XVIII. *Experiments concerning the different Efficacy of pointed and blunted Rods, in ſecuring Buildings againſt the Stroke of Lightning.* By William Henley, *F. R. S.*

Redde, Dec. 16, 1773.

FROM an accident which lately happened to the chapel in Tottenham-court road, where a poor man was killed, an account of which I had the honour of preſenting to the Royal Society, the Gentlemen, who have the care of that building, were deſirous of erecting a proper conductor, to prevent ſuch accidents in future; which was done accordingly under my direction, except three points at the top, to which I rather incline to prefer a ſingle one. On this occaſion, I was willing to obtain the beſt information I could, upon the queſtion, *whether the preference be due to points or knobs, for the termination of conductors*; for which purpoſe, I made the following experiments.

EXPERIMENT I.

I placed two of Mr. CANTON's electrometers, A. and B. [TAB. VIII. Fig. 1ſt.] inſulated, upon ſtands

of ſealing-wax, about ſeven inches aſunder, and as many from the end of a prime conductor, which was eighteen inches long, and one inch and an half diameter; and had a ball, at each end, two inches and a half diameter: the diameter of the electrical globe being nine inches. On the top of the box A, I placed a wire, projecting three inches from the end of it, and terminated by a ball three quarters of an inch in diameter. On the top of the box B, I placed a ſharp pointed wire, projecting alſo three inches from its end. The knob and point were now exactly at the ſame diſtance, namely, ſeven inches, from the end of the conductor. Then, giving the winch five or ſix turns, the light cork balls, hanging from the box A, were repelled to the diſtance of one inch from each other; but thoſe hanging from the box B, ſeparated full two inches. Then touching the prime conductor with a finger, the balls at A cloſed, while thoſe at B remained a full inch aſunder. From this experiment, I think it ſeems evident, how much better adapted a ſharp point is, to draw off lightning, than a knob of three quarters of an inch in diameter; and, conſequently, how much more likely to cauſe it to paſs in that conductor, to which it is affixed, rather than in any other part of the building, where it might occaſion much damage, as well as endanger the lives of thoſe, who might happen to be in it. The following experiments ſeem to make ſtill more ſtrongly in favour of the ſame concluſion.

EXPERIMENT II.

I affixed, to the top of a glaſs-ſtand, a wire, three eighths of an inch in diameter, terminated, at one end, by a ball, three quarters of an inch in diameter; and, at the other end, by a very ſharp point. ſee Fig. 2. Round the middle of this wire, I hung a chain twelve inches long. I then charged a bottle containing one hundred ſquare inches of coated ſurface, and, connecting the chain with the coating of the bottle, I brought the knob of it, very gently, towards the ball on the inſulated wire, that I might obſerve preciſely, at what diſtance it would be diſcharged upon it; which I found to happen conſtantly, at the diſtance of half an inch, with a loud and full exploſion. Then, re-charging the bottle, I brought the knob, in the ſame gradual manner, towards the point of the inſulated wire, to try alſo, at what diſtance that would be ſtruck; but this, in many trials, never happened at all. The point, being approached in this gradual manner, always drew off the charge imperceptibly, leaving ſcarce a ſpark in the bottle.

EXPERIMENT III.

I had now recourſe to the apparatus known, to electricians, by the name of the *thunder-houſe* which I thought a nearer reſemblance of the operations of nature, on theſe occaſions. Having connected a jar, containing five hundred and nine ſquare inches of coated ſurface, with my prime con-

conductor, ſee Fig. 3, I obſerved, that, if it was ſo charged, as to raiſe the index of my electrometer to ſixty degrees, by bringing the ball, on the wire of the thunder-houſe, to half an inch diſtance from that connected with the prime conductor, the jar would be diſcharged, and the piece in the thunder-houſe thrown out to a conſiderable diſtance. Uſing a pointed wire, for a conductor to the thunder-houſe, inſtead of the knob, as in the former experiment, the charge being the ſame, the jar was diſcharged ſilently, though ſuddenly: and the piece was not thrown out of the thunder-houſe.

EXPERIMENT IV.

Having made a double circuit to the thunder-houſe, the firſt by the knob, the ſecond by a ſharp pointed wire, at one inch and a quarter diſtance from each other, but of exactly the ſame height, ſee Fig. 4. the charge being the ſame; although the knob was brought firſt under that connected with the prime conductor, which was raiſed half an inch above it, and followed by the point, at one and a quarter inch diſtance, yet no exploſion could fall upon the knob; the point drew off all the charge ſilently; and the piece in the thunder-houſe remained unmoved.

EXPERIMENT V.

Having inſulated the jar, and connected, by chains, with the external coating, on one ſide, a knob, and, on the other ſide, a ſharp-pointed wire,

wire, both being inſulated, and ſtanding five inches from each other, ſee Fig. 5, I placed a large copper ball, C, eight inches in diameter (inſulated alſo) ſo as to ſtand exactly at half an inch diſtance both from the knob and the point. The jar being fully charged, I delivered it upon the copper-ball by my diſcharging rod, whence it leaped to the knob A, which was three quarters of an inch in diameter, and the jar was diſcharged by a loud and full exploſion, and the chain was very luminous.

Theſe experiments were made in the preſence of Mr. BELL, a very ingenious electrician, whoſe province it was to be particularly attentive to the phænomena, and he could perceive no light upon the chain, which connected the pointed wire B, with the coating of the jar.

EXPERIMENT VI.

I inſulated my three largeſt jars, containing together about ſixteen ſquare feet of coated ſurface. From the bottom of theſe jars projected a wire, terminated by a ball, three quarters of an inch in diameter; and, at the diſtance of one inch and an half from it, I placed the inſulated ball C. Fig. 6, on which I brought down the charge of the three jars, by my diſcharging rod; which leaped from thence to the ball in contact with the jars, and diſcharged them, by a loud and full exploſion; but the ſame thing did not happen, if I removed the inſulated ball only one eighth of an inch further from the other. I then removed the wire, which

was terminated by the ball, from the bottom of the jars; and placed another in its ſtead, of the ſame length and diameter, but very nicely tapered to a point, as all mine are. Then, placing the inſulated ball, C, one inch from the point, I brought down the charge of the three jars, as before, which flew upon the point, and melted it a little. The jars were diſcharged with a loud and full exploſion. But having removed the ball C, to the diſtance of one inch and an eighth from the point, the charge could not ſtrike it; though much of it was preſently drawn off ſilently, by the point, as appeared by the falling of the index of the electrometer.

From this experiment, I think it ſeems ſomewhat more than probable, that a conductor terminated by a ball, of three quarters of an inch in diameter, would be in danger of a ſtroke, from an highly electrified cloud, at a much greater diſtance, than another with a ſharp termination. Indeed I cannot help remarking, how very improbable it appears to me, that a ſharp pointed conductor ſhould, at any time, invite, or ſolicit, a ſtroke of lightning. Imagine, if you pleaſe, that a large cloud is, by the force of the wind, driven violently towards ſuch a point, and actually ſtrikes upon it; yet, as the point would act *as ſuch*, at ſomewhat more than the ſtriking diſtance, it ſeems probable, that part of the electricity of the cloud would be drawn off ſilently, before the actual ſtroke could be made; and the ſtroke itſelf might thereby, perhaps, be a little leſſened.

I ſhall

I ſhall here inſert what ſeems to afford a ſufficient proof of the truth of this reaſoning.

Extract of a letter from Captain RICHARD NAIRNE, of the Generous Friends, dated Montreal, June 24, 1773, to Mr. THOMAS MARSHAM, in the Borough.

" I ſhall make every obſervation I can, for the " good of electricity, and the ſatisfaction of my " friend Mr. HENLEY. I put up a longer top-" gallant-maſt, the day I arrived at Quebeck. The " conductor, by this means, became too ſhort; " and my mate ſtill let it hang, without making " any addition to it. They had a ſevere thunder " ſtorm that night; but think how pleaſed I was " to find, that, from the wetneſs of the ſhip's " ſides, the electricity paſſed into the water, " without the leaſt injury to the ſhip; but the " ſpark on the point of the conductor, which was " very ſharp, was ſo lucid, that my people were " very much frightned."

Since I received this account of Mr. NAIRNE's obſervation, I have been favoured with the following remark, by my ingenious and worthy friend, Lieutenant Fairlamb, of the Artillery; who informs me, that the church of St. Michael, in CHARLES TOWN, South Carolina, uſed to be ſtruck and damaged by lightning, in every two or three years from its firſt erection; but in fourteen years, that it hath been furniſhed with a pointed conductor, it hath never been ſtruck at all. It appears alſo, that when a ſtroke of

lightning fell upon a ſtable belonging to WILLIAM LYTTELTON Eſquire, Governor of South Carolina, and ſplit and threw down two of the raftors; yet the dwelling houſe, at twenty yards diſtance, being provided with a conductor, terminated by a ſharp point, eſcaped unhurt. I would here alſo juſt remark, that nothing can be more ſharply pointed, than the weather-fane which terminates the conductor,* on one of the pinnacles on the tower of St. MICHAEL's church in CORNHILL, which conſiſts of two darts, with a ſtar, having many pointed radii between them; yet in the late thunder ſtorm, the lightning does not appear to have ſtruck this building; but fell upon the key, at the top of the ſpire of St. PETER's church, which is conſiderably lower than the fane of St. MICHAEL's; and the diſtance of the two churches is not more than two hundred feet; as I have been informed by Mr. EDWARD NAIRNE who meaſured it. This key is terminated by a thick blunted end: the ſpire is covered with lead, from the key to the brick tower; and ſo far the lightning was conducted with ſafety to the building; nor could I obſerve, that there had been the leaſt fuſion upon the metal; ſome parts of it, however, I could not get at to examine; but having quitted the lead work, and entered the brick tower, it there did conſiderable damage, till it reached the leaded roof on the body of the church; whence it ſeems to have been conducted, by the pipes, which carry down the rain water, and which reach to the bottom of the building, without further damage.

* Erected by my ingenious friend MR. EDWARD NAIRNE.

Almoſt

Almoſt at the ſame inſtant that this ſpire was ſtruck, the lightning fell alſo upon a Dutch ſhip, in the river Thames, lying off the Tower, which had an iron ſpindle, terminated by a thick blunted end, at her maſt-head, and did her much damage. A very exact account of which hath been taken by Mr. BELL, and, at another opportunity, will be laid before the members of this Society.

The lightning ſtruck alſo upon the pillar, commonly called the OBELISK, in the croſs road in St. George's-fields, Southwark; a very curious obſervation of which was made, ſoon after the ſtroke, by Mr. Coventry, and Mr. Thomas Green, well known to many in the Royal Society, for his ſingular and very curious method of preſerving the ſubjects of natural hiſtory. It likewiſe ſtruck the chimney of the new Bridewell there, which it threw down to the ridge of that building, which was covered with lead; and then diſperſed itſelf with little damage. The lightning fell likewiſe upon another chimney, at LAMBETH; and upon a houſe at the Phyſick-garden, near VAUXHALL; and, as before obſerved, it appears by the beſt information, nearly at the ſame time; and in many other places, conſiderably diſtant from each other.

I have obſerved, on another occaſion, that if a round ball of metal, two inches in diameter, was preſented towards the large prime conductor to a good cylinder, at the diſtance of two inches, it would continue to receive ſuch ſtrong ſparks, as would give the perſon who held it, a ſenſible ſhock in both his legs; but that if the point of a lancet, or a wire ſix inches long, nicely tapered to a point, and tipped with ſteel, were, at the ſame time,

time, held towards the conductor, at the diſtance of two feet, the point would draw off all the electricity of it ſilently, and not ſuffer a ſpark to paſs from thence to the ball; and from this experiment I inferred, that a ſharp point might probably, in ſome meaſure, produce the ſame effect on a cloud highly charged with electricity, * and thus perhaps contribute to leſſen a little, if not actually prevent, a ſtroke. I alſo obſerved, that if the point of the wire, or lancet, was brought nearly into contact with the prime conductor; yet no ſenſation would be felt in the hand of the operator; and this, I imagined, was a kind of demonſtration, that there could be no danger of inviting a ſtroke of lightning from a cloud, by a ſharp pointed conductor; as it could make no difference in the experiment, whether the point moved towards the large prime conductor, or the conductor moved towards the point. It having, however, been objected to this experiment, that it was not analogous to the effect of nature operating by a cloud; foraſmuch as the cloud being a looſe and floating body, it might accede to, and ſtrike upon the point with its contents; which the conductor, being a fixed body, was incapable of doing, I made the following experiment.

EXPERIMENT VII.

I procured, by means of my ingenious friend Mr. Coventry, a bullock's bladder, of the largeſt ſize; which bladder Mr. Coventry gilded for me with leaf copper, and ſuſpended it, by a ſilken

* Or rather on the electric atmoſphere, ſurrounding the cloud.

ſtring, at one end of an arm of wood, placed horizontally, and turning freely upon the point of a needle; the needle being ſtuck upright in another piece of wood, inſerted in a firm baſe, and ſtanding in a perpendicular direction to the floor. The bladder was balanced by a leaden weight, at the other end of the wooden arm, ſee Fig. 7. The apparatus being thus adjuſted, I gave the bladder a ſtrong ſpark, from the knob of a charged bottle; when, preſenting towards it a braſs rod, terminated by a ball, two inches in diameter, I obſerved, that the bladder would come towards it, at the diſtance of three inches; it would even come back to it, when ſwinging in a contrary direction; and when it had got within one inch of it, it would throw off its electricity in a full and ſtrong ſpark: the bladder gave the ſpark nearly, if not quite, as large as it received it. I then gave it another ſtrong ſpark, as before, when, preſenting towards it the pointed wire above-mentioned, I could never perceive that it acceded to that; and when it was brought nearly into contact with the bladder, there was no ſpark at all, ſcarce any ſenſible quantity of electricity remaining in it. I repeated the experiments many times, with the utmoſt care and accuracy I was able; and always with the very ſame reſult.

To the obſervations I have now made, upon the different effects of ſharp pointed wires, or thoſe terminated by blunted ends, or round balls, in electrical experiments, I ſhall add another, with which I have lately been favoured by THOMAS RONAYNE Eſquire, whoſe permiſſion I have to inſert it in this paper. Having

Having cut off a few inches of ſmall harpſichord-wire, he connected one end of it with the the loop, at the bottom of his electrical battery, conſiſting of nine bottles; the other end of the wire he faſtened to his diſcharging rod, which was terminated by a large round ball. Upon this ball he took the charge of his battery, when the whole of the ſmall wire was inſtantly melted. He then cut off another piece, of equal length with the former; and, unſcrewing the ball, he fixed the ſmall wire in its ſtead, upon the upper end of his diſcharging rod. The lower end of the rod was now in contact with the bottom of the battery. The apparatus being thus diſpoſed, he re-charged the battery, and took off the charge upon the end of the ſmall wire, which was ſharply pointed; but, in this caſe, only a very little of the wire was melted; proving, as he obſerves, the preference due to points rather than knobs, as terminations to the conductors for the lightning on buildings, ſhips, &c. The ſame gentleman hath lately favoured me with the following experiment, and the inference reſulting from it.

"Having charged a battery, and unſcrewed one "of the knobs of the diſcharging rod, I cemented "a very ſmall portion of leaf gold on that end, "in ſuch a manner as to act like a point; then ap-"plying the other end, or knob, ſo as to commu-"nicate with the coatings of the jars, I ſuddenly "brought the gold-leaf, as near the diſcharging "part of the battery, as could be done without "danger of a ſtroke; ſtill advancing nearer, in "proportion to the deſcent of the index of your "elec-

" electrometer. In this manner, I exhauſted the " battery, without any ſenſible diminution, or de- " ſtruction, of the gold leaf. Whereas a greater " quantity of leaf gold may be diſſipated, by a " ſtroke from a ſingle ſmall jar, if put under one " of the knobs of the diſcharging rod, and the " ſtroke be invited by the other; for in ſuch caſe, " the leaf gold cannot, in any manner, act like a " point.

" Now as bodies act at a greater diſtance, by " how much they are more acute, and thereby " diminiſh any known electrical force; and, as in " any particular caſe, the ſmallneſs of the pencil, " or ſtroke, depends on the acuteneſs of the point " preſented, I cannot avoid giving my ſuffrage " for points, in preference to obtuſe bodies.

It may not, I think, be improper to introduce, in this place, an experiment lately made by Mr. EDWARD NAIRNE, in Cornhill; which, though it doth not immediately relate to the particular ſubject of this paper, is a very proper one to demonſtrate the utility of metallic conductors in general.

MR. NAIRNE'S EXPERIMENT.

He affixes, in a little apparatus reſembling the hulk of a ſhip, a glaſs tube, about eight inches long, and half an inch in diameter, which is to repreſent the main-maſt. The ends of the tube, which is filled with water, are properly ſecured by corks; and, through each cork, a wire is introduced, of ſuch a length as to reach nearly

to the middle of the tube, and leave a diſtance of about half an inch, between the ends of the two: as in a curious experiment of Mr. LANE's, made with ſmall phials. A ſlight ſhock, diſcharged through this apparatus, inſtantly breaks the tube in pieces, at that part, where the electric matter quits the upper wire, and expands itſelf in the water, before it reaches the lower one; as the natural electricity hath been obſerved to do, in bodies, wherein it hath met with ſuch an interrupted and broken communication of metal; but Mr. NAIRNE having fixed, at the top of ſuch a glaſs tube, and united with the wire of it, a piece of very ſmall harpſichord wire, which was continued to the bottom of it, and there faſtened to a regular communication of metal, in contact with the coating of the jars; he diſcharged through it his four batteries united, conſiſting of ſixty-four jars, containing fifty ſquare feet of coated ſurface fully charged, when the whole of the ſmall wire was inſtantly exploded and loſt; but the tube remained unhurt. An effect analogous to that of the natural electricity, where, though it hath ſometimes happened, that the conductor, being too ſmall, hath been in part deſtroyed, or much injured by a ſtroke; yet the building, to which ſuch a conductor hath been affixed, hath eſcaped, without receiving the leaſt damage.

Among ſome very intereſting remarks on the effects of lightning, by the ingenious Profeſſor WINTHROP of NEW CAMBRIDGE, which have lately been communicated to me by my learned friend Dr. FRANKLIN, I find one, on the influence of

of ſharp pointed conductors, ſo immediately relating to the queſtion under conſideration, that no apology will be neceſſary for introducing it in this place. Dr. WINTHROP, having given a very curious and exact account of a violent flaſh of lightning, which fell upon and greatly damaged HOLLIS-HALL, in NEW CAMBRIDGE, obſerves, that HARVARD-HALL, being furniſhed with pointed wires, which wires were at the diſtance of one hundred and ſixty feet from the chimney of Hollis-hall, on which the lightning fell, eſcaped unhurt, though the wires were ſeen by many to tranſmit a large quantity of it, which left viſible marks upon the bricks, where the wire hooked together. This gentleman alſo obſerves, that a tree, ſtanding at the diſtance of fifty-two feet from a pointed wire, erected upon the ſteeple of a meeting-houſe, as a conductor for the lightning, had been ſtruck and ſhivered; but that the meeting-houſe remained uninjured; and this, he ſays, is the leaſt diſtance from ſuch a conductor, ſo far as he knew, at which any thing had been ſtruck by lightning. It appears, therefore, I think, very clearly, from theſe inſtances, that ſharp pointed wires, inſtead of inviting, and drawing down ſtrokes of lightning, ſerve rather to prevent them, and that they extend their protecting influence to ſome diſtance around them, and ought therefore ever to be uſed, as the termination of the rods erected upon houſes, ſteeples, magazines, maſts of ſhips, &c. in ſhort, on all occaſions, where conductors for the lightning may be thought neceſſary.

I cannot avoid taking notice, in this place, of ſome appearances, upon the iron conductors on St. PAUL's cathedral, ſuppoſed to have been the effects of lightning; of which an account hath been given to the Royal Society, by a very ingenious and worthy member, of whoſe candor I would willingly think too highly, to ſuppoſe he can be offended, if my opinion concerning theſe appearances ſhould be different from his. In the firſt place, had thoſe bars been heated to a red heat ſo inſtantaneouſly, it ſeems probable, that the moiſture in the ſtone, which almoſt ſurrounds a conſiderable length of them, at each end, where they are inſerted in the pavement, would have been turned to ſteam; and, acting like gun-powder, would have exploded, and driven out the bars with great violence. Alſo the leaden pipes, particularly the ends of them which are in contact with the iron bars, muſt have been much melted; but theſe I carefully examined, and could not perceive, that they had been at all affected. Secondly, the end of the iron bar, ſuppoſed to be the moſt affected, was not in contact with the lead-work below it, by near two inches; yet it had no appearance of fuſion, as it certainly would have had, if ſo large a quantity of electricity had paſſed through it; the ruſt likewiſe, I think, would have been cleared away, which was not the caſe, and the end of it have been left quite bright. As to the hole through the dirt, mentioned by Mr. Gould, which lay adjoining to it; the dirt lying in a perpendicular direction, I am inclined to think, that the rain-water had ſoaked through it, and not waſhed

it intirely away. I ſhould apprehend likewiſe, that the ruſt obſerved to lie upon the pavement, had been beaten off from the bars, by the hail, or waſhed off, by the rain, which could not happen to the end of that before mentioned; it being covered by a ſtone, which compleatly ſheltered it from the weather. Had it been exploded from the bars, by ſo violent a ſtroke of lightning, as hath been ſuppoſed to paſs through them, I have ſome doubt, whether much of it, if any, would have been diſcovered. Thirdly, in ſo great a ſtroke, the pointed ornaments of copper, upon the croſs, would probably have been affected; perhaps melted down; but theſe do not appear to have received the leaſt injury. I muſt further remark, that as the conductors, on which theſe appearances were obſerved, were neither of them in contact with the lead-work below them; and there were two other conductors of equal ſize, forming a regular communication of metal throughout; it ſeems probable, that the electricity would have paſſed in the two laſt mentioned; and that thoſe ſuppoſed to be ſo much affected, would have conducted very little, if indeed any part at all of the ſhock. The improbability, I believe I might venture to ſay the impoſſibility, of thoſe bars, which are four inches broad and half an inch thick, being heated to a red heat, by lightning, appears to me ſtill more plainly, when I conſider, that in a ſtroke, which fell upon the weather fane in the ſpire of St. BRIDE's church, in Fleet-ſtreet, the iron ſpindle, which ſupported it, being twenty feet long, and two inches in diameter, and the lower ten

feet

feet of it being ſurrounded by ſtone work, and fixed firmly therein by melted lead, was not in the leaſt affected; but conducted the ſtroke, as far as it went, with ſafety to itſelf as well as the building; and no doubt would have done the ſame to the bottom, had it been continued thither. In this bar, the lightning had an opportunity of accumulating, and it appears, that it did ſo, to a moſt aſtoniſhing degree; yet the gilding only, on the fane, was a little diſcoloured, owing perhaps to the gold ſize, which connected it with the metal; and this, it ſeems, was all the damage it ſuſtained. Similar to this, I would obſerve, that the paint, on ſeveral parts of the iron-work, now in my poſſeſſion, of the chapel, through which the lightning hath paſſed, is not at all affected. An iron bar alſo, upon the OBELISK before-mentioned, of about half an inch diameter, which ſupports the lamp iron at the N. W. corner, upon which the lightning concentrated; and two of the iron rails, on which it leaped from thence, are not injured in the painting; though the points of the rails, which were the fourth on the N. and the fifth on the W. ſide, and the two corners of the iron bar, from whence it flew upon them, were melted a little. It is worthy notice, that theſe two rails were the neareſt to, and ſtood at nearly an equal diſtance, about twenty-five inches, from the lower end of the bar before-mentioned. In ſhort, the more I reflect on this remarkable account, and conſider the effects of lightning in former and ſimilar inſtances, the more firmly I find myſelf fixed in my opinion, that the appearances, obſerved

upon

upon the conductors on St. PAUL's cathedral, were not the effects of lightning, but proceeded from very different cauſes.

I have made many other experiments on the different effect of knobs or points, as oppoſed to inſulated electrified bodies; but as they all concur, in eſtabliſhing and confirming the opinions before advanced, it ſeems unneceſſary to mention them; and the more ſo, as I believe thoſe already recited will be deemed ſufficiently deciſive without them.

Having now finiſhed what I had to offer, upon the ſubject of pointed conductors, as being the moſt proper for the ſecurity of buildings, &c. I ſhall add, by way of appendix, a very curious obſervation, relating to *perſonal* ſecurity, which I find likewiſe among thoſe of the learned Profeſſor WINTHROP, communicated to me by Dr. FRANKLIN. This gentleman, having remarked, that people ſtanding in an open plain, are by no means ſecure from a ſtroke of lightning, adviſes thoſe, who may be overtaken by a ſtorm, in ſuch a ſituation, to retire within ſome ſmall diſtance, as from thirty or forty, to ten or fifteen feet, of an high tree (perhaps about fifteen or twenty feet from the outermoſt branches, may be as proper a diſtance as any) or rather two ſuch, if at hand, and there wait the event, but by no means to go under them. This advice will, I believe, be acknowledged to be moſt judicious, and, if properly attended to, may be of great

ſervice

ſervice to travellers, and be the means of ſaving the lives of numbers; and as ſuch, cannot be made too public.

P. S. Since the reading of the preceeding paper, I have taken an opportunity to repeat the moſt intereſting of the experiments therein recited; and find no reaſon to alter a tittle in my account of them.

The 6th experiment I have alſo varied a little, as follows; I placed the large copper ball, C, at ſuch a diſtance from that in contact with the jars, that on bringing down the charge by my diſcharging rod, it ſeemed to remain almoſt undiminiſhed, though the rod was kept in contact with the prime conductor a full minute. Then, repeating the experiment, with a point inſtead of a knob, the charge was, in a great meaſure, preſently drawn off ſilently. Upon the whole, it appears that though a ſharp point will draw off a charge of electricity ſilently, at a much greater diſtance than a knob, yet a knob will be ſtruck with a full exploſion, or ſhock, the charge being the ſame in both caſes, at a greater diſtance than a ſharp point; and this, I imagine, completely decides the queſtion, which I propoſed to examine.

XIX. *Re-*

Fig. 1.

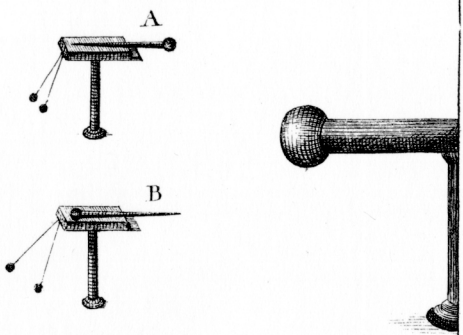
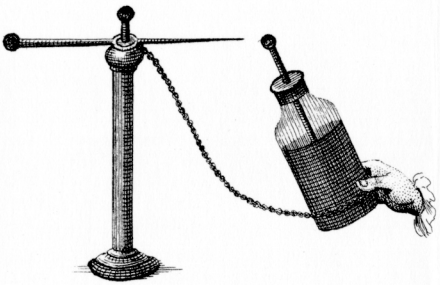


Fig. 2.



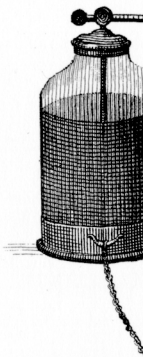


Fig. 5.

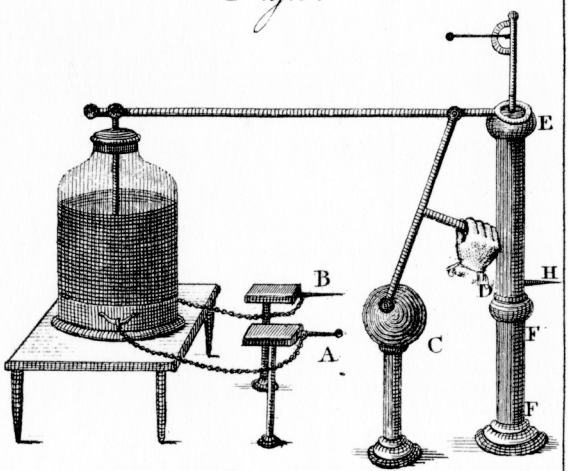
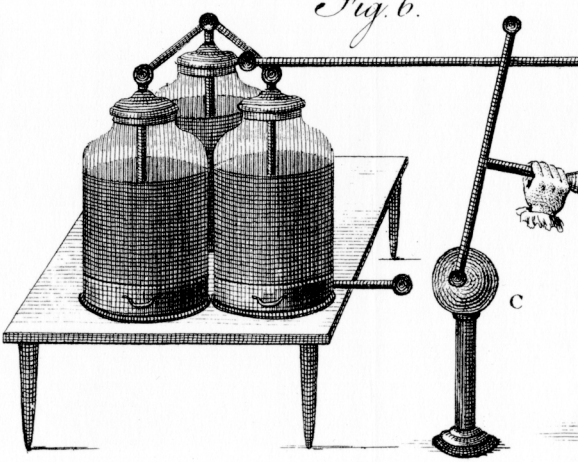


Fig. 6.



D.E. *Fig. 3.4.5.6. is the prime conductor which is supported on a Glass Rod* F.F. *The point* H. *draws off the Electricity from the excited*

2.

Fig. 3.

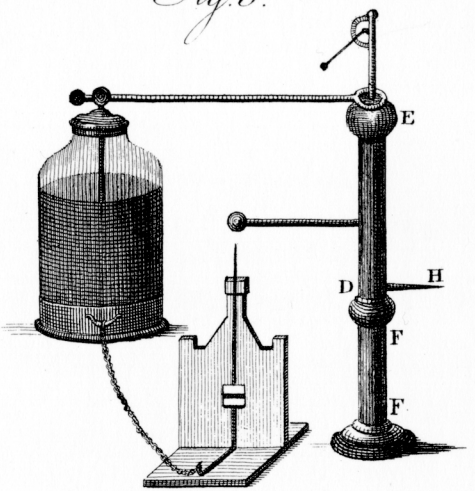


Fig. 4.

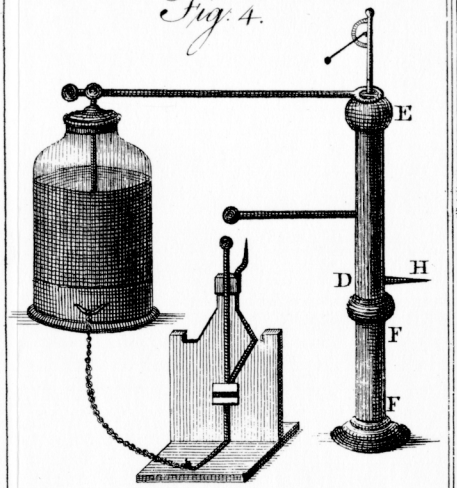


Fig. 6.

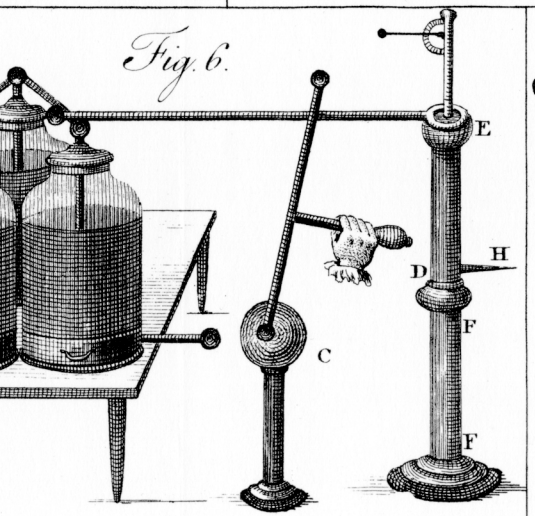
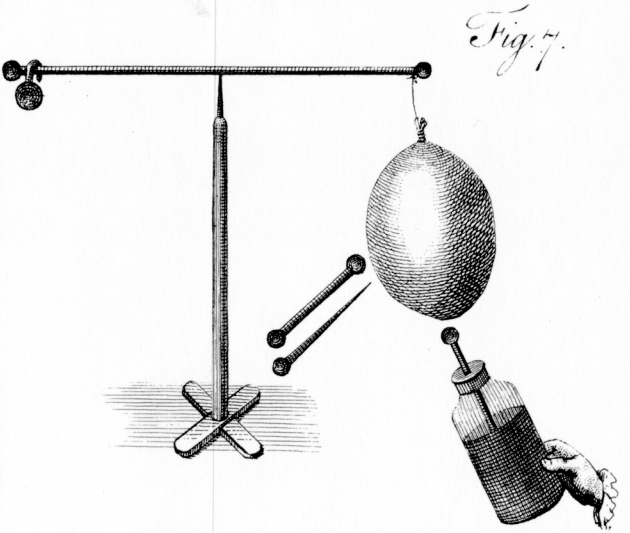


Fig. 7.



H. drain's off the Electricity from the excited Globe, which is not shewn in these figures.

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Fig. 1.

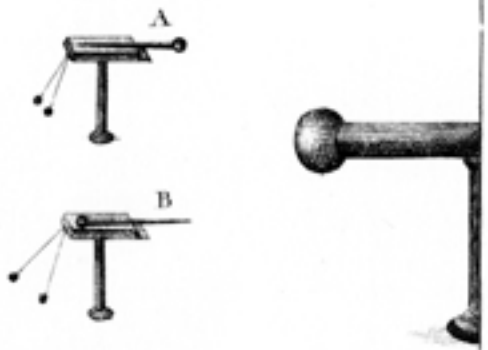


Fig. 2.

Fig. 3.

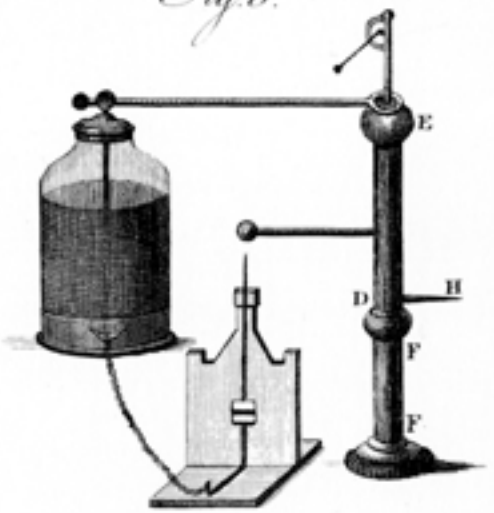


Fig. 4.

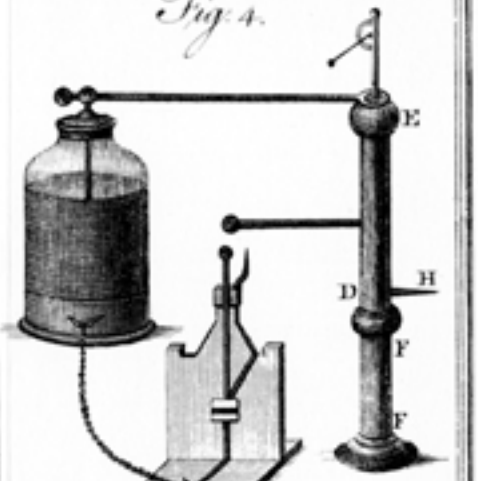


Fig. 5.

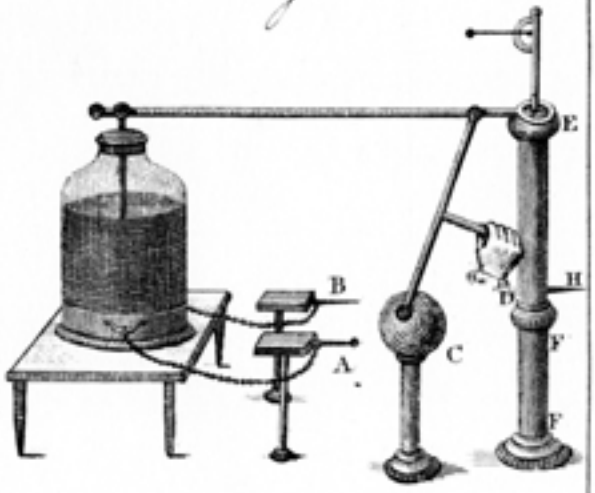


Fig. 6.

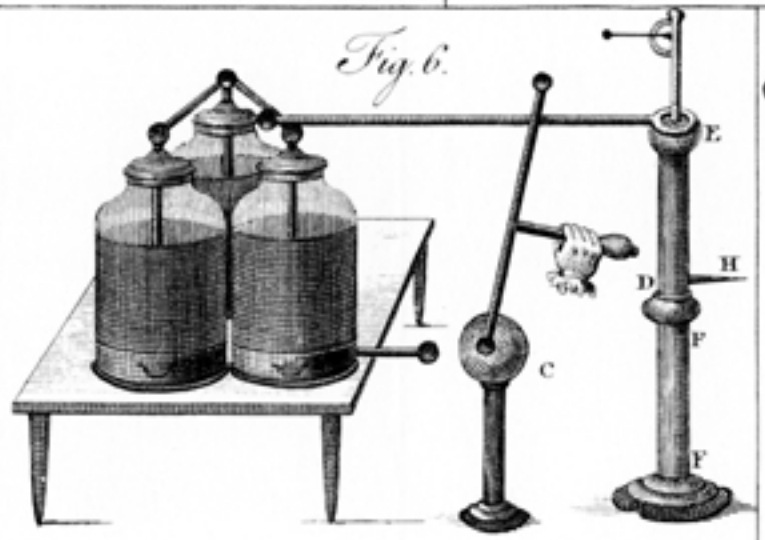
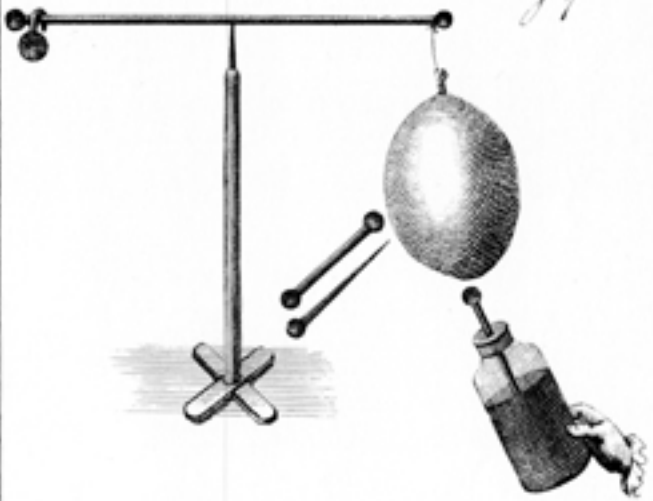


Fig. 7.



D F. Figs 3 4 5 6. is the prime conductor which is supported on a Glass Rod Y F. The point H. draws off the Electricity from the excited Globe, which is not shewn in these figures

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