightning from the clouds, by means of a kite, and proved its entire identity with electricity, which discovery led him to the construction of lightning conductors. But before treating of these, perhaps it may be interesting to give some of the precautions adopted by the ancients, in order to protect themselves against this "ethereal fire." According to Herodotus, the Thracians, in times of lightning, were in the habit of shooting arrows against the sky, to repel it from the earth. Augustus used to retire into a cave during thunder-storms, on the strength of an opinion then prevalent, that lightning never penetrated into the ground more than five feet deep. The emperors of Japan, it is said, possessed, a refinement on this mode, by building reservoirs above the caves, into which they retired, and kept them constantly filled with water, in order, as they thought, to put out the fire of the lightning. Augustus, who appears to have been terribly alarmed at this element, used, also, to wear a seal-skin cloak during storms, on account of its assumed protecting efficacy. The Romans used to build seal-skin tents into which the timid retired; and the shepherds of Cevennes, even at the present day, wear hat-bands of serpent skins for the same purpose. Tiberius wore a chaplet of laurel, whenever he dreaded danger from a storm, with a belief that lightning never touched the foliage of the laurel. And it is a notorious fact, that the American Indians, whenever the sky wears the appearance of a thunder-storm, quit their pursuits and take refuge under the nearest beech, with the full assurance that the electric bolts never scathe that tree.

If the ancients were thus industrious to use what, in their ignorance, they thought to be the means of safety against an agent, the nature of which they knew little or nothing, and the action of which they knew still less, how much more does it seem to be the duty of the present generations, who both understand this agent and the means of averting its effects, to avail themselves of the advantages of their knowledge, and employ the remedies they have at their command. Not a year passes without numerous cases of buildings being struck by lightning, for want of proper protection, particularly barns, which, in consequence of the humid gases ascending from the newly-gathered crops, are peculiarly liable to this injury. The necessity and value of lightning rods are obvious and need no further comment.

As scientific knowledge has now obtained its proper rank in our schools, but few of our readers can be ignorant of the fact, that all matter is divided into two general classes, *conductors* and *non-conductors* of electricity. These names, however, are only comparative; for the two classes gradually merge into each other, leaving the distinctive term merely an expression of degree. For instance, copper ranks very high in the scale of conductors; and air occupies a very low rank among insulators; yet, an electric shock will sooner pass through a short interval of air than along a long copper wire. This fact is dependent on a law, the due observance of which, can alone ensure the efficacy of any protecting apparatus. Another modification in a conducting body of a comparatively high class, is its *capacity*, which exercises an important influence over its conducting power. Thus an electric charge, which will pass safely and quietly along an ordinary copper wire, will deflagrate and burn up, entirely, an extremely fine wire of the same kind of metal.

The most important things to be considered in the choice of lightning rods, are, that they should consist of good conducting materials; good capacity; and should have a good connexion with moisture in the earth. In addition to these, the area of their protecting influence should be regarded; the number of rods required for each building; their position in special cases; and the modes of arranging them.

With regard to the *conducting materials* employed in their construction, metal is undoubtedly the best, and the choice would seem to lie between copper and iron. M. Pouillet makes the conducting power of copper from 5½ to 6½ times that of iron; Dr. Priestly makes it 5 times as much; and Professor Faraday 6 2-5ths times as much; so that, after having determined the sectional area of an efficient copper rod, an iron one of about 6 times that area, will possess the same conducting power. Iron, however, will not make durable and efficient conductors, unless they are entirely coated with silver, gold, copper, or tin, in consequence of their liability to rust, or oxidate, by the action of the weather.

As to the *capacity* to be given to a rod, it has been decided by common consent, that, the *sectional area* of one composed of copper, should vary from a circle one half of an inch to three-fourths of an inch in diameter, the larger area being for very tall conductors, and the smaller, for shorter ones. And now, in respect to the *form of the rods*, it is quite immaterial whether they be square, round, or flat; but let it be remembered, that, in all cases, each conductor should be as entire and as straight as possible, presenting a *single point* to the clouds, with the apex tipped with palladium, or gold.

Of all considerations, the most important is a good *connexion with the earth*, which is so very essential, that without this, all other precautions will be in vain. It is not enough that the conductor enter the earth; for it must penetrate it to some depth, in fact, till it reaches the subsoil, where it is well impregnated with water. In order to reduce the destructive action of this moisture (the oxydation of the metal), and at the same time to give the buried portion of the conductor every facility for dissipating its charge, it is better that the rod should terminate by several branches in a sunken bed of well-burnt charcoal, wood ashes, or spent tan bark.

Another important point to be considered, is the *situation and position* in which the rods are to be placed after they are put up. In all cases, they should be elevated above every other point of attraction, at least, *four times the diameter of the area* to be protected; say, in a common-sized house from 10 to 15 feet above the top of the highest chimney, or other object extending above the roof. And as before intimated, the integrity and upright position of the rods should be maintained, as far as practicable, avoiding, also, all abrupt angles and short turns. If a house, barn, church, factory, &c., be located in the immediate neighborhood of each other, and only one of them be protected, the danger of all the others will, thereby be increased. The remedy, in such a case, is so obvious, that nothing is necessary to be added on that score.

The question now presents itself, How are the rods to be affixed to the building, by *conducting*, or by *insulating staples*. Our unequivocal reply would be, by conducting staples—not those covered with copal varnish, or insulated by necks of glass bottles, as has often been recommended by writers on this subject; for, let it be remembered, that the flash, which may have forced its way through many yards of air, would find no difficulty in passing so slight obstacles as these, if such a direction formed a part of the lightning's path previously prepared, or "felt out." It is a well-established truth, that, if a conductor pass near a mass of metal in tolerable connexion with the earth, the flash will sometimes divide itself between the two channels, one portion of it continuing its course down the rod, and the other portion leaving it to pursue the side-path. Therefore, in order to alleviate this "lateral discharge," or deviation from the main channel, all suspected vicinal electrified bodies should be united to the conductor itself, by means of metallic wires or bands. Then, if the building is predisposed, by the antecedent inductive action, to share with the rod, in conveying away the fluid, let it be done in good sooth, without an explosion, without a *fracas*, as the French emphatically call it.

Conductors should neither be painted nor varnished, as that would diminish their conducting power. If made of iron, they should be coated with metal, as before suggested, and may be erected at either, or both sides, or ends of a building, at a distance of about four inches from the walls, supported by iron staples or wooden supports.

Thus we have endeavored to point out the necessity and value of lightning rods, and faithfully describe their chief characteristics, without entering much into theoretical speculations or trivial detail.—*American Agriculturist.*