

XLIV. *A Letter to the Marquifs of Rockingham, with some Observations on the Effects of Lightning.*

To the most honourable the Marquifs of Rockingham.

My Lord,

Read July 28, 1764. **I** Have taken the liberty of addressing the inclosed paper to your Lordship, as it contains a few observations on a subject not unknown to you, and may probably be thought of general use.

I have a further reason for addressing it to your Lordship, as it gives me an opportunity of expressing, in some small degree, the high sense of gratitude I bear your Lordship, for many and repeated favours and obligations conferred on,

My Lord,

Your Lordship's most obedient,

and most humble servant,

June 24, 1764,
Great Queen-street,
London.

Benjamin Wilson.

LONG

Considerations to prevent Lightning from doing Mischief to great Works, high Buildings, and large Magazines : By Mr. Wilfon, F. R. S. and Member of the Royal Academy of Sciences at Upsal.

LONG experience, since the discovery by Dr. Franklin, has now established a truth amongst philosophers, that lightening, like the electric fluid, passes more freely through iron, copper, and other metals, than through dry wood, stone, or marble.

Instances of this truth are innumerable: and to convince us thereof, we need only trace the late violent effects of lightening on St. Bride's Church, and the houses in Essex-street, &c.

For, upon examining these buildings, it appears, that there are certain thick bars of iron, through which the lightening has past, without producing any visible effects: and on the contrary, in certain parts where the junctions of those bars with the stone, or wood, are made, there the lightening, rushing from the iron, has broke the stone to pieces, and shivered the wood.

From the like experience we also learn, that if the iron is too slender for conducting the lightening, it is either dashed into pieces, or exploded like gunpowder; just in the same manner as we are able, by the electric power, to break and dissipate in vapour a very slender wire. Bars of metal, of a proper thickness, and conveniently disposed, seem therefore necessary for the security of such buildings.

It is to be noted, that the mischiefs caused by lightning are not always owing to its direction from the clouds to the buildings or other eminences, and thence
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to the earth ; but sometimes, on the contrary, from the earth, buildings, and other eminences, to the clouds. For the principle upon which its direction depends, appears to arise from the restoration of a certain *equilibrium*, in a subtile and elastic fluid, previously disturbed by various causes.

Now, according to the laws of elastic fluids, the endeavour to restore the *equilibrium* of such a fluid, will be in that direction, where the *resistance* to it's passage happens to be the least. Upon this principle we therefore see a necessity, either to open a passage for it to go freely through, by placing certain bars of metal properly ; or, to stop the passage of the fluid through such buildings entirely.

The last method would be dangerous to put in practice ; because, if high buildings were so secured, the lightening would then attack the lower buildings, which are far more numerous, and probably would destroy a greater number of people, cattle, &c.

Whereas, if the first method is preferred, the high buildings will then tend to protect the lower ones more effectually ; and may with propriety be considered, as so many pipes to carry off the lightening quietly ; either from the earth to the clouds, or from the clouds to the earth.

And that several proper conductors are necessary to carry off the lightning more readily, than some of the *accidental* or *partial* conductors, in a large town, are capable of, appears from this ; that we are able to collect small quantities of the electric fluid, with a slender apparatus in our hands only ; whilst it is exposed in the street, garden, or other open place, during the hovering of such clouds as occasion violent lightening.

From repeated observations of this kind, there is reason to believe, the quantity of lightning at particular times is so very great, that it would be dangerous to invite it to any buildings, and that unnecessarily, in the most powerful manner we are able; by suffering the several conductors to end in a *point* at the top.

On which account, it is apprehended, *pointed bars*, or *rods of metal*, ought always to be avoided:

And as the lightening must visit us, some way or other, from necessity, to restore the *equilibrium*, there can be no reason to invite it at all: but, on the contrary, when it happens to attack our buildings, we ought only so to contrive our apparatus, as to be able to carry the lightening away again by such suitable conductors, properly fixed, as will very little, if at all, promote any encrease of it's quantity.

To attain which desirable end, in some degree at least, it is proposed, that the several buildings remain as they are at the top; that is, *without having any metal above them, either pointed or not*, by way of a conductor.

On the inside of the highest part of such building, and within a foot or two of the top, it may be proper to fix a rounded bar of metal, and to continue it down along the side of the wall to any kind of moisture in the ground.

But if the building happens to be mounted with an iron spindle, for supporting a vane, or other ornament, and it should not be convenient to have it taken away, then the bar of metal ought to communicate with that spindle.

And in regard to the diameter of such a metal bar, it will probably depend upon the height
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of the building: for it is apprehended the great church of St. Paul's, to compleat the partial conductors (which are the metallic cross, ball, gallery, dome, &c.) and secure it effectually, would require a bar of metal two inches diameter, if not more: and a building like the British Museum, one considerably less. But it appears there is no occasion for any at that repository, as it is already provided, though from *accident*, like many other buildings, with very effectual conductors. The copeings of the roof thereof, and the several spouts, which are continued from thence into the ground, being all of lead.

That conductors ought to be thicker than is generally imagined, seems to appear from a late instance taken notice of in St. Bride's church by Mr. Delaval and Dr. Watson, where an iron bar two inches and a half broad, and half an inch thick, or more, was bent and broke asunder by the violence of the lightning.

The Eddystone Lighthouse, which stands upon a rock surrounded by the sea, the work of Mr. Smeaton, was thought to be an object very likely to suffer by lightning; and the more so, as the top of it consisted of a copper ball two feet in diameter, with a chimney of the same metal, passing through it down to the second floor, but no further. Directions were therefore given to make a communication of metal from the lowest part of the copper chimney down to the sea; which was executed accordingly about the year 1760, or soon after the building was finished. Now if, instead of the copper ball, a pointed bar of metal had been put in its place, or above it, and communicated with the conducting matter below, there is no saying what might be the consequence of
so

so powerful an invitation, to an edifice thus particularly situated.

Read Nov. 8, 1764. **S**INCE the former part of this paper was communicated to the Royal Society, that is, on the 5th of August, 1764, I received the following account from captain Dibden, commander of a merchant ship, who says, that in the year 1759, he was taken by the French, and carried prisoner to Fort Royal in Martinico. That in removing him from thence some time after, and on foot to St. Pierre, which is about 20 miles, his conductor, or guard, stopped at a small chapel five miles from the last place, to shelter themselves from the heavy rain which fell during a violent thunder storm. That the chapel had no steeple or tower belonging to it, but stood upon an eminence with three or four poor low houses near it. That soon after they were thus sheltered, a violent flash of lightening struck two soldiers dead, who had been leaning against the wall of the chapel between two buttresses, and not far from the rest of the company; they being all on the leeward side of the chapel.

That it made an opening in the wall about four feet high, and about three feet broad, and in that part only against which they rested.

That captain Dibden, along with other persons, entered at this hole immediately after, to see if any other damage had been done to the chapel. That they observed a square bar of iron near the hole, and upon the ground, about four feet long, and *one inch and a quarter thick*, making an angle with the wall, as they supposed, to support the upper part of an inclined tombstone, which was also thrown down and

broke to pieces. That this bar was joined in the middle to one end of another bar, about one foot long, and *one inch thick*, which laid horizontally, and, passing to the wall, had been there fastened with lead. That the lightening in rushing along the inclined bar, had wasted or reduced its thickness in some places very considerably: inasmuch, that it looked like a burnt poker which had been long used: and broke the bar into two pieces, about an inch above the joining of the lesser bar; the ends of which had a burnt flaky appearance. That the other parts of the bar were changed in colour to a grey, or whitish hue; resembling iron, after it has been exposed to a violent heat, and then suffered to cool.

That the horizontal bar had also undergone an extraordinary change by the lightening, but particularly at that end next the wall of the chapel, it being reduced from one inch in diameter, to the size of a slender wire, but *tapering towards the wall*.

That when the soldiers rested against the wall, their heads were about the same height with the shortest bar; and, from what he can recollect, were very near being opposite to that end thereof, which was inserted in the wall.

That the two soldiers were forced from the wall at the same instant by the lightening: so that their feet, which were one yard or more from it, were nearest to the wall, and their heads the farthest off. That their flesh appeared very black. That their cloaths were burnt and scorched in many parts: and their belts shriveled up, as if they had been exposed to a large fire. That captain Dibden, and other people, felt a disagreeable kind of an electric shock, at the same instant that the soldiers were killed.

Captain

Captain Dibden gave an account also, that he was lately at Virginia, 1763 : that the inhabitants of Norfolk had changed their opinions in respect to fixing of wires and small rods of iron on the tops of their houses ; from the frequent instances they have lately had of their being melted, or destroyed, by the violence of the lightening : and that now they adopted in their stead, rods of iron from half an inch thick, to three quarters of an inch thick, or more. That those rods ended in a point at the top, and extended from three feet above their houses down to the ground : and that many houses had one of these conducting irons at each end.

This account appears very material upon the present occasion, as it serves to confirm the conjectures that are now offered, in a manner so obvious as to require no particular explanation.

The captain added, that, though the pine trees are considerably higher than the oaks in the American woods, yet the oaks are the oftenest attacked by the lightening : and that he does not remember any oaks growing among the pine trees, when the latter have suffered by lightening : which must be owing to the greater *resistance* arising from the unctuous nature of the pine trees.