a very ſerene air, free from ſmoke, which enabled him to diſcern and keep ſight of the moon during the whole occultation, ſo that he might obſerve the moment of the emerſion with the ſame certainty, as that of the immerſion: for Mr. Canton, with a reflector of 18 inches only, that day plainly ſaw the moon at his houſe in Spital-fields.

The Greenwich Obſervation.

Apparent time.	h	′	″	
1751 April 15,	22	41	45	The firſt contact; doubtful to 1 ſecond.
		42	18	Quite immerged.
	23	15	36½	Began to emerge.
		16	8½	Wholly emerged.
16,	1	39	12	Venus paſſed the meridian.

J. Short.

XXXI. *An Account of Mr.* Benjamin Franklin's *Treatiſe, lately publiſhed, intituled,* Experiments and Obſervations on Electricity, made at Philadelphia in America; *by* Wm. Watſon, *F. R. S.*

Read June 6. 1751.

MR. Franklin's treatiſe, lately preſented to the Royal Society, conſiſts of four letters to his correſpondent in England, and of another part intituled "Opinions and conjectures concerning the properties and effects of the electrical matter arising from experiments and obfervations."

The four letters, the laft of which contains a new hypothefis for explaining the feveral phænomena of thunder-gufts, have either in the whole or in part been before communicated to the Royal Society. It remains therefore, that I now only lay before the Society an account of the latter part of this treatife, as well as that of a letter intended to be added thereto by the author, but which arrived too late for publication with it, and was therefore communicated to the Society by our worthy brother Mr. Peter Collinfon.

This ingenious author, from a great variety of curious and well-adapted experiments, is of opinion, that the electrical matter confifts of particles extremely fubtil; fince it can permeate common matter, even the denfeft metals, with fuch eafe and freedom, as not to receive any perceptible refiftance: and that if any one fhould doubt, whether the electrical matter paffes through the fubftance of bodies, or only over and along their furfaces, a fhock from an electrified large glafs jar, taken through his own body, will probably convince him.

Electrical matter, according to our author, differs from common matter in this, that the parts of the latter mutually attract, and thofe of the former mutually repel, each other; hence the divergency in a ftream of electrified effluvia §: but that, tho' the particles

§ As the electric ftream is obferved to diverge very little, when the experiment is made *in vacuo*, this appearance is more owing to particles of electrical matter do repel each other, they are ſtrongly attracted by all other matter.

From theſe three things, *viz.* the extreme ſubtilty of the electrical matter, the mutual repulſion of its parts, and the ſtrong attraction between them and other matter, ariſes this effect, that when a quantity of electrical matter is applied to a maſs of common matter of any bigneſs or length within our obſervation (which has not already got its quantity) it is immediately and equally diffuſed thro' the whole.

Thus common matter is a kind of ſponge to the electrical fluid; and as a ſponge would receive no water, if the parts of water were not ſmaller than the pores of the ſponge; and even then but ſlowly, if there was not a mutual attraction between thoſe parts and the parts of the ſponge; and would ſtill imbibe it faſter, if the mutual attraction among the parts of the water did not impede, ſome force being required to ſeparate them; and faſteſt, if, inſtead of attraction, there were a mutual repulſion among thoſe parts, which would act in conjunction with the attraction of the ſponge: ſo is the caſe between the electrical and common matter. In common matter indeed there is generally as much of the electrical as it will contain within its ſubſtance: if more is added, it lies without upon the ſurface ||, and forms what we call an

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to the reſiſtance of the atmoſphere, than to any natural tendency in the electricity itſelf. *W. W.*

|| The author of this account is of opinion, that what is here added, lies not only without upon the ſurface, but penetrates with the ſame degree of denſity the whole maſs of common matter, upon which it is directed.

an electrical atmosphere; and then the body is said to be electrified.

'Tis supposed, that all kinds of common matter do not attract and retain the electrical with equal force, for reasons to be given hereafter; and that those called electrics *per se*, as glass, *&c.* attract and retain it the strongest, and contain the greatest quantity.

We know, that the electrical fluid is in common matter, because we can pump it out by the globe or tube; and that common matter has near as much as it can contain; because, when we add a little more to any portion of it, the additional quantity does not enter, but forms an electrical atmosphere: and we know, that common matter has not (generally) more than it can contain; otherwise all loose portions of it would repel each other, as they constantly do when they have electric atmospheres.

The form of the electrical atmosphere is that of the body, which it surrounds. This shape may be render'd visible in a still air, by raising a smoke from dry resin dropp'd into a hot tea-spoon under the electrised body, which will be attracted and spread itself equally on all sides, covering and concealing the body. And this form it takes, because it is attracted by all parts of the surface of the body, though it cannot enter the substance already replete. Without this attraction it would not remain round the body, but be dissipated in the air.

The atmosphere of electrical particles surrounding an electrified sphere is not more disposed to leave it, or more easily drawn off from any one part of the sphere than from another, because it is equally attracted by every part. But that is not the case with

bodies

bodies of any other figure. From a cube it is more eaſily drawn at the corners than at the plane ſides, and ſo from the angles of a body of any other form, and ſtill moſt eaſily from the angle that is moſt acute; and for this reaſon points have a property of drawing on, as well as throwing off the electrical fluid, at greater diſtances than blunt bodies can.

From various experiments recited in our author's treatiſe, to which the curious may have recourſe, the preceding obſervations are deduced. You will obſerve how much they coincide with and ſupport thoſe which I ſome time ſince communicated to the Society upon the ſame ſubject.

To give even the ſhorteſt account of all the experiments contained in Mr. Franklin's book, would exceed greatly the time allowed for theſe purpoſes by the Royal Society: I ſhall content myſelf therefore with laying a few of the moſt ſingular ones before you.

The effects of lightning, and thoſe of electricity, appear very ſimilar. Lightning has often been known to ſtrike people blind. A pigeon, ſtruck dead to appearance by the electrical ſhock, recovering life, drooped ſeveral days, eat nothing, tho' crumbs were thrown to it, but declined and died. Mr. Franklin did not think of its being deprived of ſight; but afterwards a pullet, ſtruck dead in like manner, being recovered by repeatedly blowing into its lungs, when ſet down on the floor, ran headlong againſt the wall, and on examination appeared perfectly blind: hence he concluded, that the pigeon alſo had been abſolutely blinded by the ſhock. From this obſervation we ſhould be extremely cautious, how in electriſing we draw the ſtrokes, eſpecially in making the experiment of Leyden, from the eyes, or even from the parts near them.

Some time ſince it was imagined, that deafneſs had been relieved by electriſing the patient, by drawing the ſnaps from the ears, and by making him undergo the electrical commotion in the ſame manner. If hereafter this remedy ſhould be fantaſtically applied to the eyes in this manner to reſtore dimneſs of ſight, I ſhould not wonder, if perfect blindneſs were the conſequence of the experiment.

By a very ingenious experiment our author endeavours to evince the impoſſibility of ſucceſs, in the experiments propoſed by others of drawing forth the effluvia of non-electrics, cinamon, for inſtance, and by mixing them with the electrical fluid, to convey them with that into a perſon electrified: and our author thinks, that tho' the effluvia of cinamon and the electrical fluid ſhould mix within the globe, they would never come out together through the pores of the glaſs, and thus be conveyed to the prime conductor; for he thinks, that the electrical fluid itſelf cannot come through, and that the prime conductor is always ſupplied from the cuſhion, and this laſt from the floor. Beſides, when the globe is filled with cinamon, or other non-electrics, no electricity can be obtained from its outer ſurface, for the reaſons before laid down. He has tried another way, which he thought more likely to obtain a mixture of the electrical and other effluvia together, if ſuch a mixture had been poſſible. He placed a glaſs plate under his cuſhion, to cut off the communication between the cuſhion and the floor: he then brought a ſmall

ſmall chain from the cuſhion into a glaſs of oil of turpentine, and carried another chain from the oil of turpentine to the floor, taking care, that the chain from the cuſhion to the glaſs touched no part of the frame of the machine. Another chain was fixed to the prime conductor, and held in the hand of a perſon to be electrified. The ends of the two chains in the glaſs were near an inch from each other, the oil of turpentine between. Now the globe being turned could draw no fire from the floor through the machine, the communication that way being cut off by the thick glaſs plate under the cuſhion: it muſt then draw it through the chains, whoſe ends were dipp'd in the oil of turpentine. And as the oil of turpentine being in ſome degree an electric *per ſe*, would not conduct what came up from the floor, the electricity was obliged to jump from the end of one chain to the end of the other, which he could ſee in large ſparks; and thus it had a fair opportunity of ſeizing of the fineſt particles of the oil in its paſſage, and carrying them off with it: but no ſuch effect followed, nor could he perceive the leaſt difference in the ſmell of the electrical effluvia thus collected, from what it had when collected otherwiſe; nor does it otherwiſe affect the body of the perſon electrified. He likewiſe put into a phial, inſtead of water, a ſtrong purging liquid, and then charged the phial, and took repeated ſhocks from it; in which caſe every particle of the electrical fluid muſt, before it went through his body, have firſt gone thro' the liquid, when the phial is charging, and returned through it when diſcharging; yet no other effect followed than if the phial had been charged with water.

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He has alſo ſmelt the electrical fire, when drawn thro' gold, ſilver, copper, lead, iron, wood, and the human body, and could perceive no difference; the odour being always the ſame, where the ſpark does not burn what it ſtrikes; and therefore he imagines, that it does not take that ſmell from any quality of the bodies it paſſes through. There was no abridging this experiment, which I think very well conceived, and as well conducted, in a manner to make it intelligible; and therefore I have laid the author's words nearly before you.

As Mr. Franklin, in a letter to Mr. Collinſon ſome time ſince, mentioned his intending to try the power of a very ſtrong electrical ſhock upon a turkey, I deſired Mr. Collinſon to let Mr. Franklin know, that I ſhould be glad to be acquainted with the reſult of that experiment. He accordingly has been ſo very obliging as to ſend an account of it, which is to the following purpoſe. He made firſt ſeveral experiments on fowls, and found, that two large thin glaſs jars gilt, holding each about 6 gallons, and ſuch as I mentioned I had employed in the laſt paper I laid before you upon this ſubject, were ſufficient, when fully charged, to kill common hens outright; but the turkeys, though thrown into violent convulſions, and then, lying as dead for ſome minutes, would recover in leſs than a quarter of an hour. However, having added three other ſuch to the former two, though not fully charged, he killed a turkey of about ten pounds weight, and believes that they would have killed a much larger. He conceited, as himſelf ſays, that the birds kill'd in this manner eat uncommonly tender.

In making theſe experiments, he found, that a man could, without great detriment, bear a much greater ſhock than he imagined: for he inadvertently received the ſtroke of two of theſe jars through his arms and body, when they were very near fully charged. It ſeemed to him an univerſal blow throughout the body from head to foot, and was followed by a violent quick trembling in the trunk, which went gradually off in a few ſeconds. It was ſome minutes before he could recollect his thoughts, ſo as to know what was the matter; for he did not ſee the flaſh, tho' his eye was on the ſpot of the prime conductor, from whence it ſtruck the back of his hand; nor did he hear the crack, tho' the byſtanders ſaid it was a loud one; nor did he particularly feel the ſtroke on his hand, tho' he afterwards found it had raiſed a ſwelling there of the bigneſs of half a ſwan-ſhot, or piſtol-bullet. His arms and the back of his neck felt ſomewhat numbed the remainder of the evening, and his breaſt was ſore for a week after, as if it had been bruiſed. From this experiment may be ſeen the danger, even under the greateſt caution, to the operator, when making theſe experiments with large jars; for it is not to be doubted, but that ſeveral of theſe fully charged would as certainly, by increaſing them, in proportion to the ſize, kill a man, as they before did the turkey.

Upon the whole, Mr. Franklin appears in the work before us to be a very able and ingenious man; that he has a head to conceive, and a hand to carry into execution, whatever he thinks may conduce to enlighten the ſubject-matter, of which he is treating: and altho' there are in this work ſome few opinions,

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in which I cannot perfectly agree with him, I think ſcarce any body is better acquainted with the ſubject of electricity than himſelf.

XXXII. *A Letter to the Rev. Dr.* Hales, *F.R.S. from Captain* Henry Ellis, *F.R.S. dated* Jan. 7, 1750-51, *at* Cape Monte Africa, *Ship* Earl of Hallifax.

SIR,

Read June 13. 1751.

I MAKE uſe of this opportunity of writing to you, leſs from the vanity I have of having ſuch a correſpondent, than the deſire of contributing to his ſatisfaction, who eſteems it his greateſt happineſs to promote the intereſt of mankind. At yours and Lord Hallifax's recommendation, I had your ventilators fixed on board of my ſhip, at Briſtol. The following is a detail of the experiments, which I made to prove their utility.

1. I took a wax-candle, of eight to the pound, and drew it thro' a mold, to make it of one thickneſs from end to end: then weighed it exactly, and lighted it in the ſhip's hold; where I found it waſted 67 grains in 30 minutes; that place not being ventilated during 24 hours: but after ſix hours ventilation it waſted $94+\frac{1}{2}$ grains in the ſame time.

2. I carried with me into the hold a plate of ſilver, well poliſhed, and a lantern and candle, all blinded, except a round hole of about two inches diameter. I placed the plate at ſix feet diſtance from it; and with

ſuch