my anſwers to them, as a teſtimony of the very great eſteem and regard, with which I am,

My Lord,

Your Lordſhip's

moſt obedient,

humble ſervant,

Lincoln's Inn-Fields,
June 26th, 1764.

W. Watſon.

XLI. *An Account of the Effects of Lightning in* St. Bride's Church, Fleet-ſtreet, *on the* 18th *of* June 1764: *In a Letter to Mr.* Benjamin Wilſon, *F. R. S. from* Edward Delaval *Eſq*; *F. R. S.*

SIR,

Read June 28, 1764.

THE incloſed is an account of the effects of the lightning on the ſteeple and ſpire of St. Bride's church, with drawings [TAB. XIV. XV.] which very accurately expreſs the parts damaged by it.

I thought it would be of uſe, by deſcribing the ſeveral circumſtances of this accident, to ſhew more

fully the neceſſity of preventing the danger, that ſuch buildings are expoſed to.

The conſtruction of the ſpire is ſomewhat ſimilar to that of an apparatus purpoſely contrived to draw the lightning from the clouds, as it runs up towards a point, and ends in a metal vane and croſs, the figure of which, as well as the materials that they conſiſt of, ſeem calculated to admit the lightning with the leaſt reſiſtance.

At this place the firſt marks of it are ſeen: at H the top of the copper croſs, which is the higheſt part of the building, the gilding is by the exploſion partly torn off and partly diſcoloured, ſo as to differ remarkably from the reſt of the croſs where the gilding is very well preſerved. Some ſmall pieces of ſolder are melted; and all this part appears as if it had been expoſed to the fire.

The lightning ſeems to have entered here, and to have been conducted as low as the hole at A, by an iron ſpindle twenty feet in length, and two inches in diameter; of which ten feet were ſurrounded by the copper ball, vane and croſs; and the lower half was incloſed in a groove cut through the middle of the ſolid ſtones which compoſed the upper part of the ſpire, and reſted at A on the bottom of that groove, which was ſunk five inches deep into the loweſt of thoſe ſolid ſtones: this laſt mentioned ſtone being three feet broad and one deep. The interval between the ſides of the ſpindle and the groove made to receive it was filled up by melted lead poured in between them.

The lightning accumulated in the metal, having it's paſſage towards the earth ſtrongly reſiſted at this place, has in expanding itſelf formed the hole A, by burſt-

burſting off from the lower part of the ſpindle the ſtones contiguous to it on that ſide.

At each of the angles of the metal, the ſtone on which it reſted is cracked, which probably was occaſioned by the lightning iſſuing with greater freedom from thoſe parts, than from the flat ſurface.

No part of the ſpindle is in the leaſt injured by the lightning, notwithſtanding the great quantity which, from it's effects, appears to have been accumulated in it *.

From hence, as low as to the corniche B, it ſeems to have been conducted along the ſurface of the ſpire, which was wetted by the rain that had fallen in the morning, before the lightning: and having been accumulated in the iron bars B and C, in diſcharging itſelf from them, it has made the greateſt exploſion at this place.

Under this part the freedom of it's paſſage ſeems to have been hindered by all the dry ſtonework underneath, which was defended from the rain by the corniches: and it appears from ſome experiments which I formerly made †, that dry free ſtone, when warm'd to a certain degree (which probably does not exceed the heat which the ſtones of buildings acquire in hot weather) reſiſts the paſſage of the electric fluid or lightning ſo ſtrongly, that with plates of that ſtone, inſtead of glaſs, I performed the Leyden experiment.

* In the year 1750 the ſtones ſurrounding this ſpindle were ſo much damaged, that there was a neceſſity of taking them down and rebuilding that part of the ſpire. The cauſe of this was not known at that time, it is probable that it was occaſioned in the ſame manner as the preſent accident.

† Philoſophical Tranſactions, anno 1759. p. 83.

Under

Under the corniche, the lightning deſcended only by leaping from one iron to another; and at every leap its force ſeems to have been weakened, and at laſt to have been quite diſſipated.

On examining the inſide of the ſteeple beginning from the top, the firſt effect of the lightning that appears is a hole in the ſtone work at B, beginning immediately above an iron bar which ſerved to ſupport the top of the window or opening, and running upwards towards the two croſs iron bars: this, when viewed from the outſide of the church, is ſeen to have ſpread round moſt of the lower part of the ſpire, ſo that it ſeems in great danger of falling.

The next ſtroke is about four feet below: at this place four iron bars lie horizontally acroſs the ſpire, and are tied together by chain bars which are incloſed in the ſtonework: where the end of one of the croſs bars is inſerted in the ſtone, the lightning has burſt open the hole deſcribed at C, and, when the ſame is viewed at the outſide, a great part of the corniche appears to be broken off.

At D, where the two iron bars ſerving to ſupport the top of the windows meet and are joined together, the lightning accumulated in them has broken off the pier by which they were incloſed.

At Fig 2, a bar of iron, which ſerved to ſupport the top of the window in the ſame manner as thoſe laſt mentioned, 21 inches long clear of the ſtonework, and half an inch thick, is broke and bent into the poſition expreſſed in the drawing; and the ſtones immediately above it are ſhattered and disjointed.

The ſills of two windows of this ſtory are torn off from iron bars which lay beneath them.

At

At E, an iron bar N°. 1. about twenty five inches long, was incloſed nine inches deep in the ſtonework of the pier, ſeparating the Eaſt arch from the arch next it towards the North: the end of this bar joins at a right angle another bar, N°. 2, which is laid acroſs the arch. The lightning accumulated in the iron (N°. 1.) which was incloſed in the ſtonework, has burſt off all the ſtone that ſurrounded it, and part of the pier adjoining. The flaw is continued downwards, as expreſſed in the drawing, meeting with ſmaller iron cramps in it's way.

At F, the next arch lying immediately under the laſt mentioned one, an iron was incloſed in the ſtone in the ſame manner as the bar at N°. 1. The ſtone is torn off from this iron exactly in the ſame manner as at N°. 1: but the damage has not reached much further than the ſtone which was contiguous to and covered this bar. At the bottom of this arch the fill ſtone, which covered ſome cramps of iron, is torn off from it's place.

At G, the next arch under this, the force of the lightning ſeems to have been much diminiſhed, a ſmall part of one ſtone only being broken.

From the wall at the Weſt ſide of the South window of the belfry ſome ſtones are thrown down: one chalky ſtone in particular is reduced into an impalpable powder, and the wall under the Weſt window is almoſt covered with the powder: this ſtroke ſeems to have been directed towards the bells one of which is very near the place damaged: the bells have not been examined; nor can they, as I am informed, without danger of ſhaking the ſpire by their motion.

This

This is the loweſt mark which is left of the effects of the lightning.

In every part that is damaged, the lightning has acted as an elaſtic fluid, endeavouring to expand itſelf where it was accumulated in the metal: and the effects are exactly ſimilar to thoſe which would have been produced by gun-powder pent up in the ſame places, and exploded. Amongſt many other ſtones thrown to a conſiderable diſtance by theſe exploſions, one weighing above ſeventy pounds was removed fifty yards Eaſtward from the ſteeple, where it fell through the roof of a houſe.

It is evident that theſe effects would have been prevented, if a ſufficiently large metallic conductor had been extended from the metal at the top of the ſpire down to the earth, communicating with the other metallic parts of the building that lay in it's way.

From ſeveral obſervations which I made on this occaſion, ſuch a communication ſeems neceſſary in buildings of this form. The iron bars, which were fixed in the ſtonework of the Eaſt arches were ſtruck by the lightning, while thoſe in the arches fronting them on the Weſt ſide of the ſame ſtory remained untouched by it. So that I do not apprehend, that a conductor communicating with the Weſt arches only, would have preſerved the oppoſite ones from the damage which they have ſuffered.

When ſuch buildings are expoſed to very large clouds replete with lightning, there is no reaſon to imagine that they will not convey ſome of their contents to other metallic parts of the building at the ſame time as to the metal at the top: for though the

the conductor may be large enough to convey to the ground, from the top, all the lightning that enters that part; yet one ſuch ſmall conductor cannot be ſuppoſed to exhauſt thoſe immenſe bodies ſo quickly, as to diſable them from ſtriking at the ſame time other buildings, or other parts of the ſame building.

A wire, or very ſmall rod of metal, does not ſeem to be a canal ſufficiently large to conduct ſo great a quantity of lightning to the earth; eſpecially when any part of it, or of the metal communicating with it, is encloſed in the ſtone work: in which caſe, the application of it would tend to increaſe its bad effects, by conducting it to parts of the building which it might otherwiſe not have reached.

Dr. Franklyn, from obſerving that the filleting of gold leaf on the cover of a book conducted the charge of five large jars, reaſons that a wire will be ſufficient to conduct the lightning from the higheſt buildings to the earth.

But it appears from an experiment of his own, that a much larger body of metal, when incloſed between ſmall plates of thick looking glaſs, is not ſufficient to conduct a fifth part of ſuch a charge, without being melted, and burſting to pieces the plates of glaſs.

And it is remarkable, that in thoſe parts of the church where the effects of the lightning are moſt conſpicuous, the iron was incloſed in a reſiſting ſubſtance ſimilar to the glaſs ſurrounding the gold leaf in that experiment.

Wires, inſtead of conducting the lightning, have frequently been melted by the exploſion. So that,

I think, a conductor of metal leſs than ſix or eight inches in breadth, and a quarter of an inch in thickneſs (or an equal quantity of metal in any other form that may be found more convenient) cannot with ſafety be depended on, where buildings are expoſed to the reception of ſo great a quantity of lightning. Theſe are the only points in which I have ventured to differ from Dr. Franklyn.

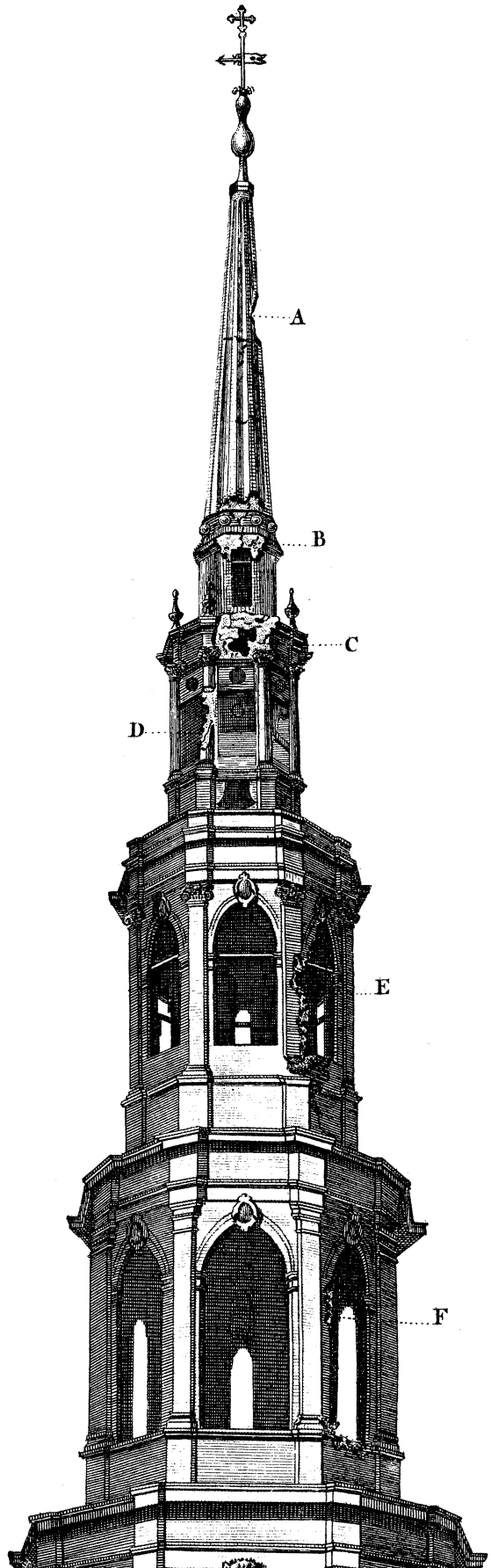
I ſhall not think my time ill employed, if theſe obſervations contribute to our ſecurity againſt the effects of lightning. Certainly an inquiry into the properties of the electric fluid, as it furniſhes us with the means of preventing ſuch accidents, is far from being an uſeleſs ſpeculation. I am,

Sir,

your moſt humble ſervant,

Old Palace Yard,
June 28, 1764.

Edward Delaval.


A
B
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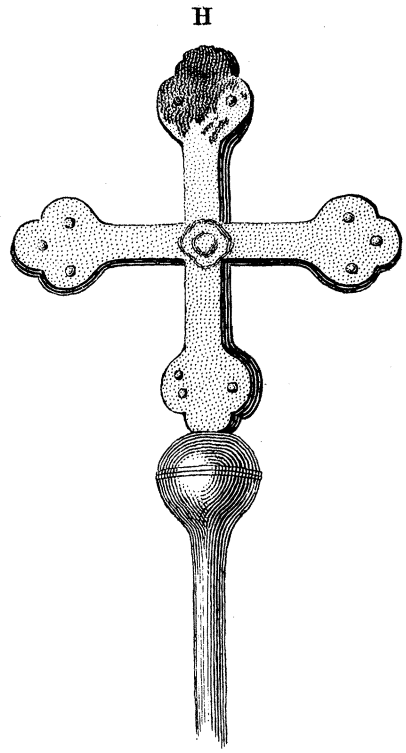
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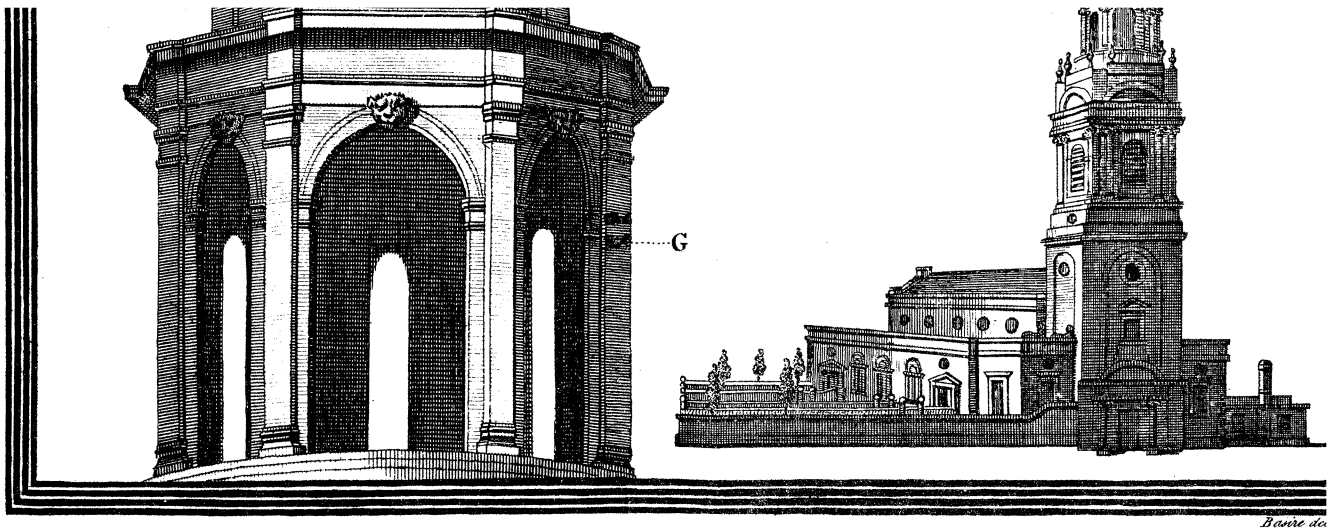

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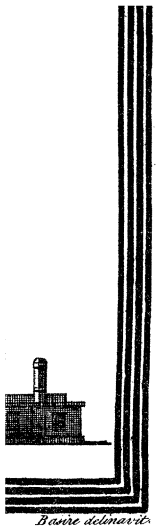


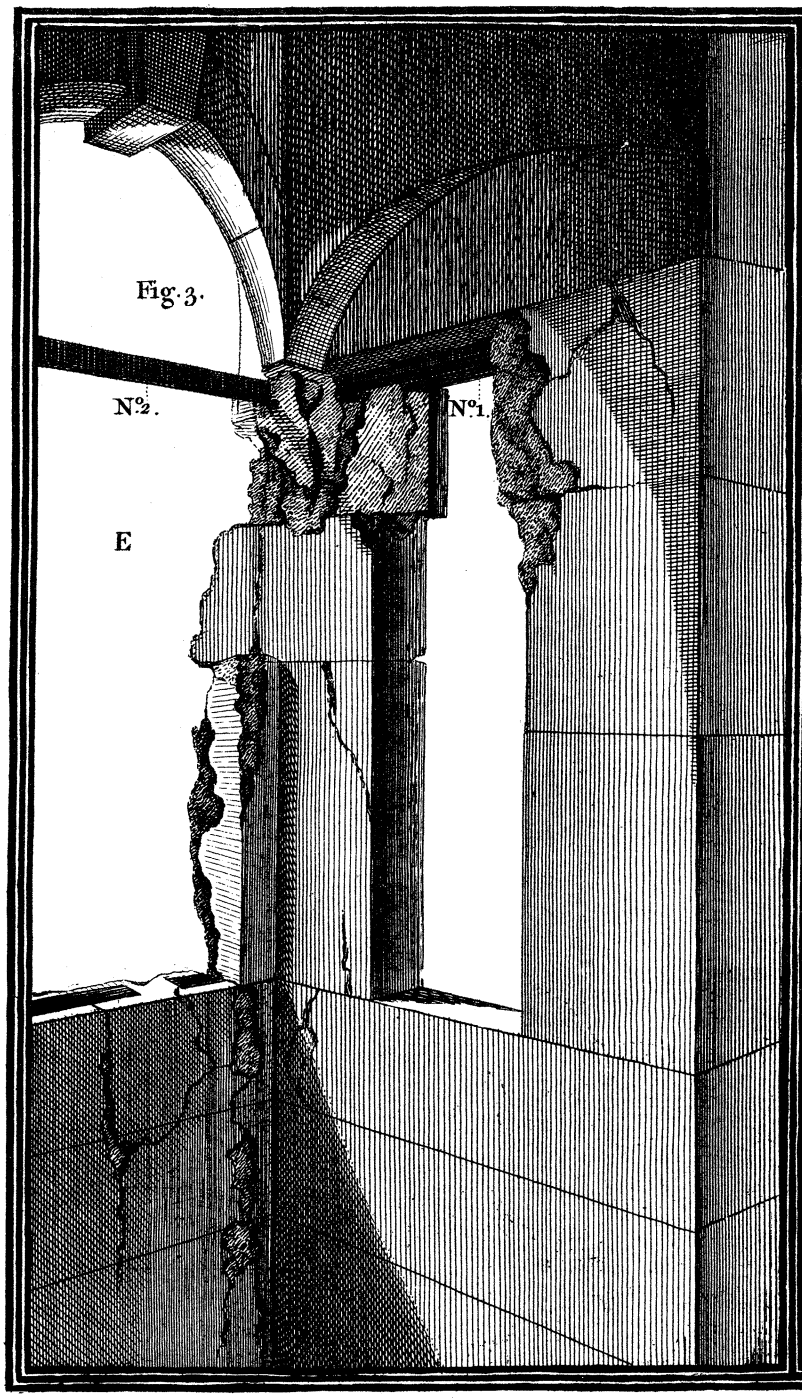
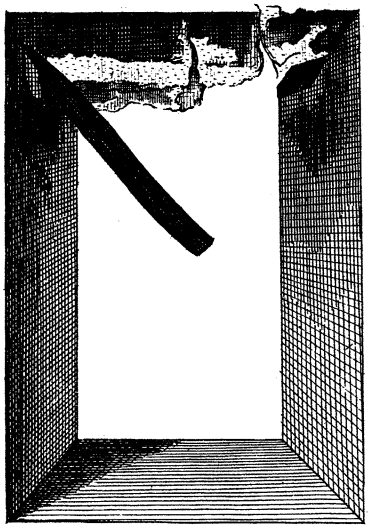
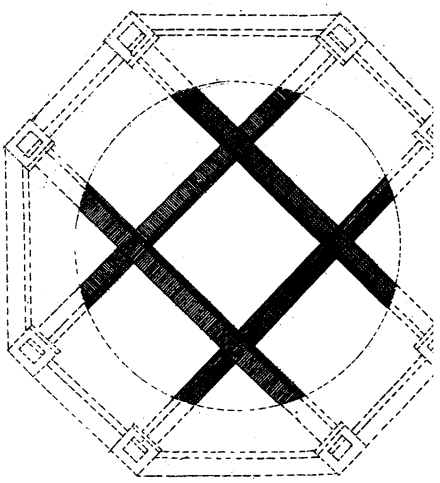
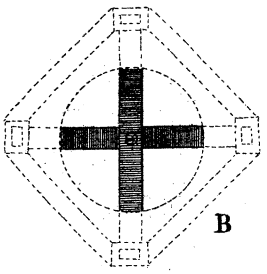


Fig. 2.







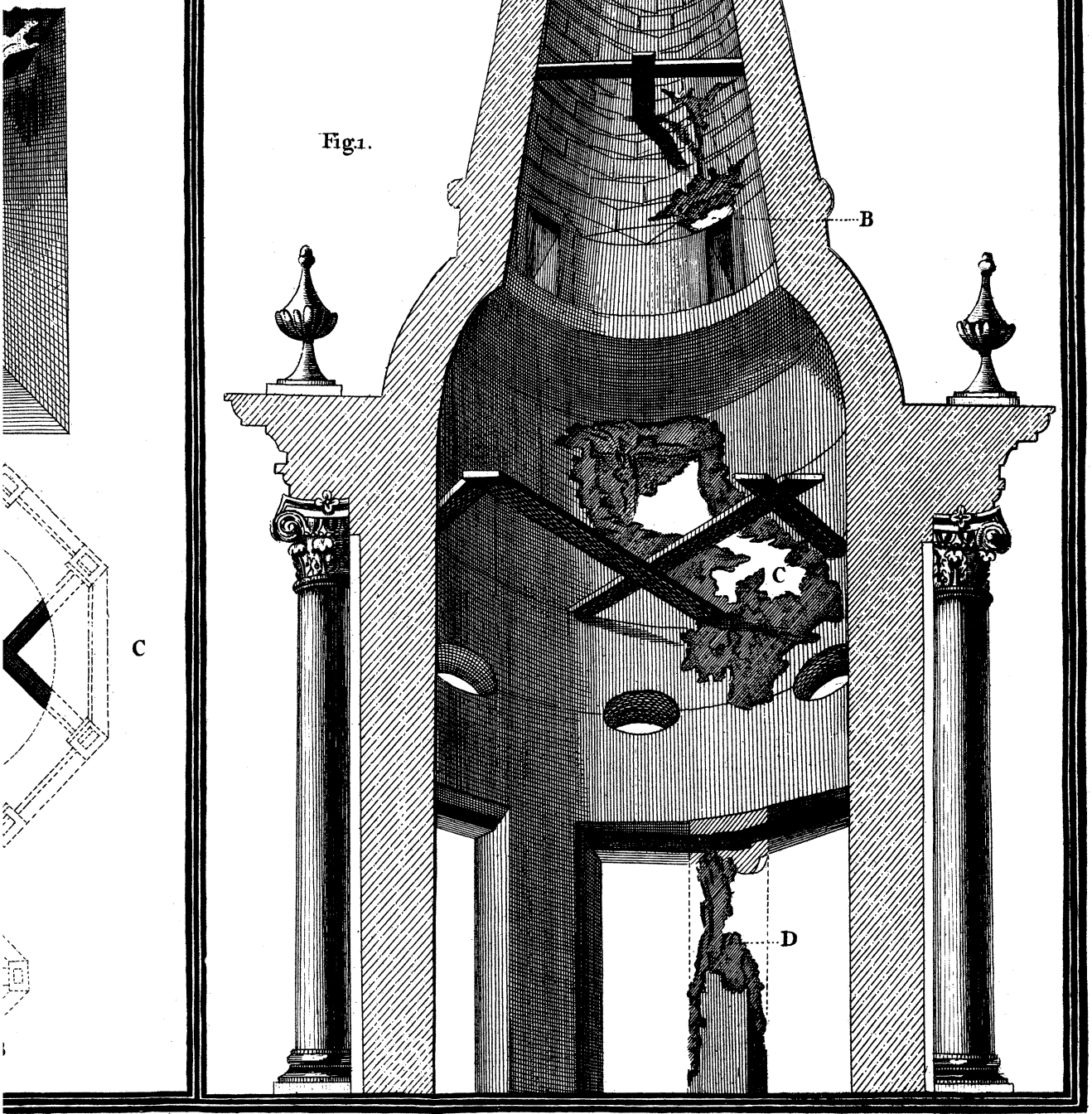


Fig. 1.
B
C
D
C


A
B
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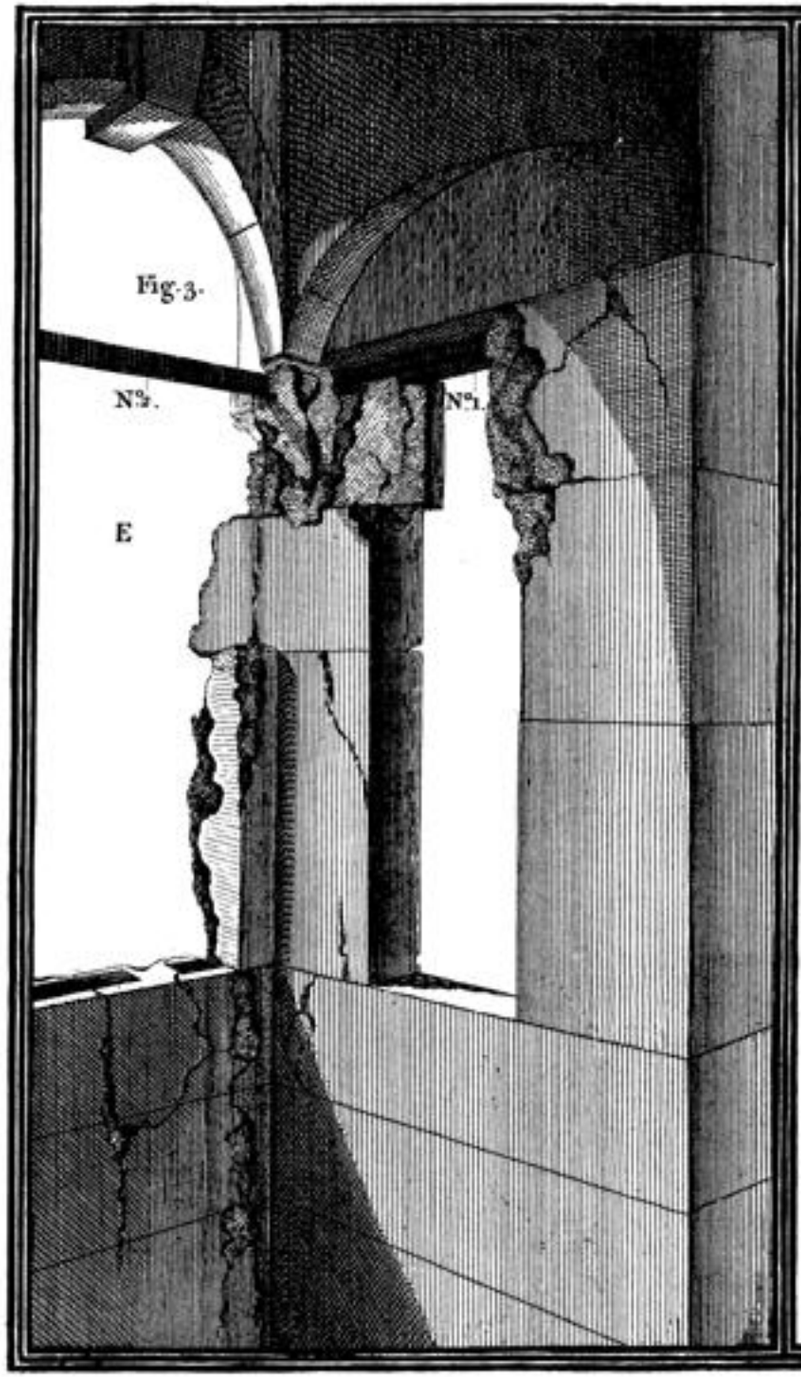

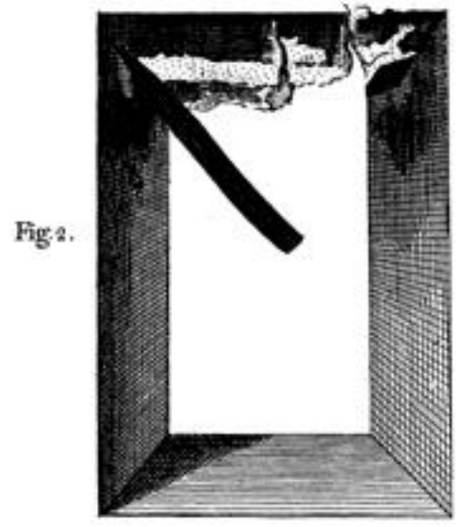
Fig. 2.