XLIV. *A Letter to the Marquiſs of* Rockingham, *with ſome Obſervations on the Effects of Lightening.*

To the moſt honourable the Marquiſs 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 Lightening from doing Miſchief to great Works, high Buildings, and large Magazines: By Mr. Wilſon, *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 lightening 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

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 lightening.

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 lightening; 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

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

Read Nov. 8, 1764. SINCE 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: inſomuch, 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 oftenеſt 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.